A History of Plant Pathology in Virginia (1888-1997)

By Curtis W. Roane

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A History of Plant Pathology in Virginia: Introduction

On August 20, 1926, Erwin F. Smith, the pioneer plant bacteriologist, addressed the International Congress of Plant Sciences at Ithaca, New York, under the title, "Fifty Years of Pathology." Strict adherence to the title would include an era back to 1876. At that time, Virginia Agricultural and Mechanical College was four years old and had just graduated its first students. The Agricultural Experiment Station, was to be created by an act of the Virginia General Assembly on March 1, 1886 but was not organized until 1888. Smith's opening statement could be made today with as much veracity as it reflected in 1926:

"In many ways the last 50 years is a remarkable period in the history of the world. Among its striking characteristics, the most impressive perhaps have been the enormous advances in scientific discovery. This period has seen an entire change in our views as to the constitution of matter, the development of living things, and the extent of the cosmos. Outward in various directions the visible universe has been extended thousands of light years, downward it has been extended into the minutest subdivisions of matter far beyond the "atoms" of the old Greeks, or the wildest dreams of Victorian physicists and chemists. In pathology the advances have been no less wonderful."

For the period 1872 to 1888, there was no Plant Pathology at Va. A. & M., and after 1891 until 1908, it was as taught and studied by mycologists. Plant Pathology in Virginia had its start soon after William B. Alwood was appointed Vice-Director of the Virginia Agricultural Experiment Station in 1888. He was also designated Horticulturist and Entomologist. In 1891, Alwood was appointed Professor and Head of Horticulture, Entomology, and Mycology, whereupon he was for the first time assigned teaching duties in these three disciplines. A vignette of agriculture as Alwood took up the reins might be helpful.

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A History of Plant Pathology in Virginia: The Pre-Alwood Era

It is difficult for one to look back over 100 years and portray the world as it really was before 1888. Fungi had been demonstrated to cause some plant diseases, but there was much skepticism and mystery about most, and there were virtually no remedies for any. Sulphur was useful for the powdery mildews, and copper salts had been found useful for controlling grain smuts and downy mildews. Many plant diseases had been recognized, even named, but their parasitic instigators were not yet recognized. Bacteria were known from the time of Leeuwenhoek in 1683; Koch (1867) and Pasteur (1877) had demonstrated them to be animal pathogens, and Burrill (1877) demonstrated that bacteria caused fire blight of apple and pear. Many fungus diseases were known from the efforts of Berkeley, DeBary, Kühn, and Farlow; viruses were unknown but diseases later attributed to viruses were recognized; the wheat gall nematode was known since Needham found it in 1743 but was not known as a cause of a plant malady until Roffredi's work in 1775-6. Cabbage club root had been studied by Woronin (1876). In 1882, Robert Koch invented the poured plate method, an assistant substituted agar-agar for Koch's gelatin and a second assistant named Petri devised the culture dishes that bear his name. Thus, four simple innovations, cotton plugs, poured-plates, agar-agar, and Petri dishes became the greatest contributions of all time to the advancement of bacteriology and mycology. Also in 1882, Robert Hartig's textbook of tree diseases appeared. DeBary published his magnificent book whose title translates to "Comparative Morphology and Biology of the Fungi, Mycetozoa, and Bacteria." Although Millardet realized the possibilities of copper sulphate and lime for control of grape downy mildew in 1882, he experimented with various mixtures until 1884, and in 1885 published his discovery. Thereafter it was "demonstrated everywhere to be a sovereign remedy not only for the ravages of grape Peronospora (= Plasmopara) but also for many other diseases of cultivated plants, including black rot of grape and the devastating mildew (Phytophthora) of the potato. This was the first great advance in plant therapeutics" (Smith, 1926). In 1885, the Section of Mycology was established in the U.S. Department of Agriculture with F. L. Scribner as Chief. Smith was appointed his first assistant in 1886, and in the same year Mayer demonstrated that tobacco mosaic was an infectious disease. Spray equipment was being developed and the world's grape, orchard, and potato crops were being blued with Bordeaux mixture. In 1887, the U. S. Department of Agriculture renamed its Section of Mycology the Section of Vegetable Pathology; essentially, that was the birth of Plant Pathology in the United States, although Burrill had included plant pathogenic fungi in a botany course at the University of Illinois beginning in 1873, and Farlow at Harvard in 1875 had emphasized fungi causing diseases of plants. However, through 1890, American Plant Pathology, as Smith (1926) said, "was little more than sublimated mycology." In 1887, the Hatch Act was passed by Congress; this paved the way for establishment of state agricultural experiment stations. Oscar Rierson of Glendover, Virginia, first used Bordeaux mixture for grape black rot (Wingard, 1951).

In 1888, Jensen described the hot-water treatment for control of barley and wheat loose smuts, but most significantly for Virginia, the Virginia Agricultural Experiment Station was organized and staffed with funds entirely of federal origin in consequence of the Hatch Act. William B. Alwood, Botanist and Entomologist; Walker Bowman, Chemist; and D. O. Nourse, Agriculturist (Young, 1975) were the first staff members appointed to get research programs under way. The Alwood era had begun.

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A History of Plant Pathology in Virginia: The Alwood Era (1888-1904)

When William B. Alwood was appointed Vice-Director of the Virginia Agricultural Experiment Station, the grape industry in Virginia had been virtually destroyed; apple scab, bitter rot and fire blight were exacting large tolls from fruit growers' pockets. Wingard (1951) wrote that fire blight had destroyed a promising pear orchard industry in the James River Valley. From colonial days, tobacco and corn had been major crops. History textbooks record how tobacco and flax soon wore out the land and farmers were constantly clearing new land for these crops. We can speculate that in addition to nutrient depletion, increases of soil-borne pathogens endemic to Virginia may have contributed to soils becoming "worn out." Fusarium wilts are sometimes seed-borne and may have been introduced; thus, they may also have contributed to "worn out" soils. Perhaps root knot was a factor. Crop rotation was probably an established but haphazardly practiced procedure. By the late 19th century, the major area of tobacco production was centered in Southside Virginia, i.e., the southern piedmont counties; the orchard industry was widely scattered, with apples mostly in the piedmont and mountains; and grains were produced mostly in the Valley of Virginia and southwestern counties although most farmers were obligated to produce feed grains to power their horse-drawn implements. No doubt potatoes, beans, and cole crops were the remaining staple crops. Cotton and peanuts were established in the southeastern counties. Alwood had received training at the Royal Pomology School in Germany and the Pasteur Institute in France; therefore, his initial interests were in fruit production and utilization. Prior to his appointment to the Virginia Agricultural Experiment Station, he had been the superintendant of the Ohio Experiment Station Farm for 4 years and a special agent for the U.S.D.A. In addition to being Station Vice-Director, he was designated Professor of Botany and Entomology from 1888 to 1891; in 1891, he was named Professor of Horticulture, Entomology, and Mycology and Head of the Department of Horticulture, Entomology, and Mycology with teaching assignments in the College added. As the Station staff was very small, administrative duties were light, red tape and empire building had not yet become the way of life for administrators, and the 40 hour week was far in the future, Alwood could devote most of his time to research, publication, and teaching. He set a pace not matched by many of his successors. But before a single publication was issued by the Experiment Station, criticisms appeared in the January 1989 Southern Planter (pp. 34-36) by a "Farmer" who was apparently peeved by the placing of the Station atop "the Alleghany watershed some 3000 feet high," (he over estimated by nearly 1000 feet) "the climate and the products of its vicinity have little in common with large areas of the State where the need of such aid to agriculture as it was intended to give is the greatest." He had prefaced this statement by: "What has become of our Experiment Station of which we had heard so much last winter, and from which many of us were led to expect valuable aid and information? The Station was last heard of by the farming public about 9th of May last (= 1888), at which time an announcement was issued, stating that the Station had been organized," and further indicating the kind of work that would be undertaken. "Since that announcement in May last, chinch bug and other insects have ravaged our wheat and corn fields, the fungoid diseases have rotted our apples and peaches on the trees and grapes on the vines, while mildew and rust attacked the foliage. The cry has gone up from section after section, How can we best contend with these destructive agencies? The United States Department of Agriculture has been doing a noble work, indicating the best lines on which a defense might be made,... But what was our Experiment Station doing, to which all such tests of possible remedies and preventatives properly belonged?"

"Farmer" was not merely a crank and an impatient one at that, he was aware of the book "Black Rot" (of grape) and indications by the author, F. L. Scribner, a U.S.D.A. plant pathologist, that apple rot as well as grape black rot might be controlled by similar treatments. (The bulletin by Lamson-Scribner was actually entitled, "Fungus Diseases of Grape and Other Plants and Their Treatment", published by J. T. Lovett Co., N. J. It is acclaimed as the first American phytopathological handbook). "Farmer" was also well acquainted with the structure and finances of the Experiment Station, "and by next March the Station will have been drawn and doubtless expended its first $15,000. Surely they have some good work to show for that large sum.... There are many who think that no good work can be expected of the Station as at present organized." It was later revealed in a letter of January 17, 1889 (Sou. Planter, Mar. 1889, pp. 129-131) to Prof. W. B. Preston, Director of the Virginia Agricultural Experiment Station, that "Farmer" was Col. H. M. Magruder, an agent of the Albemarle County Board of Supervisors who with other citizens had sought to have the Experiment Station located near the University of Virginia. In a letter of January 22, 1889 (Ibid, pp. 131-134), Preston clarified some of Magruder's misconceptions of the Station and elaborated on Station plans. Both Magruder and Preston declared their dedication to the Station's purpose of solving agricultural problems. Additional correspondence on the matter appeared in the April 1889 Southern Planter. Thus, with a cloud of doubt hanging over the Station, Alwood published his first writings addressing agricultural problems in the August 1889 Southern Planter. This magazine was a respected regional publication serving Virginia, North Carolina, and the Delmarva Peninsula.

With Alwood's training in horticulture, especially pomology, it seemed logical that he direct immediate attention to the problems confronting fruit growers. He began by publishing popular articles in the Southern Planter magazine.

The first, in the August 1889 issue (pp. 125-126), was titled "Implements for Applying Insecticides and Fungicides, Etc." This was the first publication in Virginia related to Plant Pathology. In it Alwood described and illustrated various handpowered, double acting pumps of mostly European origin available for spraying crops. Liquid was ejected during both upward and downward strokes. Alwood lamented the lack of manufacturers of good spray equipment in this country.

Alwood's second publication was entitled "Strawberry Culture;" no diseases were mentioned (Sou. Planter, Sept. 1889, pp. 169-170). He also reviewed bulletins published by the Minnesota Experiment Station and by the U.S.D.A. In the latter, B. T. Galloway, translating from Sorauer, explained potato scab as due to the liberation of ammonia (from manure), which in the free state, attacked the cork cells and caused the corky formations to penetrate deeper into the tubers. (We know now that manure favors the activity of Streptomyces scabies).

In the September issue, Alwood also had a column entitled "Potato Rot" (pp. 171-172) in which he describes late blight, including foliage blight, tuber rot, and sources of inoculum much as they are perceived today. For control, he recommended planting disease-free tubers in soil free of potato debris, sorting harvested tubers twice to remove infected ones, and with reservations, the application of copper sulphate preparations such as used for grapes (without specifically mentioning Bordeaux mixture). He doubted that the heavy tangled vines could have been penetrated sufficiently to accomplish any control. This was Alwood's first original composition on plant diseases of Virginia crops and the first mention of Phytophthora infestans in a Virginia publication.

There followed a review of and comments on a preliminary report (of 212 pp.) by Erwin F. Smith on peach yellows which at the time was well established in Virginia. Smith's report dwelt on eliminating possible causes. Alwood suggested several remedial procedures some of which would not have influenced prevalence and spread of yellows. He did advise destruction of infected trees as soon as symptoms appeared and avoidance of propagation from symptomatic trees. These are current practices.

In the October issue (pp. 223-225), Alwood described cedar-apple rust on both hosts and the dissemination of sporidia and aeciospores. The destruction of cedar trees in the vicinity of apple orchards was advocated. This was Alwood's first original paper on a specific disease of apples with the date line September 7, 1889. The fact that he advocated destruction of cedar trees predates L. R. Jones of Vermont who in 1893 recommended cedar eradication for a zone 1 mile wide around apple orchards. Jones' recommendation came after experimentation; Alwood surmized cedar eradication would reduce apple rust after a review of the literature. Later, Virginia would enact a law implementing cedar eradication to protect apple orchards.

In a brief note (Sou. Planter, Oct. 1889, p. 225), Alwood reported on his visits to Virginia peach orchards where he found yellows in abundance. "Thousands of trees were being cut down and the growers are at a loss what to do." He suggested growers attempt to carry a special law through the Legislature in the winter of 1890, "which shall provide for competent inspection and destruction of diseased trees." It was urgent to petition the 1890 General Assembly because a delay would result in two additional years of losses as the Legislature met only biennially.

In October, 1889, Alwood published his first Experiment Station bulletin (no. 2) entitled "I. Experiment Orchard. II. Small Fruits." The only references to plant diseases were on p. 3:

"As far as can be determined at present, there has been no loss to speak of, except in the case of peaches, and this was due principally to yellows, the stock being already infected with this disease when received."

and on p. 5:
"In selecting varieties of orchard fruits, the aim has been to choose a large number of standard old sorts ... Fortunately it is not necessary in Virginia to pay particular attention to "iron clads;" and yet these may prove to have some valuable characteristics as resistants of fungus diseases, etc. Hence they will be grown to some extent."

Thus, Alwood displayed a continuing interest in plant diseases and mentioned for the first time the concept of controlling diseases by means of disease resistance. An abstract of Bulletin No. 2 appeared in the Southern Planter, November 1889, pp. 267-269.

There also appeared in the November 1889 Southern Planter (pp. 269-270) an article by Alwood entitled, "Restrictive Legislation Against the Peach Yellows," in which for the second time the General Assembly was urged to enact a law in behalf of Virginia fruit growers. Some of Alwood's statements follow:

"This disease of peach is almost as old as peach-culture on this continent, and undoubtedly has been a curse to the peach-grower for a hundred years or more."

"Virtually, the whole eastern portion of the continent, wherever peaches have been grown on a large scale, is infected (we would say "infested"). That the disease is communicable is definitely settled, and does not require further argument. The best pomologists for the past fifty years have recognized this fact" and, "the best pomologists, beginning sixty years ago (= 1839) with William Prince, ..., have all advocated the prompt destruction of infected trees as the only means of staying the disease."

(Note: According to F. D. Heald, A Manual of Plant Diseases, 2nd ed., 1933, p. 266, peach yellows was first noted near Philadelphia in 1791. It occurs only in North America. The contagious character of the disease was recognized by Judge Peters in 1806, who wrote "I find that sickly trees often infect those in vigor near them by some morbid effluvia.")

Alwood continued "This disease, then, being clearly of an infectious nature, restrictive legislation is in order, and the state has the same right to deal with it as with any infectious malady of live stock." And further, "With the popular mind it seems impossible to make it clear that in strict inspection and prompt eradication lies the only hope of a successful future for the peach industry. The fact that restrictive legislation is the only hope can be especially instanced in various sections of the country where this disease has utterly devastated the orchards, yet, under rigid inspection and eradication, the disease has not only been checked, but a new impetus given to planting."

From his visits to orchards, Alwood concluded that the disease had a firm foothold in Virginia and that "This disease is a dark cloud on the future of peach-growing in our State," and, "this is a most serious misfortune, coming just at this juncture, when the canning industry is being so rapidly extended" in our State. Although growers favored the legislation which would provide for rigid inspection and forcible destruction of infected trees, many who feared their private interests would suffer, opposed any such legislation. Alwood did not identify the opposition. Thus, in 1889, Alwood lobbied for the 1890 General Assembly to take action. Michigan in 1875, and Ontario in 1881, and New York in 1887 had enacted such legislation.

In the Southern Planter, February 1890 (pp. 60-61), an item stated that the legislation was advancing through committees and it appeared that Virginia's first law directed at regulating a plant disease would be passed. The item ended with, "We trust that our friends will urge upon their representatives the support of the bill. The disease is not yet widely spread through the State, but a year or two's neglect will be attended by irreparable damage. `Shut the stable-door before the horse is stolen'."

After a meeting of the Virginia Fruit and Vegetable Packers Association, Roanoke, Virginia, April 2, 1890, Alwood commented on the futility of the meeting (Sou. Planter, June 1890, p. 275) and stated that he had "prepared a bill last winter which was passed by the legislature, in such amended form as to make its execution difficult, yet it contains good features, and could be executed if there was proper effort on the part of a strong State Horticultural Society." It appeared to him that as far as yellows control was concerned, his efforts went for naught even though a bill was passed. Although obviously disappointed, he moved ahead with other projects.

During the peach yellows legislative lobbying effort, Alwood and Walker Bowman, Station Chemist, published Experiment Station Bulletin No. 4, A Study of Tomatoes, January 1890. It consisted of two parts, field tests and chemical composition studies conducted in 1889. The only disease mentioned was "the rot" which, presumably, was anthracnose. It also has been called "ripe-rot." The authors wrote, "The belief appears to be well founded that fresh stable manures tend to induce the fungus disease known as the rot, hence, chemical manures are to be preferred for this crop. Sufficient critical attention has not been given to this question, yet there appears to be some truth in the foregoing statement." As to quality of tomato fruits for the fresh market and canning industry the authors stated that in addition to having several horticultural traits, the fruits must be free of fungous diseases. "Care was taken to make the same notes on the rotten fruit at each period (of harvest)...The rot attacked the fruits considerably during the early period of ripening, but as the season became less rainy it almost entirely ceased...Red Currant, Red Cherry and Pear shaped are very slightly, if at all, attacked by this disease." For the late-planted varieties, there was a comparison with early planted ones. "The quantity of diseased fruits on the two patches was comparatively about the same. Neither of the patches suffered from the rot as much as it had been anticipated they would, notwithstanding the wet season and heavy clay soil." Thus, a subtle awareness of environmental and predisposing factors was expressed.

In Bulletin No. 6, Variety Tests with Potatoes, March 1890, Alwood and co-author R. H. Price, Assistant in Horticulture, gave yields and tuber characteristics of about 125 Irish potato varieties and they recorded the number of rotten tubers at the time of digging. They also gave a detailed account of "the blight or rot" of potato, similar to that appearing in the Southern Planter, September 1889, pp. 171-172. A little more technical information about Phytophthora infestans was provided. They also added that P. infestans infected tissue provided an avenue for "one of the germs of decay, a still lower form of plant life, and the rot is thus produced. The affected tuber before decay supervenes shows the presence of disease by discoloration of the tissue," no doubt an allusion to soft rotting bacteria. This section on blight seemed to be an added afterthought to Bulletin No. 6.

An article by Alwood entitled "Apple Scab and Black Rot of Grapes in Albemarle" appeared in the Southern Planter, June 1890, pp. 275-276. He wrote, "Experiments made the past year at different points indicate that there is a possibility of checking to some extent this dread disease, apple scab, and we are glad to announce that this department has experiments underway which may be of value to the growers in the near future." He described the preparation and use of Bordeaux mixture and a modified form in which sodium carbonate was substituted for unslaked or burnt lime (NaCO3 for CaO). The latter was known as Burgundy mixture and had also been invented in France soon after Bordeaux mixture was described (Walker, J. C., Plant Pathology, 3rd ed., McGraw-Hill, 1969). He also described how growers were applying sprays for grape mildew and black rot and plugged the use of the Japy knapsack sprayer which he had imported beginning in 1888. The Japy sprayer was described and illustrated by Alwood in his first publication (Sou. Planter, Aug. 1889, pp. 125-126). From these activities, Alwood is given credit for introducing European spray technology to Virginia fruit growers.

In Bulletin No. 7, July 1890, Variety Tests with Strawberries (also published in Sou. Planter, Aug.-Dec. 1890) Alwood only mentions that "There was but little appearance of `leaf blight' or `spot' and the general conditions were favorable to strong growth." No doubt Alwood was referring to the disease caused by Mycosphaerella fragariae; this leaf spot was well known in America before 1880 (Anderson, H. W., Diseases of Fruit Crops, McGraw-Hill, 1956).

In the October 1890 Southern Planter (pp. 462-463), Alwood described the use of Bordeaux (4-5-50) and Burgundy mixtures (also 4-5-50) in an article entitled "Treatment of Black Rot of Grapes." His principal contribution was the reduction in the amount of copper and calcium compounds and thereby reduction in cost of preparation. The more dilute products were easier to apply and just as effective. He also touted Burgundy mixture by saying he had used it a year before F. D. Chester of the Delaware Station published on it in March 1889. "I consider this an important fungicidal preparation and claim priority in its use as here stated." It is not clear whether Alwood is claiming he developed Burgundy mixture (actually invented in France), adapted it to grapes, or what. He made no reference to Mason, but did acknowledge reading the writings of Millardet and his chemist associate Gayon. In this respect, Alwood's contribution is a bit muddied.

There appeared in the Southern Planter, November 1890 (p. 525), an item proclaiming that Va. A. & M. had opened with 135 students enrolled and that "A special course of lectures on Economic Entomology and Mycology has also been provided for. This will be taught by Prof. Alwood, of the Experiment Station, and it is intended in these lectures to give the students an understanding of the parasitic insects and fungi which prey upon cultivated plants with proper methods of treating the same." Descriptions of the courses first appeared in the 1891-92 college catalogue.

Finally, in the December 1890 Southern Planter (pp. 573-4), it was announced that Col. H. M. Magruder, a long-time critic of the Experiment Station, its organization, failure to meet the needs of farmers, its extravagance, etc., was appointed "Superintendent of the Farm Department and Out-Door Experiment Work at this Station." Magruder had written criticism of the Station to W. B. Preston, first Station Director under the pen name "Farmer." The appointment of "Farmer" to the Experiment Station staff as a competent agriculturist may have been quite proper; on the other hand, it may have been a sneaky way to squelch his criticism. "If you can't lick 'em, join 'em!"

"It appears to be the intention of the Board (of Control) that Col. Magruder shall travel over the State for the purpose of meeting and consulting with farmers, addressing public meetings, and making a special study of the conditions and needs of agriculture in the several sections of the State... the Farm Department shall bear such a relation to the teaching of agriculture as the shops do to the teaching of mechanics, and that such special work as co-operative dairying, fruit-canning, etc., shall be illustrated by practical working plants. These are certainly strides in the right direction. The farmers of Virginia desire that agriculture shall be taught by modern illustrative methods, in field and laboratory, rather than by day class lectures and textbook recitations." This was how the Editor of the Southern Planter described the situation, 24 years before the Smith-Lever Act of the U.S. Congress stimulated the introduction and development of the Cooperative Agricultural Extension Services. Virginia, however, was to have only a brief fulfillment of its classrooms in the fields from Magruder. On June 1, 1891, about 6 months after his appointment to the Station, Magruder died of a heart attack (Alwood paid tribute to him, Sou. Planter 1891, pp. 376-7). The concept of Extension had been hatched. How did it develop after Magruder, and was Plant Pathology to be a part of it?

In January 1891 (Sou. Planter, pp. 14-15), Alwood announced he was about to make another importation of Japy Spray-pumps from France. He invited subscriptions and pointed out the cost would be about $15 per pump to be submitted with each subscription, "as I charge no commission, and cannot run the risk of loss. The Government compels us to pay 45 per cent duty on these pumps, or they would be imported for much less; but, as it is, they are considerably cheaper than inferior American makes can be bought for."

In 1891, Alwood published Experiment Station Bulletins nos. 8, Potato Tests; 9, Tomatoes; and 11, Vegetables, but did not address plant diseases therein. In the March 1891 Southern Planter (pp. 128-131), Alwood advised fruit-growers to experiment with 8 "washes" to find the best for each circumstance. He described how to lay out the test plots and what records to keep. The washes for vineyards were sulphate of iron, lye, 2 Bordeaux formulations, 2 Burgundy formulations, and 2 formulations of copper carbonate in ammonia. "It is hoped that this series of experiments will help determine the value of washes on the dormant vines, and the after-treatment is calculated to give information as to the strength and frequency of applications necessary with three of the most important fungicides used on grapes."

For apples, 5 treatments were proposed; namely, lye, Bordeaux (4-5-50) and Burgundy (4-5-50) mixtures, copper carbonate and ammonia, and potassium sulphide. The experiment was designed to give the grower information on the control of scab, black leaf spot (Phyllosticta) and rust. In 1890, under Alwood's direction, Mr. William Mann of Albemarle County conducted experiments using the above named products on a schedule of applications beginning March 25 and ending June 2. Sprays were applied during dormancy, at blossom fall, 10 days after blossom fall, and another 2 weeks later. Although experimental, this was the first published spray schedule. The results pointed to Burgundy mixture as being the best formula to check scab. The effects on leaf spot and rust were not noted.

In May 1891 (Sou. Planter, p. 249), Alwood made additional comments regarding the March issue article under the title "Notes on Treatment of Grapes." He urged growers to experiment with the various spray materials, to apply dormant washes, to destroy old fruit by burning or burying, and to pay attention to disease development so that the recommended 10-14 day intervals between sprays may be modified as the favorability of conditions varied. "If he finds the disease making headway at any time, treatment should be repeated regardless of when previous treatment was made." He pointed out that variations in temperature and moisture were the main factors which could speed or slow disease development.

The September 1891 Southern Planter (p. 498) reported that Prof. Wm. B. Alwood "has been elected Professor of Horticulture, Entomology, and Mycology, and will carry into the college work the ability he has shown in the Station." He was listed as Botanist and Horticulturist in Experiment Station Bulletins 1-10. In Bulletin no. 11, October 1891, E. A. Smyth, Jr., is listed as Botanist for the first time. According to the Southern Planter, Smyth was also chairman of the Department of Biology. With this arrangement, the groundwork was in place for the squabbles over where applied and basic botany courses should be taught. These changes along with others cited in the Southern Planter were initiated by President John M. McBryde and all were heartily applauded by the editor. (Note: In succeeding bulletins, Smyth was listed as Biologist).

In the October 1891 Southern Planter (pp. 548-550), an article "Plant Diseases and Their Treatment," by Dr. B. T. Galloway of the U.S.D.A. based on a speech read at the "Charlottesville Intitute" was initiated in the first of 2 installments. Galloway began by emphasizing the economic importance and destructiveness of plant diseases and by attributing most of them to fungi. He described a disease cycle using grape black rot as an example and pointed out that his agency had been conducting black rot control experiments in Albemarle county for the past 2 years. Like Alwood, he lamented the fact that no high quality, American-made sprayers were available so the U.S.D.A. had a knapsack type designed, developed and tested. Plans for its construction were distributed in a Department publication. The development of engine powered sprayers was also underway. Thereupon he described spray materials similar to those publicized by Alwood. In part 2 (Sou. Planter Nov. 1891, pp. 615-616), Galloway outlined a spray schedule of 4 applications in which the various copper sprays were used at different stages of vine growth, thus, to minimize spray injury. After a question and answer period, Galloway described grape anthrax (= anthracnose) and downy mildew control measures.

Galloway described "Potato Rot" which "it is now being held that this disease is due to a fungus, which is scientifically termed phitiptera, but the evidence is somewhat defective in that there are other diseases equally destructive which are not due to this parasite at all." (Note: Certainly Galloway knew the fungus to be Phytophthora; therefore, his speech must have been recorded by a reporter unfamiliar with fungi. This is apparent from the concluding paragraph) "Dr. Galloway then spoke at some length on the disease known as `Peach Yellows' stating that it was very prevalent in portions of Virginia, and that the only sure remedy was to dig up the trees, root and all, and burn them. We must put Bordeaux mixture on the foliage before the fungus has a chance to infest the leaves." (The terms infect and infest were used interchangeably by Alwood and Galloway. In addition, Bordeaux mixture would not prevent or reduce the incidence of peach yellows.) On leaf blight and scab of pear (Fabraea maculata and Venturia pyrina) he recommended Bordeaux Mixture exclusively but for apple scab, he recommended the ammoniacal solution, the first application to be made when apples attained the size of buckshot. The cost per tree was "sixteen to seventeen cents."

An inquiry addressed to Alwood from the Secretary of the Fruit Commission of

California concerning the prevalence of peach yellows and its transmissibility through propagation stock caused Alwood to suspect that California was preparing to establish "a quarantine against all infected States." Alwood considered this to be a just action by California to protect its peach industry; he recognized that it would work a hardship on Virginia nurserymen. Although yellows had never been observed in Virginia peach nurseries, Virginia peach orchardists had not acted promptly upon finding yellowed trees. "They are waiting until they experience personally the disasters of Delaware, Maryland, and other peach growers before they are willing to act" (Sou. Planter October 1891, p. 552). To Alwood's statements the Editor added the following:

"The reply of Prof. Alwood to the enquiry as to peach yellows, and the possible result of this State being quarantined much to the loss of our nurserymen, points to the necessity for the coming Legislature dealing with this question of peach yellows prevention in an effective manner. The last Legislature passed a bill dealing with the question, but in so imperfect a form as to be practically useless. We invite the attention of members of the Legislature and State Board of Agriculture to the question." (p. 553).

Alwood also reported that the French Ministry in Washington had inquired of the Virginia Commissioner of Agriculture as to which grape diseases "are especially injurious in Virginia, and what remedial measures are being used, and the success which attends them. To this query it was a pleasure to reply, that black rot our only really serious disease is now treated with a high degree of success." He mentioned that other diseases of grape were controlled by black rot remedies and that Dr. Galloway "has in his work the past summer, arrived at nearly identical conclusions with my own in regard to weak preparations," of copper sulphate solutions (pp. 552-3).

Alwood also called attention to an outbreak of a new foliage spot, which as described was probably Physalospora or frogeye leaf spot. Upon further investigation he promised to publish more about it (p. 553).

In the Annual Report of the Experiment Station, 1890-1891, Alwood summarized his plant disease experiments:

"The work has been confined mostly to treatment of grapes and apples for the diseases now so seriously affecting them in this State and I am glad to report that the work has been quite successful. It can be confidently stated that the question of controlling the black rot (Laestadia bidwellii), and the mildew (Peronospora), of grape is now settled, and the statements which I have published during the past two years concerning the efficacy of the weaker preparations of Bordeaux mixture are fully substantiated....During the year the work on the apple scab (Fusicladium dendriticum) and the brown spot of the apple leaf (Phyllosticta pirina) has been more successful that I had anticipated, and practically settles the question of the control of these two diseases." Today, even with more fastidious fungicides and equipment, we are hesitant to speak with such confidence.

Alwood published Experiment Station Bulletin No. 15, April 1892, Treatment of Diseases of the Grape, in which he addressed primarily the control of black rot (Laestadia bidwellii, now Guignardia bidwellii) but implied that the procedures were also efficacious for anthracnose (Sphaceloma ampelinum), brown rot (Peronospora viticola, now Plasmopara viticola), and powdery mildew (Uncinula spiralis, now U. necator). In the prefatory note, Alwood wrote, "In this Bulletin it is intended to present a condensed statement of the more important practical results of the work on the Grape, and, avoiding technical details, to make the discussion sufficiently complete and historical, in order that those of our constituents who are unfamiliar with the general literature of the subject may understand the same." (p. 32). Awareness of the work of French investigators and of Scribner and Galloway of the U.S.D.A. is expressed and for the first time in a Virginia Experiment Station bulletin, the publications of others were cited. Emphasis was given to the preparation and application of three formulas of Bordeaux mixture and of soda-copper and ammoniacal copper carbonate sprays and the costs were compared. Also for the first time tables were published in which the percent of rotted fruit from sprayed and unsprayed vines was compared. The expense of the preparations (but not the treatment cost per unit of vines) was compared and the concern about spray residue was considered. As seen in the following quotation, the attitude of consumers toward pesticides seems to have originated with the initial use of pesticides.

"The question of the residue left upon the fruit when mature and the character of this residue, is of much importance. On the part of consumers there is an ever-present fear concerning such matters; and their lack of correct information tends to make them peculiarly liable to a panic when unintentional, or otherwise, a scare concerning so-called poisoned fruit is started. Hence growers will serve their own interests by exerting every effort to so treat the vineyards as to leave no dangerous compounds upon the fruit and by improving every opportunity to remove false impressions as to the harmfulness of any slight residue which may be left upon the treated fruit." (p. 41).

In the Conclusions (p. 43), several principles of plant pathology were stated:

1. Plant diseases are prevented, not cured.
2. Practice crop sanitation; destroy crop residues and decayed fruits.
3. Apply dormant sprays.
4. Early spraying of growing vines obviates the need for late sprays.
5. Thorough coverage is necessary.
6. A spray schedule of four treatments based on the condition of the vines is described.
7. Bordeaux mixture 4-5-50 ($CuSO_4$-lime-water), the so-called weak preparation, is recommended based on experiments conducted for three years.
8. The results are compared with those of others and are found to agree.
9. Pesticide residues must be avoided.

In June 1892, Alwood published Virginia Agricultural Experiment Station Bulletin no. 17, Four Diseases of the Apple and Treatment of Same. The four diseases and their causal fungi were rust (Gymnosporangium macropus, now G. juniperi-virginianeae), scab (Fusicladium dendriticum, now Venturia inaequalis), bitter rot (Gloeosporium fructigenum, now Glomerella cingulata), and brown leaf spot (Phyllosticta pirina); no doubt Alwood had found the leafspotting form of Botryosphaeria obtusa which in the imperfect stage is Sphaeropsis malorum. (P. pirina is now Phoma pomorum and could have been found by Alwood but it was not the cause of brown spot or frog-eye leaf spot as we now know it). Each disease was carefully described and remedial measures were given. For rust, the destruction of cedar trees near orchards was emphasized; for scab, bitter rot, and leaf spot, destruction of fallen leaves and fruits was emphasized; and for all four diseases, a spray schedule was prescribed based on the stages of growth of the trees. As in the grape disease bulletin, copper sprays were stipulated after a dormant lye wash. No literature was cited; no experimental data were presented. However, some principles were expounded in the bulletin:

1. Destruction of alternate hosts of heteroecious rusts; here, destruction of cedar, the telial host of cedar-apple rust.
2. Destruction of overwintering stages of fungi; here, destruction of old leaves and decaying fruit for control of apple scab, bitter rot, and brown leaf spot.
3. The timing of topical treatments in advance of expected outbreaks of disease.
4. The timing of sprays to prevent secondary spread of fungus diseases. In support of this principle, Alwood prepared a spray calendar.
5. Roguing of infected fruit before packing for storage.
6. Phytotoxicity may be expressed by leaf scorch or fruit russet.

Alwood described methods of treating, and equipment for applying treatments. Although the information presented was not supported by data, his summarizing statements provided a clue as to the efficacy of the treatments. "The experimental work, from which the data for the foregoing discussion is derived, has been in progress here and elsewhere in the State, under our direction, for several years... That a very large percentage of the loss can be saved is fully settled. Our results warrant us in claiming that fifty to seventy-five percent of a crop has been saved by using these treatments." Bulletin nos. 15 and 17 were summarized in the Southern Planter February 1892, pp. 82-84. In the October issue (pp. 558-559), Alwood responded to criticism that lime is an unnecessary ingredient in sprays for grape black rot control. He demonstrated an awareness of varying physiologic constraints imposed by different weather conditions from year to year. He also pointed out that since chemical remedies also irritate or impair various host tissues, one should use the minimum amount that will secure immunity and he emphasized the importance of protecting the vulnerable foliage during periods favoring disease development. Since the frequency and intensity of rainfall would affect the number of spray applications, "be ye always ready."

(Note: During my preparation of this phase of plant pathology history, I discovered the following statement at the beginning of the December 1893 issue (p. 667) of The Southern Planter: "The Southern Planter is the official journal of the Virginia State Board of Agriculture and of the Virginia State Experiment Station." This statement was reprinted in subsequent issues through 1893. I could find nothing in Experiment Station records to support that statement. However, The Southern Planter each month carried articles prepared by various Experiment Station researchers).

In Experiment Station Bulletin no. 22, November 1892, entitled Bush Fruits, Alwood mentioned powdery mildew (Sphaerotheca mors-uvae) as a serious disease of some gooseberry varieties. He recommended bisulphide of potassium and weak Bordeaux mixture as alternative treatments. Currants should also be treated with Bordeaux mixture to control a foliage disease not named. The bulletin was reprinted in the January 1893 Southern Planter (pp. 20-22). No specific diseases of bramble fruits were mentioned although it was stated that red raspberries were very subject to disease in the summer.

Alwood published Experiment Station Bulletin no. 24, Injurious Insects and Diseases of Plants With Remedial Measures for the Same, dated January 1893. He recapitulated bulletins 15 and 17 on diseases of grape and apple and described diseases of cherry (brown rot, Monilia fructigena; brown leaf spot, Phyllosticta pyrini); plum (brown rot; black knot, Plowrightia morbosa; shot-hole, Septoria cerasina); peach (leaf curl, Taphrina deformans; brown rot; and shot hole as in cherry); pear (fire blight; a bacterial disease; leaf blight or fruit cracking, Entomosporium maculatum; scab was mentioned). Except for fire-blight, lye washes applied to dormant trees and vines and Bordeaux mixture, ammonia copper carbonate, and soda-carbonate applied to blossoms, fruit and foliage were recommended for all fungus diseases. No remedy for fire-blight was known but pruning of diseased parts was strongly advised. He described and devoted considerable discussion to control of peach yellows and lamented that the General Assembly had passed an ineffective law providing for inspection of nurseries and orchards, detection, and destruction of yellows infected trees. The bulletin concludes with a section on preparation and timing of sprays, and machinery for applying them.

In Bulletin no. 40, May 1894, Ripe Rot, or Bitter Rot of Apples, Alwood for the first time published illustrations of a disease and its causal fungus. He also for only the second time cited the publications of others, and he provided a bibliography of all known papers (= 32) on bitter rot. This bulletin included technical discussions on the nomenclature and synonymy of Gloeosporium fructiginum, the common name of the disease, symptoms, microscopic characters of the pustule, characters of the spore, spore germination, characters of the mycelium, and economic importance in the United States and Territories. Although a brief description of control measures was included, reference was made to prior bulletins for details. Alwood acknowledged information supplied informally by B. T. Galloway, Chief of the Division of Vegetable Pathology, U.S.D.A.; A. B. Seymour; J. B. Wllis; and his student assistant J. F. Strauss, who prepared the excellent drawings. This was the first truly scientific and scholarly publication on a single disease issued from the Virginia Agricultural Experiment Station. An abstract in lay-language was published without literature citations but with the drawings in the July 1893 Southern Planter (pp. 414-416), nearly a year prior to the date of issue of the bulletin.

B. T. Galloway, published an article, Two Destructive Irish Potato Diseases - How to Prevent Them, in the June 1894 Southern Planter (p. 307). He described late blight and the Macrosporium potato disease (= early blight). He pointed out that a daily mean temperature of 72-74°F accompanied by moist weather favored an outbreak of late blight and that a temperature mean above 77°F would check the disease. He also stated that early blight was often mistaken for late blight and he described how to distinguish them. He described the important preventative principles for controlling the diseases, and emphasized the use of Bordeaux mixture. The annual cost should not exceed $6.00 per acre. Since the cost was low, he emphasized spraying, disease or no disease. "It is a fact well established by experiments, that even if no diseases whatever appear, spraying with the Bordeaux mixture will increase the yield to such an extent as to make the work profitable."

In the December 1894 issue (Sou. Planter 55:613-614), Liberty Hyde Bailey described peach yellows in excellent detail and emphasized that the cause of it had not yet been determined. He advised immediate, total destruction of affected trees. Even pits from affected trees "may be expected to propagate the disease."

Alwood seems to have taken leave from publishing about plant diseases in the 1895 Southern Planter. Notes from different sources appeared in the magazine concerning various plant diseases including strawberry leaf blight (= leaf spot) by L. H. Bailey (March 1895, p. 120); a spray calendar for fruits and vegetables from the New York, Cornell, Experiment Station (April 1895, pp. 174-176); diseases affecting apple, cherry, and other fruit trees (brown rot and fire blight) described in correspondence involving the Virginia Commissioner of Agriculture, Thomas Whitehead, and the Acting Chief of the Division of Vegetable Pathology, U.S.D.A., Albert F. Woods (June 1895, pp. 277-278); diseases of cabbage and turnip; namely, club root with the use of lime for its control; this was an abstract of a New York (Cornell) bulletin (June 1895, pp. 278-279); finger and toe disease of cabbages, another name for club root, wherein control of cruciferous weeds, 2-year rotation and the use of lime and potash was prescribed (an abstract of an article by G. Massee of Kew Gardens, August 1895, p. 376); peach rot briefly described by B. T. Galloway expressing disappointment of ineffectiveness of control measures (August 1895, p. 376); correspondence and rebuttal to an article on the true nature of pear blight (November 1895, pp. 522-524); and, finally, W. F. Massey of the North Carolina Experiment Station and frequent author of botanical and agricultural articles in the Southern Planter, commented on and clarified statements about the November items on pear blight (December 1895, pp. 568-569). Alwood did not contribute any notes on plant pathology to the 1895 Southern Planter but he prepared six Experiment Station bulletins, two of which addressed plant diseases.

Virginia Agricultural Experiment Station Bulletin no. 49, Pear Culture, was published by Alwood in February 1895. He described pear growing at Blacksburg from 1889 through early 1895, and declared that the "orchard has been singularly free from injury by diseases or insect attack." He attributed this to having practiced rigorous sanitary measures and applying several washes combining fungicides and insecticides. Fire blight was of minor importance and the leaf blight and fruit cracking caused by Entomosporium maculatum was held in check by the washes. In the summary, he emphasized that washes must be applied in off-crop as well as good crop years if trees are to be kept healthy and that promptness of remedial action is essential.

In Bulletin no. 59, December 1895, entitled Experiment Garden Notes - Part I, tomato production in the field and under glass was discussed. Alwood mentioned that only a few fruits were lost under glass from the black rot, Macrosporium solani (Note: This fungus often is a secondary invader of fruits having blossom-end rot but sometimes causes a stem-end rot. Alwood's black rot is uncommon in greenhouses). Spring celery production was hampered by Cercospora apii causing leaf blight, but in the fall crop, leaf blight was held in check by the liberal use of Bordeaux mixture.

Heretofore, the emphasis has been on Alwood's Experiment Station work, but since 1891, he had also been teaching courses in Horticulture, Entomology and Mycology. Two courses in Mycology were listed in the College Catalogues for the 1891-2 through the 1898-9 sessions. Mycology was a systematic study of fungi, two lecture hours per week. Laboratory Mycology was described as a "study of fungi as pathogenic organisms causing diseases of cultivated plants," two three-hour periods per week. Even though the catalogue was very slim, the texts and reference works for each course were listed. For the mycology courses, the list was as follows:

DeBary, Comparative Morphology and Biology of Fungi (the catalogue omitted a portion of the title "Mycotozoa and Bacteria").
- Bennett and Murray, Cryptogamic Botany.
- Saccardo, Sylloge Fungorum.
- Plowright, A Monograph of (the British) Uredineae and Ustilagineae.
- Burrill, Monograph of Uredinaceae and Erysipheae.

Such a list would scare a modern V.P.I. & S.U. student to death, even at the graduate level. The catalogue also stated, "In addition ... the Department has facilities for giving advanced courses in ... Vegetable Pathology," and "The Department has ... a collection of specimens of diseased plants embracing one thousand species of parasitic fungi," much more than we have now. How was this collection assembled so soon after the inception of mycology course work? It would be interesting to see a list of the specimens for up through 1895, fewer than 25 plant diseases had been mentioned in publications emanating from the Experiment Station, all of which were associated with horticultural crops.

Through 1895, Alwood had been a one-man department, teaching in three disciplines, with the acknowledged assistance in pathology work of only J. F. Strauss, who illustrated the bitter rot of apple bulletin. As Vice-Director he was trying to develop an experiment station with all its attendant problems of finance, staff, buildings, orchards, vineyards, gardens, machinery, implements, philosophies, and rapport with the public and politicians. In 1896, W. M. Scott, and in 1898, Harvey L. Price, for whom the venerable Price Hall is named, assisted with teaching horticulture and mycology courses.

In June 1896, the Experiment Station Bulletin no. 65, Notes on the Cherry Orchard, was published by Alwood. After describing 24 varieties, he advised growers to prune away swellings caused by the black knot of fungus, to prevent leaf diseases by spraying judiciously with Bordeaux mixture, and to reduce brown rot of fruit by a schedule beginning with a dormant lye wash and continuing with three sprays of Bordeaux mixture. Although the cover dates the bulletin as June 1896, it was issued July 1897. Likewise, Bulletin no. 67, Notes on the Plum Orchard, dated August 1896, was issued August 1897; why the delay is unknown. On plums, only brown rot was mentioned. Sanitation, i.e. removal of old fruit from trees and the spray schedules as for plums were prescribed.

For the period 1896-1897, Alwood was occupied by efforts to control the San José scale. Legislation for suppression of the pest in 1896 (published in the May 1896, Sou. Planter, pp. 228-229) and ultimately, Alwood, as Experiment Station Entomologist had been appointed to execute the provisions of the act. He published four bulletins on the subject. None of his writings appeared in the 1896 and 1897 Southern Planter.

After 1895, the Southern Planter seems to have rescinded its self-proclaimed officialdom as journal of the Virginia Agricultural Experiment Station. It published a spray calendar presumably compiled by the editors from several bulletins published by various states and the U.S.D.A. Numerous diseases and insects were included and 15 species or groups of plants were listed. The margins were embellished with bold face admonishments that yellowed peach trees, fire-blighted, black-knotted and club-rooted materials should be burned. Club root of cabbage, cauliflower, and turnips should also be accompanied by strict rotations. The calendar first published in April

1896 (pp. 162-164), was reprinted in the May 1897 issue (pp. 216-218) and for several more years without revision.

In reviewing the Southern Planter 1888 through 1897, I found many articles on the culture of tobacco, corn, small grains, sugar beets, hay crops, cotton and peanuts but none mentioned plant diseases; the first on these crops appeared in June 1897 (p. 250). An item entitled Rust on Wheat, was printed (p. 250) in response to a letter from a Tennessee subscriber. He asked for the cause and remedy of wheat rust. The editor described the "disease of a fungoid character which attacks wheat in every country of the world where wheat is grown." Rainy, sultry weather, low-lying fields, rich soils, excessive use of manure, late and thin sowings all were said to favor rust. Control measures mentioned were sprays which though effective were not considered practicable, burn rusted straw, and "grow only so-called rust resistant varieties, of which there are several, which are only very slightly liable to attack. Even these suffer from it under certain climatic conditions." (Note: Probably there were no rust resistant, soft, red, winter wheats suitable for Tennessee in 1897). The rust referred to here must have been leaf rust (Puccinia recondita).

Since the Southern Planter was published in Richmond, Virginia, items published therein regarding plant pathology are acceptable as an integral part of this history. Therefore, the following items are incorporated here, because they are of regional importance.

A New York (Cornell) bulletin describing the effects of Bordeaux mixture on blight (probably meaning both early and late blight) and Irish potato yield was abstracted in the July 1897 issue (pp. 297-298). In the absence of disease, spraying was profitable on some varieties, but costly on others.

The most recent North Carolina General Assembly, as of July 1897 "passed an act constituting a Commission for the extermination of noxious insects, fungous diseases and weeds which are affecting or may affect crops" (p. 303). The San José and other scale insects, peach yellows, peach and plum rosette, fire blight, and black knot were the diseases. No weeds were named. The law was similar to Virginia's "San José law" enacted in 1896.

Following the item above, inquiries from several subscribers complaining about pear and apple blight precipitated a long quotation of M. B. Waite's work and results (pp. 303-304). Essentially, Waite described the disease on all affected parts, reported that Kieffer and Duchess pears were less severely attacked than Bartlett and Clapp Favorite, pointed out that conditions favoring rapid growth also favored disease development, and suggested that growers avoid manure or nitrogenous fertilizers and that they prune out blighted branches promptly during and at the end of the growing season.

Another item, The Red Rust of the Blackberry (August 1897, p. 353), recognizes without saying that the rust fungus grows systemically in the plant and recommends total destruction of infected plants. Undoubtedly, the fungus was Gymnoconia interstitialis.

Items relative to plant pathology appearing in the 1898 Southern Planter included one explaining how to prevent oat smuts by a 10-minute treatment in water at 138°F (Feb., p. 54); the annual spray calendar, a reprint from previous years (April, p. 172-

174); a reprint of the San José scale law enacted February 28, 1898, by the Virginia General Assembly (May, pp. 238-240) and undersigned by Alwood, Entomologist. In this reprint, there was no mention of fungous diseases. In June (p. 266), W. F. Massey responded vehemently to an Albemarle County grower inquiring about "Johnson Grass" as a hay crop. Massey had recognized it to be a problem with long lasting dire consequences. He wrote, "The man who introduces this grass into a grain growing section ought to be executed as a public enemy ... It is a fact that once introduced in a neighborhood it is soon all over every field in that neighborhood, and is there to stay ... If I was in a section where there was no Johnson grass, and was engaged in grain or tobacco farming, and one of my neighbors proposed to sow Johnson grass on his land, I would try hard to get an injunction out of the courts to stop him." In the 1960's it would be shown that Johnson grass harbored two viruses of corn which would cause severe reductions in yields of grain and silage. Oh, if we had only heeded Massey!

An act of Congress May 10, 1898, authorized the testing of agricultural seeds for purity beginning July 1, 1898 (June, pp. 288-289). Aside from specifying limits on per cent purity and germination, "the seed must be true to name, and practically free from smut, bunt, ergot ... and the seeds of dodder (Cuscuta spp.)." This was the first mention of bunt, ergot, and dodder in literature published in Virginia.

In an item "Apple and Pear Blight," the spread of the bacteria is chiefly by bees and the first site of infection is the nectary (July, p. 321). This was the first mention of bees in various articles on fire blight in a Virginia publication and no doubt was taken from an article by M. B. Waite in the U.S.D.A. Yearbook of Agriculture for 1895. In a September item on "Pear Blight" (p. 424), B. T. Galloway described the paradox that bees spread fire-blight bacteria while doing the necessary pollination of flowers. Both articles highlighted the need to prune out infected branches as soon as possible.

B. D. Halsted of the New Jersey station was cited for writing that asparagus rust has been damaging along the Atlantic coast from New England to Florida. It had been detected in 1896. No practical remedy was revealed (September, p. 424).

In a note "To Prevent Smut in Wheat, Barley, and Oats," growers were advised to immerse seed in water at 135 to 145°F for 5 minutes (October, p. 453). This was corrected in the November issue (p. 502) to 130 to 135° with an optimum of 132° for smuts of wheat, oats, and barley. None of these diseases had yet been mentioned in Virginia Agricultural Experiment Station publications.

The oat variety Red Rust Proof was mentioned as the best to plant in Alabama in October to November. There had been no mention of oat rust in the Southern Planter, 1888-1898. The article concluded with the advice to scald oat seed at 130 to 135° for 10 to 15 minutes. The saving resulting from this treatment was said to be "5 to 20 per cent of the crop, and sometimes more." (October, p. 465).

There were no plant disease notes by Alwood in either the 1898 or 1889 Southern Planter. Presumably, he was fully occupied by San José scale inspection work or in preparation of the orchard technique bulletins.

In 1899, Alwood published five bulletins under the title "Orchard Technique"; number IV in the series subtitled "Spraying the Orchard" is the only one to address plant diseases. He described dormant lye sprays (NaOH or KOH) which were aimed at control of apple scab (Fusicladium dendriticum, now Venturia inaequalis) and brown rot of stone fruits (Monilia fructigena, now Monilinia fructicola in our area). The second spray, Bordeaux mixture and an insecticide, was aimed at the apple diseases orange rust (Gymnosporangium macropus, now G. juniperi-virginianeae); and brown leaf spot (attributed to Phyllosticta pirina but most probably was caused by the black rot fungus, Botryosphaeria obtusa); and the stone fruit diseases peach leaf curl (Exoascus deformans, now Taphrina d.), and leaf spot (Septoria cerasina, or probably bacterial blight or shot-hole, true identity uncertain). Additional sprays were recommended at different stages of flower and fruit development each illustrated by a drawing. Preparation of the various fungicide-insecticide sprays was described, and spray equipment was illustrated. Although the bulletin was dated May 1899, it was actually issued March 1900. This gave Alwood time to append a section on fire blight of pear and apple, prompted by a severe outbreak in 1899. Although M. B. Waite in 1891, had shown that bees transmitted the fire-blight bacterium, Alwood cautiously stated about the bacteria exuding from overwintered cankers, "They may be carried by insects which visit sap exudations or in some other manner to the tender parts of the growing plants." Pruning of diseased plant parts at the end of the growing season was strongly recommended.

In Experiment Station Bulletin no. 102, July 1899, The Crop Pest Law, enacted and approved by the General Assembly of Virginia March, 5, 1900, was presented verbatim; the bulletin was issued May 7, 1900. (Note: I do not yet comprehend the dating of Experiment Station bulletins.) R. H. Price, former Assistant in Horticulture, also noted the discrepancy and suggested that it was a scheme to give the impression that bulletins were published monthly (Sou. Planter 1903, p. 646). The oddity here is that the bulletin, from the cover date, appears to anticipate legislative action.) Although the law was precipitated by the San José scale, the scope and operation of the law was broadened by a Board created by the law to include the wooly aphis, peach yellows, black knot of plums, and fire blight of pear and apple. A previous act directed only toward the scale had been approved on March 5, 1896. The 1900 act gave teeth to the ineffective peach yellows law of 1890. The pertinent points of the act were as follows:

1. The Board of Control of the Virginia Agricultural Experiment Station was created as the State Board of Crop Pest Commissioners; J. T. Brown was elected President of the Board, and J. M. McBryde, Experiment Station Director and President of the College, was elected Secretary. The Board appointed W. B. Alwood State Entomologist and Pathologist, with J. L. Phillips and H. L. Price as assistants.
2. The Board was empowered to list dangerous insects and diseases, and describe them and give the manners of their dissemination, and provide rules and regulations under which the State Entomologist and Pathologist shall proceed to control, eradicate, destroy, and prevent the dissemination of said pests.
3. The Board of Commissioners was empowered to establish quarantines and regulations against the sale and transportation of nursery stock within the State when the same is found infested with specified pests.
4. The Board was empowered to regulate nursery stock entering the State.
5. The Board of Commissioners was required to inspect annually all nursery stock and issue certificates of freedom from pests to nurserymen within the State and like certificates were required on all stock entering the State.
6. The law conferred police powers upon the Commissioners and provided for fines

of $50 to $100 upon conviction of violators. Those who hindered the work of inspectors were subject to lesser fines.
7. The generous sum of $1000 was appropriated to support the activities of the Commissioners enforcing the law.
8. Previous acts inconsistent with the 1900 act were repealed. (This eliminated prior ineffective acts regarding peach yellows and San José scale).
9. Rules governing inspectors, nurserymen, appeals, etc., were spelled out. The pests, their symptoms and features, and treatments were described. For yellowed peach trees, total destruction was required; for plum knot, pruning before knots ruptured was required; for fire blight, fall pruning for older trees was required but immediate pruning was required of nursery stock as soon as stock became symptomatic.

Bulletin 102 ended with a summary of work conducted on San José scale since 1896. The law was the first in Virginia to provide for regulated control of a fungus disease (plum black knot) and a bacterial disease (fire blight). The Commissioners included peach yellows under fungus diseases in their terminology. It would later be attributed to a virus but now is known to be caused by a mycoplasma-like organism.

In 1899, items in the Southern Planter pertaining to plant pathology began in the January issue (pp. 16-17) with J. B. Watkin's comments about how he controlled fire blight of pear in his Chesterfield County orchard. He refrained from using nitrogen fertilizer or legumes as cover crops until late summer nor did he cultivate until late summer. This way he maintained a short stout growth. Even Bartlett pears had very little blight and that was promptly pruned out.

In a report of the proceedings of the annual meeting of the Virginia State Horticultural Society for December 1898 (Sou. Planter, January 1899, pp. 17-18), Alwood spoke on the construction of some recent spray machines adaptable for orchard work.

A complaint by a farmer in Orange County that his cabbage and turnip plants rotted before they matured resulted in a response by W. F. Massey in his Enquirer's Column that club root may have been the disease in question (March 1899, p. 115). The farmer, in the April issue (p. 174) pleaded that he had not provided an adequate description of his cabbage and turnip rot. He elaborated further and Massey concluded that the disease was black rot caused by a bacterium (now Xanthomonas campestris pv. campestris) and that no remedy had been discovered. He advised rotations and strict sanitation.

From Bedford County came some apple leaves which Massey diagnosed as having cedar-apple rust (August 1899, pp. 377-378). He carefully described the disease and its cycle then wrote, "It is very probable that the fungus on the apple trees may continue to live from year to year without re-infection from cedars ... It is perennial, and as soon as the leaves appear that fungus spores begin to develop ... cutting down the cedar trees may check its development, but if it lives over in the apple trees (?) cannot be considered certain to destroy it." (Note: Something was omitted (cedar eradication?) from the end of the statement; it appears as it was printed. Twig infections have been observed on apple, but I know of no record of the rust overwintering on apple.)

To the question, "Is the winter gray turf oat a rust proof oat?", Massey replied, "In the sense of being immune to the attacks of the fungus making what is called rust, no oats or wheat are rust proof. It is thought that the red rust proof oats are more resistant than other varieties."

A farmer from Curl's Neck Farm, Henrico County, described some Irish potato tests to determine their profitability. When the tubers were dug, it was recorded that the foliage had been free of blight and it was obvious that scabby potatoes were a factor in the poorly producing plots (November 1899, p. 523-524).

The spray calendar of previous years was reprinted and again in 1900 (Sou. Planter, Mar. 1900, p. 146-148). There were no publications on plant pathology issued by the Experiment Station in 1900. Presumably, Alwood was heavily committed as the State Entomologist to implementing and enforcing the San José scale law. He was also preparing the initial manuscripts for his Orchard Studies bulletins, the first of 16 were to be issued in 1901. The February 1900 Southern Planter (p. 88) contained an item reviewing the second report of the State Inspector for San José scale. The Inspector (presumably Alwood) made the following points:

1. Proper enforcement of the act, along with the investigations made necessary under its provisions, requires the time of a trained man.
2. The need for polic legislation is increasing with the widespread occurrence insect enemies and plant diseases, which may be transported upon nursery stock and from orchard to orchard --- examples well known are the woolly aphis of apple, black knot of plum and cherry, peach yellows, etc., and there is a constantly increasing danger of the introduction of pests which do not occur in this State.
3. This department (= Horticulture, Entomology, and Mycology) ought not to attempt to further conduct such laborious and important work unless money sufficient to organize it on an independent basis is furnished. A sum not less than $2,000 per annum is needed for this purpose.
4. A Board of Crop Pest Commissioners should be constituted with the power to designate what pests shall be held to be dangerously injurious, and hence be subject to quarantine regulations within the State.
5. The Board should be invested with powers of quarantine against communities likely to ship diseased plants into this State.

Letters to the Enquirer's Column in 1900 addressed pear fire blight (p. 265), potato scab (p. 140), grape black rot (p. 265), and tomato blossom-end rot for which Massey recommend the useless remedy of spraying with Bordeaux mixture (p. 492); he suggested that a wilt and stem rot was the Southern blight caused by a bacterium for which there was no remedy (p. 492). Pear fire blight was discussed in detail by B. T. Galloway of the U.S.D.A. (pp. 497-498). The principles of control emphasized were to (1) put the tree in a condition to resist blight or to render it less liable to the disease and (2) exterminate the microbe itself, for, if carried out fully, there can be no blight. Details for implementing each principle were provided.

In the October 1900 issue (p. 555), J. L. Phillips, Acting State Entomologist and Pathologist, gave a detailed account of peach yellows paying particular attention to early symptoms and he urged growers to eliminate affected trees as soon as symptoms appeared. He added that "the State law covers the case fully, and there should be no hesitancy about applying it wherever peach growers are in danger. Close attention will do much toward making the growing of peaches a thriving and profitable industry."

Alwood, in 1901, began a series of Experiment Station bulletins entitled "Orchard Studies". The first four of these, published in 1901, contained no plant pathology. However, several items on plant diseases appeared in the Southern Planter that year.

From the Georgia Experiment Station, A. L. Quaintance gave an interesting testimonial on the efficacy of Bordeaux mixture for control of peach brown rot (p. 27). A farmer who had sprayed his peaches several times had no trouble with brown rot in most of his orchard. Next to a road bordering the orchard, fruit rotted badly although properly sprayed. In a strip about 100 yards wide there was diminishing amount of rot progressing inward from the road. Across the road lay the culprit, an unsprayed orchard.

A farmer from Northampton County claimed that potato scab was caused by a worm chewing on the tubers. The editor retorted that scab was a fungoid disease and stated that soil may be infected with the scab organism. He implied that the disease could be remedied only by planting potatoes in soil free of it. Corrosive sublamate was recommended for treatment of seed pieces, i.e., potato sets (p. 148). The spray calendar was reprinted again (pp. 154-156). A farmer from Henrico County, Virginia inquired about the cause and control of sweet potato black rot. The Editor responded that a fungus caused the disease and the only healthy roots and healthy slips or cuttings should be used as propagation material (p. 309). Another farmer from James City County, Virginia claimed guano gave scab-free potatoes but barnyard manure increased it (p. 402). Perhaps guano reduced the pH.

Despite the great number of items on control of fire blight which appeared in various issues of the Southern Planter, it remained number one on the Enquirer's Column list. A farmer asked if using a great deal of stable manure contributed to the havoc played by fire blight in his orchards. The editor reminded him that manure favored sappy growth and, consequently, fire blight. He was advised to reduce the manure (p. 457-458).

A gentleman named Norman Robinson, address unknown, wrote about the dismal failure of pear orchards in southern Georgia and northern Florida (December, 1901, p. 683-684). He claimed that such a loss to the fruit industry was inexcusable and he proceeded to describe his success as a pear orchardist. His strict, frequent pruning and destruction of infected wood was the key to his success. He also advised fertilizing with heavy doses of potash and phosphates, and providing nitrogen only from annual crops of cowpeas. He was apparently well-read on the researches into fire blight control. Although Robinson seemed very confident, even knowledgeable persons such as Alwood were defeated by the disease. A recounting of the situation is presented in Experiment Station Bulletin no. 135, Orchard Studies. VIII. On the Occurrence and Treatment of Fire Blight in the Pear Orchard, dated April 1902 on the cover (but issued June 1903), and authored by Alwood.

The test orchard at Blacksburg was ten years old in 1899. Up to that time, only traces of fire blight had appeared. In "the spring of 1899, ... the blight showed more abundantly, but still not enough to cause much alarm ... We had been able to control the trouble by cutting away the diseased portions, in accordance with old recommendations so frequently made, and we had supplemented this treatment by the thorough use of the Bordeaux spray. The work appeared to show that ... one might be able to grow pear trees successfully with but a slight amount of injury from fire blight. However, beginning with the spring of 1900, the attack of blight upon this orchard became very severe, and, regardless of cutting out diseased wood and thorough application of Bordeaux spray, the attack progressed so rapidly that some of the trees were entirely destroyed." Alwood described the losing battle through the spring of 1903 (despite having the bulletin dated April 1902). The relative resistance of 33 varieties was described and summarized. "After our experience with the blight, we suggest the following list of varieties for home use and commercial planting. Well treated, these would appear to promise the best results:

For summer: Barlett and Tyson.

For autumn and late fruit: Seckel, Bosc (finest quality, amateur only), Louise, Rutter, Kieffer (especially for commercial purposes), and Lawrence."

In addition, Alwood lamented, "Our efforts to stay the fire blight ... have failed to hold the disease in check ... We do not think it would be profitable for orchardists to try to save such badly diseased trees as some shown in the illustrations." Essentially, this was the coup de grace of Virginia's pear industry.

Alwood contributed 16 bulletins in the Orchard Studies series, 12 of these are cover dated 1902 although no. XVI was issued in September 1904. Bulletin no. 132, Orchard Studies. V. Report on Crab Apples, dated January 1902, by Alwood and H. L. Price was issued April 1903. The bulletin is devoted primarily to variety description and culture. The authors mentioned orange rust (Gymnosporangium macropus, now G. juniperi-virginianae), fire blight (Micrococcus amylovora, now Erwinia amylovora) and black rot canker (Sphaeropsis malorum, now Botryosphaeria obtusa) as the primary diseases of crab apple. Surprisingly, scab was not mentioned. Systematic spraying, pruning and culture as required for apples was recommended.

Bulletin no. 134, March 1902 (issued June 1903) co-authored with H. L. Price was no. VII in the series, Spraying the Plum Orchard. Notes on Varieties of Domestica Plums. In the spraying section, protection from the leaf blight (caused by Cylindrosporium padi) and brown rot (caused by Sclerotinia fructigena) was sought. Up to 8 treatments with Bordeaux spray were applied from March 13 to August 2, 1901. Some plots received only the first two or four treatments in which case the leaf blight had induced defoliation by August 1, and poor blossom production and growth in the spring 1902. The authors concluded that season-long spraying with Bordeaux mixture was necessary for successful plum production. In the second part, twenty-one varieties are described, nine of which were mentioned as susceptible to brown rot. No reactions to leaf blight were mentioned.

Bulletins 136 through 139, all by Alwood, were devoted to cider production. Number 140, September 1902 (issued September 1903), Orchard Studies. XI. Some Observations on Crown Gall of Apple Trees, by Alwood was a comprehensive, illustrated description of the disease whose cause was not yet known. (Note: Actually the disease was shown to be of bacterial origin by Cavara of Italy in 1897. Hedgecock first probably isolated the bacterium from grapes in 1903 and reproduced the disease, but Smith and Townsend produced the irrefutable evidence that a bacterium caused the disease in the 1904-1906 period).

First acquaintance with crown gall of apple came in 1896 during surveys for San José scale in nurseries. Reports of the disease increased to an alarming extent in the next four years. The Board of Crop Pest Commissioners decided to exclude galled apple trees from sale in the State. Several experiments were conducted to determine the progress of the disease, symptoms, and modes of dissemination. Both galls and hairy roots were pictured. Nurserymen were advised to destroy all symptomatic plants and not to sell such plants and planters were to reject all trees showing cancerous growth at the crown or abnormal root development. "There appears to be no hope of remedial treatment." Alwood referred in the text to J. W. Toumey who worked with the disease on almond and named the causal organism Dendrophagus globus, which is a slime mold. There was no formally cited research.

Alwood and J. L. Phillips published Experiment Station Bulletin no. 141, October 1902, Orchard Studies. XIV. The Lime-Sulphur Wash, with 54 illustrations (photographs and drawings by J. F. Strauss). Lime-sulphur was to be used primarily for control of the San José scale. There was no mention of disease control. Lime-sulphur had been the subject of bulletins published by at least nine experiment stations and the U.S.D.A., according to table I in our subject bulletin 141. Exactly when it was recognized as a remedy for peach leaf curl is not clear, but Californians about 1880-1885 found the combination of lime, sulphur and salt solution used as a dormant spray against San José scale also controlled peach leaf curl. Surely Alwood knew of this. The bulletin describes preparations, dilutions, timing cautions, and equipment needed. Even though the authors described experiments conducted in the spring of 1903, the bulletin is recognized as being published in 1902. What a sneaky way to gain priority on original discoveries.

The final bulletin, no. 142, cover-dated 1902, in the Orchard Studies series related to plant pathology was XV. The Bitter Rot of Apples. The topic had been discussed in bulletin no. 40, long since out of print. Number XV, though dated in November 1902, was actually issued in February 1904. Alwood gave a detailed account of the various discoveries and names given the bitter rot fungus beginning with Berkeley in 1854, and ending with Von Schrenk and Spaulding in 1902. At least eight names were given the fungus in that period. Alwood summarized with, "Therefore, out of a plentitude of names, the bitter rot fungus has, we will hope, reached a stable designation - viz., Glomorella refomaculans, as given by Spaulding and Von Schrenk in Bulletin 44, Bureau of Plant Industry, United States Department of Agriculture." Note the misspelling of "Glomerella." Alas, the fungus was to be given at least one more name that is currently used,

Glomerella cingulata. Only the common name, bitter rot, has remained stable.

As for control of bitter rot, the basic procedures described in the 1894 bulletin had not changed. Cankers on limbs were added as sources of infection and, thus, pruning was specified for their elimination. Removing rotted fruit and spraying with Bordeaux mixture, now simply called "Bordeaux", were re-emphasized. New figures illustrating twig and limb cankers were beautifully illustrated by J. F. Strauss.

Although Alwood refers to others in his historical review of bitter rot, he did not append a literature cited section (nor did anyone else who prepared Station bulletins in the Alwood era) and one would have to search other publications for references to original papers. Since this would be Alwood's last bulletin on plant diseases, someone else would have to set the precedence of citing literature in Virginia Agricultural Experiment Station publications. Furthermore it would be another eight years before the Station printed a bulletin relative to plant pathology. This left the Southern

Planter as the primary source of plant disease information for Virginians.

In 1902, the academic Department of Mycology and Entomology was established with Alwood as Head; John L. Phillips who had assisted him since 1899, joined him in the new department. Phillips was also named Assistant State Entomologist and Pathologist; he was not a member of the Experiment Station staff. In the 1902-1903 College catalogue, Alwood and Phillips listed the following pathology-related courses:

MYCOLOGY, 2 lect./wk. - Fungus systematics

LABORATORY MYCOLOGY, 2 3-hr. labs./wk. - Determinative mycology, especially of fungi causing diseases of plants, artificial culture, and on plant tissues. Students must collect and determine 50 species and write a thesis on some species studied in the laboratory. (Note: It would be interesting to see a list of 50 specimens collected by students since this is more than the number of plant diseases mentioned in Station bulletins through 1902.)

ADVANCED WORK - Courses in special groups of fungi, pathology of cultivated plants, study of yeast ferments (industrial mycology).

In the 1903-1904 catalogue, William A. P. Moncure, M.S., V.P.I., was listed as Instructor in Mycology. In addition to the courses listed above, there appeared for the first time a course in Plant Pathology:

PLANT PATHOLOGY, 3 lect./wk., - text, Plant Diseases by G. Massee, required by juniors majoring in Horticulture.

As Moncure remained Instructor of Mycology through 1908, course listings remained the same except for adjustments required when the College changed from the semester to the quarter system of terms. More will be said about Moncure later; plant pathology in the Southern Planter 1902 through 1904 will be now reviewed.

Farmers in Dinwiddie (1902, pp. 8, 80; 1904, p. 324) and Lunenburg Counties (1904, p. 167) registered the first complaints about a white leaf fleck of tobacco. The disease was not diagnosed but was thought to be fungoid in origin and actually may have been "weather fleck" which was described in the 1920's and recognized as being caused by ozone in 1964 (see Lucas, G. B., 1975. Diseases of Tobacco, 3rd ed.:571-578).

Spray calendars were published each year (1902, pp. 154-155; 1903, pp. 172-173; 1904, pp. 174-175); although the content remained essentially constant, the format was changed and R. H. Price edited the calendars beginning in 1903. Only copper compounds were recommended for fruit and vegetable sprays. Lime-sulphur had not been introduced but its forerunner, a lime, sulphur, and salt mixture was recommended in 1904 as a dormant spray for San José scale. Its fungicidal value would soon be recognized. Mercuric chloride was recommended for a potato seed-piece dip from the inception of the calendar in 1896. (Note: a calendar from Cornell published in an 1895 issue preceded the one compiled specifically for the Southern Planter).

Fire blight of pear and apple was the disease that precipitated the most letters to the Enquirer's Column and Editor (1902) pp. 156, 405, 458, 520; 1904, 332, 666).

Apparently one learned gentleman had not yet subscribed to the germ theory of disease but clung to Unger's theory that microorganisms associated with disease were the result of and not the cause of disease (1904, pp. 666). More scholarly, and scientifically correct for the era, discussions appeared at intervals (1902, p. 579; 1903, pp. 507-508 1904, pp. 332). Alwood presented a review of Orchard Studies. VIII., which thoroughly covered the Station experiences with fire blight (1904, pp. 507-508). Bitter rot was the subject of comments (1904, p. 332); there were reviews of bulletins from the Delaware Station (1902, p. 579), the U.S.D.A. (1903, p. 764), and Alwood's Orchard Studies. XV. (1904, pp. 255-257). Crown gall was the subject of items contributed by M. B. Waite (1902, p. 634) and Alwood (p. 693). In the latter, differentiating between crown gall symptoms and wooly aphis damage was stressed. Alwood's bulletin Orchard Studies. XIII., on crown gall was reviewed briefly in 1903 (p. 776). From Fauquier County came a complaint, the first, about apple root rot (1902, p. 213). No diagnosis was provided; most probably it was the black root rot, caused by Xylaria mali, which Fromme in the future would study in detail (Va. Agri. Expt. Sta. Tech. Bul. 34, 1928). Alwood reviewed his bulletin no. 134, Spraying the Plum Orchard (1903, pp. 571-574) and Waite provided suggestions for controlling peach leaf curl with a mix of lime, sulphur, and salt solution; tomato blight and rot with Bordeaux mixture; and cantaloupe blight with the same (1903, p. 253). An article reprinted from the American Agriculturist discussed "running-out" of potato seed stocks (1902, p. 221). The viruses causing it had not yet been recognized. The author suggested that shifting potatoes to different soils will prolong the vigor of the stock. Other inquiries about horticultural crops included information about sweet potato black rot (1903, p. 309) which could be remedied by using vine cuttings from sound roots sprouted in clean soil, and a request for a description of peach yellows (1904, p. 662).

Agronomic crops began receiving more attention. A Halifax farmer described how he controlled wheat smut by soaking seeds in a solution of bluestone (1902, p. 69). J. W. Ingham wrote an essay on the smuts of grains (1902, pp. 209-210), in which he gave a reasonable but slightly inaccurate description of the smut cycle. He cited Hilgard of California and Swingle of the U.S.D.A. as his sources. He clearly differentiated between bunt and loose smut of wheat and knew that the latter was difficult to control. He only mentioned the hot water treatment but gave detailed accounts for use of copper sulphate soaks. He erred by saying corn smut infects the kernels.

A Lunenburg County, Virginia farmer described wheat head blight (= scab) almost perfectly (1904, p. 528) but the disease was not generally known in 1904. M. S. Carleton, a Cerealist for the U.S.D.A., ascribed the disease to a bacterium and flatly stated that the pink fungus associated with it was not the cause. We learned in 1909 from the work of Selby and Manns that Gibberella saubinetii, now G. zeae and Fusarium roseum, now F. graminearum are teleomorph and anamorph of the same fungus. What Carleton had seen no doubt was the early Fusarium stage of scab.

A North Carolina farmer wanted to know what caused corn to smut and would the smut harm livestock that consumed it (1903, p. 628). The Editor attributed it correctly to Ustilago zeae, described the disease cycle, and said that it would not harm livestock. There was one other disase, not previously mentioned in Virginia, that when diagnosed, drew a surprizing reply. A Mecklenburg County farmer sent in an alfalfa specimen badly spotted and defoliated. The diagnosis by C. L. Shear, U.S.D.A. Pathologist, was that Pseudopeziza medicaginis was spotting the leaves. If the plants were badly diseased, the farmer was advised "it would probably be best to burn the field and plant it to some other crop." We know better now.

The reader may wonder why I have detailed so many items from 15 years of the Southern Planter, coinciding with Alwood's tenure at Blacksburg. My motive was to provide insight into our status of knowledge as perceived by authorities and laymen and to point out that farmers had disease problems with agronomic crops even though they were totally ignored by Alwood and his associates. It is pretty obvious that fruit crops had the greatest problems of the era, that perishability of harvested fruit was tied to diseases of the trees and vines and therefore successful remedies were required. Since Alwood was a trained pomologist, he probably felt more comfortable dealing with fruit problems. In addition, a strong State Horticultural Society (in reality a fruit growers society) lobbied to ensure the Station would solve problems of its members. Thus, the diseases of grains, cotton, peanuts, and tobacco were ignored. Except for a few, notably beans, tomato, sweet potato, and Irish potato, vegetables were given only token notice.

There were very few remedies available; the repeated recommendation to spray with Bordeaux mixture must have been frustrating and monotonous. So now, in 1904 we find Alwood, the savior of the Virginia fruit industry, suddenly at a crisis according to D. L. Kinnear in The First 100 Years: A History of V.P.I. "In 1904, President McBryde effected a more thorough administrative plan by organizing the College into four departments, each with its own dean and faculty." Among them were the Agricultural Department, Professor A. M. Soule, Dean. "At the same time, McBryde relinquished the direction of the Experiment Station to Soule. The first results were both unhappy and unexpected. As McBryde reported it, Professor Alwood resigned because he had not been appointed director of the Experiment Station ... Alwood's resignation had been particularly distressing to McBryde, since it had resulted from complete misunderstanding between the two men. Alwood, one of the truly great scientists of early V.P.I., after more than a decade of dedicated service, had become greatly discouraged over lack of financial support for his research. About a year prior to his resignation he had gone to McBryde to discuss the situation. In the lengthy discussion and planning that followed, Alwood got the impression he was in line for the directorship of the station and perhaps for the deanship of agriculture. McBryde, on the other hand, got the impression that Alwood did not want either the directorship or the deanship. With the announcement of the appointment of Andrew Soule as dean of agriculture and director of the Agricultural Experiment Station, Alwood immediately demanded an explanation from McBryde regarding the change of plans. McBryde's surprised answer and detailed explanation had been unsatisfactory to Alwood, who immediately protested to the board and then resigned," effective September 1, 1904.

Alwood had not exactly burned all the bridges behind him. In 1895, he had initiated the first of nine bulletins related to utilization of apples by fermentive processes. These dealt with cider and vinegar production. He was also an expert viticulturist and he studied winemaking. Apparently, he excelled at the latter because he was a member of the Jury of Awards at the St. Louis Exposition in 1904, and Vice-President of the International Congress of Viticulture, France, 1907, where he was decorated by the French government for his contributions in pomology and enology. He moved to the Charlottesville area to a home he called "Stonehenge." There he established an enological laboratory which was later incorporated into the U.S.D.A. Bureau of Chemistry. He was named Chief of Enological Investigations. About 1915, the U.S.D.A. laboratory was moved to Sandusky, Ohio but it appears that Alwood remained at Stonehenge. In 1923, he was awarded a certificate of merit by V.P.I. The Alwood era effectively ended on September 1, 1904 but he continued to be loyal to V.P.I. The Alwood era ended forever on April 13, 1946.

Recapitulation

- Alwood introduced to Virginians through research and writing the technologies of plant disease and insect control in fruit production.
- He imported and sold at no profit the finest European spray equipment because he was disappointed in the quality of American-made sprayers.
- He exploited the copper fungicides, especially Bordeaux mixture, and succeeded in controlling several grape, pear, peach, and apple diseases through its use.
- He introduced orchardists to the spray calendar based on the plant stages manifested throughout the growing season.
- He promoted legislation for control of the peach yellows disease but it was not until the San José scale law included peach yellows could there be any enforced control of it.
- He served as Vice-Director of the Experiment Station, Horticulturist and Entomologist for 16 years and Mycologist for 14 of those years.
- He authored, or was senior author for 56 Experiment Station bulletins, 10 of which addressed plant diseases.
- He wrote numerous articles on various subjects for the Southern Planter throughout his tenure at V.P.I.
- He stimulated the development of a weak organization into a strong Virginia State Horticultural Society.
- He taught for 13 years mycology courses which emphasized fungi as pathogenic organisms causing diseases of cultivated plants.
- He was head of the Department of Horticulture, Entomology, and Mycology in the College from 1891 to 1902, and became Head of the Department of Mycology and Entomology in 1902 and remained so until he resigned in 1904.
- He advised 14 graduate students; nine became entomologists, two became horticulturists (one was Harvey L. Price who became Head of the Department of Horticulture in 1902, and later Dean of Agriculture, and was the person for who Price Hall is named) and three became mycologist or plant pathologists (William A. Murrill became Assitant Director of the N. Y. Botanical Garden; W. M. Scott became State Entomologist of Georgia, and later, a plant pathologist for the U.S.D.A.; William A. P. Moncure was Instructor in Mycology at V.P.I., 1903-1908).

  Alwood accomplished more at V.P.I. in 16 years than many others have in life-long careers. He travelled throughout the state, when travel must have been difficult, to visit orchards and nurseries. He made contributions with little help, little money and with shabby equipment and primitive buildings and he did so without a college degree. Today he wouldn't even be interviewed; the yardstick is number of degrees along with years of post-doctoral work and number of papers published, not wisdom, industry, and talent.

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2, 4, 6, 7, 8, 9, 11, 15*, 17*, 24*, 27, 30, 37, 40*, 48, 49, 57, 58, 59, 60, 62, 65, 67, 71, 72, 74, 79, 82, 88, 91, 94, 98, 99, 100*, 101, 102*, 127, 128, 129, 130, 131, 132, 133, 134*, 135*, 136, 137, 138, 139, 140*, 141*, 142*, 143, 146, 150, 151.

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A History of Plant Pathology in Virginia: The Moncure Era (1904-1908)

When William Alwood resigned on September 1, 1904, William Anderson Patterson Moncure was Instructor in Mycology. He was immediately appointed Assistant Mycologist for the Virginia Agricultural Experiment Station (VAES) but he remained Instructor in the College. The College calendar was based on the semester system but this would change for the 1905-06 session.

According to the 1903-04 catalogue, Moncure taught Mycology, two lectures/wk. and Mycology Laboratory two three-hour periods/wk. Mycology was described as a study of fungus systematics and Mycology Laboratory as a study of fungi causing diseases of cultivated plants. Plant Pathology, three lectures/wk was listed for the first time in a VPI catalogue. It was described as "An elementary discussion of the diseases of plants caused by vegetable parasites, with especial reference to methods of prevention and treatment of specific diseases. Lectures and text criticism of literature of the subject.

Textbook - Plant Diseases (Massee)

(Class meets three times a week during second term).

The textbook was by the British author G. Massee, "A textbook of Plant Diseases" to which should be added "Caused by Cryptogemic Parasites", Macmillan, 1903, 472 pp.

Both Mycology and Plant Pathology were required courses for juniors majoring in Horticulture.

In 1905-06, VPI converted to the quarter system of instruction. This would remain in effect until fall of 1988. For the quarter system, some revision of courses was undertaken. Plant Pathology remained at three hours/wk but was offered in the first and second quarters. Laboratory Plant Pathology was given three hours three times/wk in the third quarter. Thus, plant pathology in some form required one year of instruction. Lecture was described as a study of diseases caused by insects and vegetable parasites, and Laboratory as clinics on plant diseases, etiology, and control.

In addition, Moncure offered Systematic Mycology, three lectures/wk first quarter described as fungus classification; Laboratory Mycology, also three three-hour labs/wk first quarter, included media preparation, isolation of fungi, identification, study of organisms causing plant diseases, fermentation, and putrefaction; Applied Mycology, two lectures/wk, described as the mycology of foods, food preservation, and industrial mycology; Advanced Work, a two-year advanced course, with hours by arrangement in the study of plant diseases, fermentation, and canning. These courses remained in effect through the 1907-08 session. Moncure was in charge of these through the spring of 1907. According to the catalogue for 1907-08, both plant pathology courses were taught by B. B. Ked and all other courses were taught by Meade Ferguson, the first Ph.D. in the department. On May 1, Moncure was appointed Investigator of Horticultural By-Products inthe VAES and his association with plant pathology ended.

In the catalogue for the 1906-07 session, there is the following introduction to the course descriptions.

"Department of Mycology:

The Department has a well-lighted and well furnished classroom and special laboratories arranged for the specific uses of mycology. Also available are compound microscopes, sterilizers, incubators, etc., necessary for the study of micro-organisms" and "a division of the greenhouses is used for the growing and treatment of plant diseases during winter months".

During the period 1904-08 as Assistant Mycologist for the VAES, Moncure studied vinegar fermentations, "aiming to bring it to the same state of development that has been reached in our experiments on ciders", and further "We have distributed among the farmers of the State a few cultures of ferments with the view of determining their values used under ordinary conditions, and by unskilled parties". In 1906, Moncure, R. J. Davidson (chemist for whom Davidson Hall is named), and W. B. Ellett published VAES Bulletin 160, The influence of selected yeasts upon fermentation.

There were also plans to cooperate with the Bureau of Plant Industry, USDA, to make a plant disease survey in Virginia. This is the only evidence that Moncure intended to give attention to plant pathology outside the classroom. Thus, it can be deduced that plant pathology in the VAES was essentially shelved during the Moncure era because the Director and President did not see fit to replace Alwood in plant pathological research. Moncure conducted useful and basic research in fermentation and oenology, thereby continuing a program initiated by Alwood, but for four years, plant pathology in the VAES was a dead issue. It was brought back to life with the appointment on September 1, 1908, of Dr. Howard S. Reed, Plant Pathologist in the VAES and Professor of Mycology and Bacteriology for VPI. Moncure resigned from the Station on March 1, 1910, to enter private employment.

During Alwood's tenure the "Southern Planter" magazine was frequently used as an outlet of information on plant diseases and their control. Moncure used this only once to publish an essay entitled "Sanitation as Applied to Plants" (Sou. Planter, Oct. 1905, pp. 755-756). This was his sole publication on plant pathology and it appears to have been based upon his lecture notes on disease control in the course "Plant Pathology". Several quotes from the essay are given below because they give us considerable insight into the status of plant pathology at VPI at the beginning of the 20th century. They are of considerable interest to this writer because he taught "Principles of Plant Disease Control" in the 1950's and 1960's. Moncure opened with:

"People quite generally are beginning to see the necessity of sanitation as applied to themselves and to lower animals; yet how few realize that these same conditions are necessary for successful growth of plants."

Moncure listed three general causes of disease:

- Impoverished or Improper Nourishment. (We devote time to this cause in modern courses.)
- Insect Injury. (This subject is taught by Entomologists but clinical pathologists must be able to recognize insect injuries.)
- Bacterial and Fungous Injury. (There were no, or very few, recognized viral or nematodal diseases in Moncure's time.) For this group to which "belong the bulk of all disease," ... "The most effective treatment ... is sanitation which means but little more than the destruction of all sources of infection."

"In the plant kingdom there is no known system of internal treatment, therefore plant pathologists have to confine their efforts to treating the plants externally and to disinfecting the surrounding premises. Because of this advantage," (i.e. treating animals internally), "one can often cure a germ disease attacking an animal, whereas in the plant kingdom the best that can be hoped for in many cases is to prevent the disease or to hold it in check if it has already gained a foothold."

"Sanitary conditions ... are usually controlled in communities, and as a result contagious or infectious diseases are confined to comparatively small localities. In respect to plants, one can control only his own premises. No matter how careful an individual is with his own plants, they are always open to infection from his less careful neighbors."

Moncure then cited ways by which sanitation might be implemented:

Some fungi infect plants months before symptoms appear, as in the case of wheat smut. "The only way to treat such a disease is to prevent the infection of the wheat and this is accomplished by thorough disinfection of the wheat seed before planting." (Note: Disinfection would apply to wheat loose smut, but disinfestation would apply to the bunt fungi.)

Moncure listed several "recognized sanitary rules", some of which are paraphrased below:

- "Practice an intelligent system of rotation" so that "the spores of the diseases peculiar to a certain plant will die before that plant occupies the same position again."
- "Clean out fence corners," where "seedling fruit trees spring up." In other words, eliminate weeds as sources of disease.
- "Destroy, by burning, all plants killed by disease" before inoculum generated upon them can spread.
- Destroy by burning all plants seen to have incurable diseases to prevent it from serving as a further source of inoculum. Here he cited peach yellows as such a disease.
- Destroy infected plant parts to prevent infections from destroying whole plants, as in tree diseases.
- "When a fungus requires two host plants for its growth as in the case with the "rust" of wheat, destroy the plant," (presumably barberry but not so stated), "in order to prevent further spread of the disease." This breaks the life cycle of the fungus.
- Spray before disease appears.
- Disinfect seeds before planting them.

Avoid especially susceptible varieties (although by Moncure's time, few resistant varieties were available).

Moncure's comments about wheat "rust" are the first published in Virginia literature relating to black stem rust and the eradication of barberry. However, it would take legislation before progress would be made in Virginia toward eradication of alternate hosts, either barberry or cedar.

No publications on plant diseases were issued by the VAES from 1904 to 1908. However, J. L. Phillips, the State Entomologist stationed in Blacksburg, published a number of Virginia State Board of Crop Pest Commissioners Circulars on plant diseases and items or letters sometimes lengthy, about diseases in the "Southern Planter." Phillips' office embraced plant pathology although his title suggested he was strictly an entomologist. He was empowered to enforce laws pertaining to peach yellows, San José Scale and healthy nursery stock. Enforcement of laws pertaining to plant diseases has been the function of the State Entomologist for many years. He wrote several items emphasizing the importance of destroying peach trees as soon as the early symptoms of yellows appeared. He cited a program conducted by Michigan peach growers who, by conducting a careful survelliance of their orchards, discovered and immediately destroyed yellowed trees and thereby greatly reduced the incidence of the disease. He also warned purchasers to examine nursery stock and reject any showing crown gall. In addition, fire blight, peach yellows, peach rosette, little peach and black knot were described as being disseminated in nursery stock.

The editor of "Southern Planter" also contributed items on plant disease. In December 1906 (p. 963) they described the serious problem of apple bitter rot, its distribution, symptoms, and the best schedule of pesticide usage for its control. W. M. Scott, B.P.I., U.S.D.A., and a former student of Alwood's had worked out the schedule by experimenting in orchards near Charlottesville. Simply, it involved 4 applications of 5-5-50 Bordeaux mixture applied biweekly beginning 5-6 weeks after bloom.

Each year in the March issue, "The Southern Planter" published a spray calendar and formulas for preparation of sprays. Diseases addressed were apple scab and bitter rot, bean anthracnose, bramble rusts, grape anthracnose, black rot, downy and powdery mildew, peach fruit rot, pear fire blight, plum fruit rot and shothole fungus, Irish potato blights, sweet potato black rot, strawberry rust, mildew, and blight and tomato fruit rot. By 1908 only peach leaf curl had been added. Materials were Bordeaux mixture and lime sulphur, and ammoniacal copper carbonate; there was little else from which to choose. Up to five applications were prescribed. Specific recommendations for management were also included.

Finally "The Southern Planter" published an Enquirers Column; queries about plant diseases appeared in nearly every issue. These queries about diseases can, in limited way, provide a record of commonality of some diseases and in some cases the first record for Virginia.

The most frequent inquiry was about fire blight of pear and apple, followed by dodder in clover. There were single inquiries about peach brown and leaf curl, potato scab, cucumber wilt, apple bitter rot, alfalfa leaf spot. Wheat scab in 1908 and smut in 1905 and tobacco ringspot in 1906 were mentioned for the first time; ringspot was the first tobacco disease mentioned since the VAES was established. The cause would not be known for nearly two decades.

The Moncure era was hardly one of note in plant pathology. No bulletins regarding diseases were issued by the Experiment Station. The State Entomologist and the editors of "The Southern Planter" provided the published literature. Hopefully, plant pathology in Virginia had bottomed out. There were signs that this was true; the Virginia Truck Experiment Station was established in 190 , and the VPI administration would hire a plant pathologist for the first time in September 1908.

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A History of Plant Pathology in Virginia: The Reed Era (1908-1915)

Howard S. Reed was appointed Plant Pathologist in the Agricultural Experiment Station on September 1, 1908 and Professor of Mycology and Bacteriology in the College. He was pictured in V.P.I. Bul. I(4) and his previous history was given (p. 16). This was the true beginning of plant pathology at V.P.I. Prior to Reed's coming, W. B. Alwood had conducted most of the plant pathology research and W. A. P. Moncure and E. B. Fred had taught the first plant pathology courses. However, Alwood's efforts had been divided among entomology, horticulture, and mycology as indicated by his titles, and oenology and other fermentive studies as indicated by his later publications and activities. His student, Moncure, had succeeded him in his academic assignment and pursued the study of fermentations in a continuing effort to utilize fruits unfit for fresh markets but suitable for fermentation. Strains of yeasts were improved and made available for industrial and domestic use by Moncure; this was his greatest accomplishment. Another of Alwood's students, J. L. Phillips, had become the wearer of one of Alwood's many hats. Alwood had been designated State Entomologist in 1903 and Phillips was appointed Assistant State Entomologist and Pathologist. Upon Alwood's resignation in 1904, Phillips was appointed State Entomologist and Plant Pathologist. Most of his writings in "The Southern Planter" were published under the title, State Entomologist, even though the position empowered him to enforce laws dealing with peach yellows and diseases of nursery stock. Although Phillips' office was in Blacksburg, his position was administered by the Virginia State Board of Crop Pest Commission in Richmond.

At the time of Reed's appointment, E. B. Fred, with only a B.S. degree from V.P.I., 1907, had been teaching plant pathology and bacteriology and as a graduate student, continuing the research on nitrogen-fixing bacteria, work that had been initiated by Meade Ferguson. Fred was awarded the M.S. degree in 1908 from V.P.I. and later earned the Ph.D. degree in Germany. In 1913 he moved to the University of Wisconsin, where he became a world authority on nitrogen-fixation and the genus Rhizobium and its function as a nodulation bacterium. He had built a considerable reputation in this field while associated with V.P.I. In 1934, he became Dean of the Graduate School; in 1943 Dean of Agriculture and from 1945 to 1958 he served with distinction as President of the University of Wisconsin. In 1913, when Fred resigned, V.P.I. or more accurately, the Commonwealth of Virginia was not ready for the likes of E. B. Fred. Thus, in 1908 in association with three people at Blacksburg, Fred, Moncure, and Phillips, whose interests in plant pathology were only marginal, Dr. Reed began the work of giving meaning to plant pathology in Virginia.

Some other factors influenced Reed's potential to succeed. Agricultural Hall (now Price Hall) had recently been completed and was for at least the rest of the 20th century to be the home for plant pathology at V.P.I. The tobacco research station had been established in 1906, and the Virginia Truck Experiment Station in 1907. The former would have no pathology-related research for 30 years, whereas the latter would soon generate studies on plant diseases and indeed would soon become a center for state-federal cooperation in plant pathology. Mendelian genetics had been rediscovered in 1900, the recognition of virus diseases was well underway, many bacterial diseases had been recognized, chestnut blight and white pine blister rust had recently been introduced into North America, wilt resistant flax, cotton, watermelon, and cowpeas had been found or bred. Biffen had made the first study of inheritance of rust resistance, and the American Phytopathological Society was being organized.

Reed had studied under the tutelage of B. M. Duggar at the University of Missouri and was awarded the Ph.D. degree in 1907. He came to V.P.I. having been an Assistant in Botany at the University of Michigan, Instructor in Botany at Missouri, and a Soil Chemist with the Bureau of Soils, USDA. Under Duggar, he studied plant pathology and physiology. When the American Phytopathological Society was organized in 1908, Reed became one of the 130 charter members.

It came about as follows:

The American Phytopathological Society came into being primarily because of the vision and initiative of Cornelius L. Shear (father of our own G. Myron Shear). He proposed the organization to his colleagues working in the U.S. Department of Agriculture at Washington and on December 15, 1908, they held a preliminary meeting. Thereafter, pathologists around the country and in Canada were invited to convene at the American Association for the Advancement of Science annual meetings in Baltimore on December 30. At that meeting by a vote of 32 to 12, the A.P.S. was brought into existence. Pathologists from around North America were invited to become charter members; 130 persons accepted. Among those with ties to V.P.I. were two of Alwood's students, W. A. Murrill and W. M. Scott. Reed was the only V.P.I. faculty member available to join; he did. Thus, both plant pathology at V.P.I. and the A.P.S. emerged within the last 4 months of 1908. (S. A. E. McCallan, 1959. The American Phytopathological Society - The first fifty years, in Plant Pathology, Problems and Progress, 1908-1958, C. S. Holton, ed., Univ. of Wis. Press, Madison, Wis., 588 pp.)

Four months after his arrival at V.P.I., Reed had to submit an annual report of progress to Experiment Station Director S. W. Fletcher. Reed lamented that, "time has necessarily been spent organizing the work ... and formulating some policies. Regarding these policies ... an attempt is being made to place the work primarily upon a scientific as well as practical basis ... it is also intended that the work of this department shall go deep enough in solving the problems before us as to learn the principles upon which they rest."

"The diseases of cultivated plants in this State are in many respects but little known, and it is impossible to find upon record any accurate data concerning some of the fungous and bacterial diseases which annually cause losses of many thousands of dollars to the agricultural interests of the State."

"Plans are underway for collecting accurate information during the coming season and for recording it in such a way that it will be quickly and easily available for purposes of reference and study." (VAES Ann. Rept. for 1908).

In the fall of 1908, while organizing his projects for the Experiment Station, Reed was responsible for 31 contact hours of teaching:

Introductory Bacteriology, 3 hr; Laboratory Bacteriology, 6 hr; Bacteriology and Clinical Diagnosis, 15 hr; Plant Pathology, 3 hr; Systematic Mycology, 3 hr; and Journal Club, 1 hr.

Journal Club apparently was Reed's own creation and was described as follows:

The advanced students in this department meet bi-weekly to present the results of current work in Mycology and Bacteriology and other appropriate topics. Reports of research in progress are also given from time to time. Interested persons are cordially welcomed. (This statement appeared in the 1909 through 1916 V.P.I. catalogues; thereafter, Journal Club was no longer listed).

E. B. Fred taught some of these courses in 1908-09, but took leave to pursue graduate work in Germany in 1909-10; it is not clear how many hours Reed actually taught but it is clear that as department head he was expected to see that the courses were staffed. During the first year of teaching, the contact load burgeoned to a monstrous 40 hours in the winter quarter and tapered off to a mere 25 hours in spring. Six hrs. of Laboratory Plant Pathology and 3 hrs. of Applied Mycology accounted for the additional 9 hrs. in winter. (See V.P.I.. catalogue 1908-09 session).

Apparently, Reed's first publication from V.P.I. originated from an observation that apple limbs cankered by the black rot fungus sometimes blossomed in the fall (Plant World 11:256, 1908). He published nothing in 1909 but thereafter he regularly published the results of his research in Experiment Station bulletins and he wrote popular articles for The Southern Planter. Meanwhile the Department name became Bacteriology and Plant Pathology in the Experiment Station and Mycology and Bacteriology in the College, and Phillips, the State Entomologist, wrote in The Southern Planter, November 1908, that six dangerously injurious diseases were apt to be distributed on nursery stock. These were crown gall, peach yellows, peach rosette, little peach, black knot of cherry and plum, and fire blight.

Records of other diseases appeared in the Enquirers Column of The Southern Planter; viz., July 8, wheat scab was identified for a Botetourt farmer by M. A. Carleton of the USDA, with the comment that scab had been very damaging from North Carolina to Pennsylvania and west into Indiana, and a Simplicity, Va., farmer described rotting Irish potatoes which the editor "attributed to blight of several kinds all of which could be controlled with Bordeaux mixture." (Nov. 1908).

In his Annual Report for 1908, G. W. Koiner, Commissioner of the Virginia Department of Agriculture and Immigration wrote about the "Tobacco wilt disease" (Va. Dept. Agri. & Imm. Ann. Rept. 1908, pp. 106-112). He described Granville wilt (= southern bacterial wilt) caused by Bacillus solanacearum and indicated the disease had occurred in some tobacco-growing counties of Virginia. His article was essentially a reprinting of the 1908 U.S.D.A. B.P.I. Bulletin 141, The Granville Wilt of Tobacco, by E. F. Smith. The disease was reported to occur in association with nematode injuries. Farmers were advised to use "disease-free land". The need for Granville wilt and nematode-resistant varieties was stressed.

In 1909, J. S. Cooley became Reed's graduate assistant; together they surveyed for plant diseases in Virginia. In the annual report for 1909, Director Fletcher listed the following projects and experiments in progress under the leadership of Reed:

1. Relation of parasitic fungi and bacteria to their host plant. - A study of of modification of host plant organs caused by parasites and the role of several biochemical substances in the interaction. Subjects were cedar rust, bitter rot, and black rot of apples.
2. The principles of infection of uredineous fungi. - A physiological and epidemiological study of rust fungi.
3. Plant disease survey of Virginia. - A cooperative study with the Bureau of Plant Industry, U.S.D.A., to determine the prevalence of diseases of economic plants in Virginia.
4. Field experiments upon plant diseases. - An effort to control certain plant diseases by experimenting in areas where problems existed. The list included spinach leaf spot or mildew (the work being conducted at the Virginia Truck Experiment Station which had no resident pathologist), cabbage club root (on farms at Rural Retreat, Wythe Co.), tomato blight (primarily Phytophthora infestans), apple leaf diseases (spraying experiments at Harrisonburg in Rockingham Co. and Fontella in Bedford Co., and peach yellows (work in cooperation with the State Crop Pest Commission which funded the work).

From the foregoing list, it can be seen that Reed had initiated some tough basic research while also seeking to aid the agricultural industry.

Some publications related to Virginia plant diseases appeared in various places; two were issued by the Virginia State Board of Crop Pest Commission from the State Entomologist: Circular 4 titled "Yellows and Some Other Important Diseases of Peach" and Cir. 5 "Peach Yellows as it Affects Nurserymen". The "other important diseases" were peach leaf curl and brown rot.

In 1909, when J. S. Cooley became Reed's graduate student, the plant disease survey was undertaken in earnest. The stated purpose was "to collect information on the extent of fungus diseases and the resulting injury to crops". The procedure was to send to 900 selected addresses a form listing 43 diseases on 18 crops for which information was desired with encouragement to send voucher specimens and to submit samples and inquiries about any observed disease. It is not known to the current writers whether all of these diseases had been previously recognized in the State or whether some were suspected as being present but had not actually been reported. Among those listed for which we had no previous notations were cowpea leaf spot, peanut leaf spot, tobacco root rot and frenching. The latter was sent out in 1909 and 1910 and many satisfactory replies were received. The results were reported in the Annual Report of the Agricultural Experiment Station for 1909 and 1910, published in 1911. We will summarize the results later.

Reed did not avail himself to The Southern Planter in 1909 as a means of issuing timely statements on plant diseases. This would have given him early recognition among agricultural leaders. However, several articles were published therein by knowledgeable persons. Phillips provided informative "Notes on spraying and spraying ingredients" (Mar. 1909, p. 233). He stressed the care to be taken to avoid spray damage with Bordeaux mixture at full strength. He described boiled and self-boiled lime sulphur and their uses for brown rot. He appended a summary of pear fire blight control wherein he addressed not sprays but soil amendments that would help to ameliorate fire blight. He stressed that one must avoid nitrogenous fertilizers but heavy applications of phosphorus and potash would benefit. Leguminous cover crops were to be avoided.

In an adjoining article, "Inspection for peach yellows and San Jose scab" (Sou. Planter 1909:233-234), Phillips stressed the importance of frequent orchard inspection, recognition and prompt destruction of trees suspected to have yellows. As a consequence, tree losses could be reduced to 1 in 1,000 or less. By this method, Albemarle Co. in 1908 had reduced tree losses to less than 10 in 1,000. In the August 1909 issue (Sou. Planter, 1909, p. 760.), Phillips reviewed the "Progress in control of peach yellows" in Rockingham Co. where the incidence of yellows was reduced from over 20% prior to 1908 to 14% in 1908, and 4% in 1909. In the September issue (Sou. Planter, 1909, p. 846), Phillips in a letter titled "Control of peach yellows in the nursery", advised nurserymen how to obtain yellows-free pits for seedlings and thereby eliminate pits as a source of yellows.

In October 1909, the editors of The Southern Planter published a note on "Preventive for wheat smut", (Sou. Planter, 1909, p. 938). "Add one pint of formalin (40% formaldehyde) to 30 gallons of water, soak seeds for 40 minutes and spread them to dry." (Note: This would eliminate stinking smut or bunt but not loose smut.)

The annual spray calendar appeared in the March 1909 issue (Sou. Planter, p. 232). There were no significant changes.

In the May1909 issue (Sou. Planter, 1909, pp. 477-479), C. T. Adams, a senior at V.P.I. majoring in Horticulture, published a comprehensive review of "Fungus diseases of the Irish, or round potato." However, it also included fungous diseases of the tomato. This publication was probably a thesis presented to the Horticulture faculty as a requirement for the B.S. degree. For potato he described early blight (Alternaria solanum), potato rot (Phytophthora infestans), scab (Oospora scabies), brown rot (Bacillus solanacearum), and leaf curl (Macrosporium solani). For tomato, he described leaf rust (Cladosporium fulvum), damping off (Pythium de baryanum), wilt or sleeping disease (Fusarium lycopersici), black rot (Macrosporium tomato), bacterial disease (as in potato, B. solanacearum), and point rot (for which he described blossom- end rot). He ended with recipes for preparation of 5-5-50 Bordeaux mixture which he had prescribed for all potato and tomato foliage diseases, and potassium sulphide solution which he recommended for control of tomato black rot.

Other sources of publications relating to Virginia's plant diseases may be noted. The Virginia Department of Agriculture (VDA) published in 1909 an article by W. M. Scott, a former student of Alwood, who now worked as a fruit pathologist for the USDA in Washington, D.C. He contributed to the Virginia Department of Agriculture & Immigration Annual Report for 1909 (pp. 126-133) an article, "Spraying for the control of peach brown rot and scab." He described the preparation of self-boiled lime-sulfur and experiments showing that lime-sulfur treatments combined with lead arsenate doubled yields of peaches. With lime-sulfur, there was no foliage damage as with Bordeaux mixture.

M. W. Waite's address to the Virginia State Horticulture Society, "Russeting of apples by spray", was reprinted (Va. Dept. Agri. & Imm. Ann. Rept. 1909:83-90). He noted certain apple varieties were more prone to russet when sprayed with Bordeaux mixture. On them, he suggested growers use weak Bordeaux or switch to lime-sulfur until fruit exceeded one inch diameter. (Originally printed in Rept. 13th Ann. Session Va. State Hort. Society for 1908, Pub. 1909:142-156).

The Enquirers Column in various issues of The Southern Planter for 1909 had numerous questions about plant diseases. The answers indicate in some cases the editors should have sought expert advice:

Feb. - Accomack Co. farmer had both tomatoes and potatoes dying soon after planting. Ans. - Southern bacterial wilt of tomato and Irish potato. Maybe early blight of potato. Spray with Bordeaux (wouldn't work for bacterial wilt).

Feb. - Augusta Co. - Diseased cherries. Ans. - Black knot; prune it out.

Mar. - Fauquier Co. - Can you replant where yellowed peach trees have been removed? Ans. - No, not for 2 years (Pathologists did not yet know yellows was spread by insects).

Mar. - Prince William Co. - Give the formula for treating oats to control smut. Ans. - Soak seeds for 2 hr. in formaldehyde solution, 1 lb. to 50 gal. of water or in hot water at 133oF for 5-10 min.

June - Sussex Co. - Asks about planting cedar trees near orchards. Ans. - Do not plant cedars near orchards. Editor then describes an apple leaf blight (rust) caused by a fungus that comes from cedar balls.

July - Patrick Co. - Describes 5% smut in Fulcaster wheat and asks for a remedy. Ans. - Soak seed in formalin solution (as in Mar. above) or hot water, 132-135oF for 15 min. (The formalin treatment would control bunt but not loose smut which the farmer probably saw).

July - James City Co. - How to control mildew on roses. Ans. - Dust with sulphur.

Aug. - Louisa Co. - How to control oats smut. Ans. - See March issue (above).

The Enquirers Column gives some clues as to the prevalent plant diseases of the era. It is strange that tobacco was rarely a topic in the column, despite its importance to the economy.

The Virginia Truck Experiment Station published Bulletin no. 1, "The control of malnutrition diseases," by L. L. Harter in 1909. On a number of farms, soils formerly producing poor truck crops produced lush crops after they were limed. At low pH, several elements were rendered insoluble; they were made soluble and available at near neutrality. The bulletin was reprinted in the Ann. Rept. Va. Dept. Agri. & Imm. 1909:105-118. In Bulletin no. 3, 1909, T. C. Johnson, Director wrote about "Some seed potato questions." In comments on late blight and blackleg, he blamed seed-borne inoculum for outbreaks, which could be avoided by securing "disease-free seed."

Harvey L. Price, V.P.I. Horticulturist published in 1909 shirt-pocket-sized Circular no. 7, "Fighting the Insects and Diseases of Orchard, Field and Garden Crops". Circular implies something brief, but this was a 148 page booklet measuring 3 1/2 x 6" containing much of the practical information about plant diseases available at the time. There were sections on diseases and insects of pomes, drupes, grape, Ribes spp., Rubus spp., strawberry, most vegetables, grains, tobacco, roses, sprayers, pumps, and pesticides. It contained many illustrations. Among diseases not previously encountered in Virginia literature were cereal black stem rust (no mention of barberry bushes in the State), ergot of rye (mention of ergotism in farm animals but not in man), tobacco calico (probably mosaic) which was said to be spread by contact. This appears to have been a most useful publication; it certainly was the most comprehensive.

Dr. J. B. Emerson was invited to speak to the Horticulture Society on "Chestnut culture" (Rept. 13 the Ann. Session, Va. State Hort. Soc. for 1908:76-89 pub. 1909). He intended to expound on methods of increasing profits from marketing the nuts of chestnut but he decided that because of the probable doom of chestnut trees by the bark disease, that growers would waste their time developing chestnut groves. Instead, he reviewed a communication from Perley Spaulding, USDA, B.P.I., Pathologist, who worked on tree diseases, "The bark disease of the chestnut". Spaulding described the disease and how measures to stop its advance had failed. He stated that there had been a report of the disease as far south as South Western Virginia. Society President G. E. Murrell, who lived in Fontella, Bedford Co. vowed that an agent of the USDA found the disease in a chestnut grove near Lynchburg (could have been Campbell, Bedford or Amherst Co.; we think it was Bedford).

Other events significant to plant pathology occurred in 1909: The American Phytopathological Society held its first annual meeting in December at Boston, and Mycologia volume 1 was published; a V.P.I. graduate, one of Alwood's students, W. A. Murrill, was editor. Benjamin M. Dugger published "Fungous Diseases of Plants with Chapters on Physiology, Culture Methods, and Technique." It would be known by the first four words of the title. This was the first American textbook on plant pathology. Dugger had been Reed's advisor for his Ph.D. program so it was quite appropriate that it became the text for V.P.I. plant pathology courses. None of the publications issued in the Alwood era were cited by Dugger.

In 1910, Reed and Cooley continued their survey of plant diseases in Virginia and their investigation of a spinach disease, Reed published four papers based apparently on research carried out before he came to V.P.I. These were, "An interesting Marasmius fairy ring" (Plant World 11:256); "The fungus Diplodia as a possible factor in the aetiology of pellagra" (N. Y. Med. J. 91:164); "The effects of certain chemical agents upon the transpiration and growth of wheat seedlings" (Bot. Gazette 49:81); and "A note on two species of the genus Calostoma" = Mitremyces, Lycoperdaceae, the puff balls (Plant World 13:October 1912 issue).

Reed published two articles in The Southern Planter for July 1910. The first, in letter form, addressed "Blackleg, a disease of the Irish potato" (Sou. Planter 71:740- 741). He described the disease briefly and wrote that there were traces of it in some Tidewater counties in 1908 and 1909. A grower from Driver, Nansemond Co. reported that the disease "only occurred in fields planted with Northern-grown seed. Adjoining fields planted with seed from Southwest Virginia have not shown any indications of blackleg." Reed cited bulletin 174 of the Maine Experiment Station for the following control measures:

- Select seed from fields where the disease has not appeared.
- Discard all wounded, cracked and decayed seed.

- Disinfect the seed tubers with formaldehyde.

Reed concluded that seed from Southwest Virginia should be suitable for planting in trucking regions. It was not known at the time that the seed corn maggot transmitted the bacteria causing blackleg.

In an article titled, "How to control the "fire blight", and subtitled "Cause and treatment of a disease that is devastating the fruit trees of Virginia" (Sou. Planter 71:763-765), Reed admits that "no remedial measures are entirely successful, much can be done to prevent the spread of the disease", and he cites an eleven point program to retard the progress of the disease; the program is primarily for pears. It stressed pruning frequently, keeping the orchard in sod, using high potash-phosphate fertilizers no nitrogen, growing Kieffer and Seckel varieties, and that spraying is of no value, contrary to some previous claims.

Phillips continued to remind growers to remove yellowed peach trees and to report to inspectors such trees on neighboring property. Lyman Carrier, V.P.I. Agronomist, contributed an item on "Dodder" in which he described the appearance, parasitism, and how the plant is disseminated. He illustrated four species of dodder seeds in comparison to clover and alfalfa. He described eradication by mowing and burning infestations and suggested growing non-host crops such as corn and potato for 2 years (Sou. Planter 71:127-128, 1910). This article was also included in the Virginia Department of Agriculture Report for 1910 (p. 37).

The annual spray calendar appeared in the March issue (as usual) and there was a discussion of procedures and materials provided. Self-boiled lime-sulphur was a relatively new innovation attributed to W. M. Scott about 1908; therefore, directions on how to prepare it were included for the first time (Sou. Planter 71:March).

Charles H. Crabill, while a junior at V.P.I., wrote a two-part letter to The Southern Planter entitled "Some apple and pear diseases and how to control them" (Sou. Planter 71:643-644, 741-742). It was a very comprehensive review of apple bitter rot, scab, black rot, cedar rust, blotch, crown gall, hairy root, sooty blotch or fly speck and pink rot and pear scab, fire blight, and Septoria leaf spot. The scientific names, symptoms, effect of weather, manner of dissemination, description of inoculum, and control measures for each were included. Perhaps this publication caught Reed's attention, or perhaps Reed advised Crabill during its preparation, but whatever the circumstances, Crabill became Reed's graduate student after he was awarded the B.S. with highest honors in 1911. He was also named Assistant Plant Pathologist in the Experiment Station.

In the Enquirers Column for 1910, the following questions about plant diseases were published:

July - Brunswick Co. - How to control smut in wheat. Ans. - Soak for 40 min. in formalin 1 pt. in 20 gal. of water. (Smut must have meant bunt to the editor. Even though not as conspicuous in the field as loose smut, it was very apparent in threshed grain.)

Aug. - Source not reported - A complaint about Irish potato blackleg drew advice to plant seed potatoes from blackleg-free sources.

- Rappahannock Co. - Cabbage when half grown, dries up, yellows, drop leaves; plants have poor roots. Editor suggests black rot or club root (black rot more plausible).

Sept. - James City Co. - Grapes rotted before ripening. Ans. - Cause is black rot; spray with Bordeaux mixture, clean up the bark and prune.

- Accomack Co. - Wheat causes "land specks" on Irish potatoes? Ans. - Blight, spray with Bordeaux mixture. (Was probably black scurf, Rhizoctonia; need for extension plant pathologist clearly demonstrated.)

Other events of significance in 1910 were the passage of the Federal Insecticide, Fungicide, and Rodenticide Act. It probably had no impact upon work in progress in Virginia but a talk by W. M. Scott certainly did. Scott, V.P.I. '96, Horticulture, had become a fruit pathologist in the Bureau of Plant Industry. He worked with Virginia orchardists to evaluate fruit sprays. He contributed to the Virginia Agricultural Experiment Station the text for bulletin 188 (1910) "The Use of Lime- Sulphure Sprays in the Summer Spraying of Virginia-Apple Orchards". He had given a talk to the Virginia State Horticulture Society at their 14th annual meeting, Winchester January 5th 1910, entitled, "The substitution of lime-sulphur preparations for Bordeaux mixture in spraying Virginia apple orchards" (Rept. Va. State Hort. Soc. for 1910, pp. 71-82). No doubt the speech was a paraphrasing of bulletin 188. Scott began by saying, "Spraying is the one operation above every other orchard practice which determines the quality of the fruit produced. It, therefore, behooves us to give this subject the most careful consideration". And so it is even today.

Scott cited the various diseases of different apple varieties and which varieties were most subject to Bordeaux injury. He described experiments conducted at Crozet, Fishersville, and Mt. Jackson. He concluded that lime-sulphur "is destined to largely take the place of Bordeaux mixture in spraying varieties of apples subject to serious injury from application of the latter."

At the 14th annual session of the Virginia State Horticulture Society, J. L. Phillips presented a report of the State Entomologist in which he dwelt upon the control of crown gall and peach yellows in nurseries. There were numerous questions from the members to which Phillips gave explicit answers. He emphasized for peach yellows that when growers have a high incidence of yellows in the first three years of a new orchard, there was a serious problem in the nursery from which the trees were purchased.

The discussion highlighted the fact the yellows was transmitted by peach propagation methods but did not explain some outbreaks in trees having come from apparently healthy nursery stock. An explanation would not be disclosed until 1933 when L. O. Kunkel would publish a paper on "Insect transmission of peach yellows" (Contr. Boyce Thompson Inst. 5:19-28, 1933), in which he reported that the plum leaf hopper, Macropsis trimaculata, was the vector. In a follow-up discussion, there was an indication by the growers that detection of yellows in orchards was not sufficiently supported by the State, and by Phillips that if growers would inspect their own orchards, dependence on the State would be a lessening necessity.

In June 1910, Phillips resigned the position of State Entomologist to work at the Piedmont Orchard Company, Linden, Warren Co. He had done an excellent job of controlling crown gall and peach yellows through nursery and orchard inspection and by working tirelessly with the State Horticultural Society. He continually impressed members to monitor and destroy diseased trees with early symptoms. Following his advice kept them in business. W. J. Price, Assistant State Entomologist, served as Acting Entomologist until December 1, when E. A. Back assumed the position of Entomologist. Among other events, an Apple Rust Laboratory was established in the Agricultural High School at Middletown, Frederick Co. On March 13, 1910, J. S. Cooley filed an M.S. thesis in plant pathology entitled "Histological study of Plasmodiophora brassicae". He did not explain initial infection by the fungus but demonstrated that subsequently the fungus is further distributed during mitosis of the host cells. In 1911, he would become Assistant Plant Pathologist in the Experiment Station and would work for a while at the Middletown Laboratory.

In 1911, Reed published two Experiment Station bulletins on troublesome plant diseases. Club root of cabbage had plagued cabbage growers in southwest Virginia for several years. In the bulletin "Cabbage Club Root in Virginia" (VAES Bul. 191), Reed described experiments in which he demonstrated that liming and a 3-year rotation were essential for controlling the disease. The experiments were conducted at Rural Retreat in Wythe Co. In the bulletin entitled "Tomato Blight and Rot in Virginia" (VAES Bul. 192), Reed reported that late blight was the primary disease interfering with tomato production. He recommended procedures that were being used on potatoes, namely, spray with Bordeaux mixture 2 weeks after transplanting and every 10-14 days thereafter. Diseased vines should be destroyed at the end of the season. The plots were located at Christiansburg and Blacksburg.

During his years as graduate assistant, Cooley had aided Reed in two major projects which they summarized in detail in the Experiment Station Annual Report (which covered not one but two years) for 1909 and 1910, published in 1911. In "Heterosporium variabile Cke., its relation to Spinacea oleracea and environmental factors", (VAES Ann. Rept. 1909 and 1910, pp. 78-99), Reed and Cooley reported that spinach leaf spot was an association of two fungi, H. variabile and Colletotrichum spinaciae, the latter causing anthracnose. In addition, it was found that H. variabile is a weak pathogen and usually follows infections by Peronospora effusa. In the bulletin, morphology, sporulation, ecology, and physiology of H. variabile were described. The work was done in laboratories at V.P.I. and on the Virginia Truck Experiment Station property, in cooperation with T. C. Johnson, Va. T.E.S. Director.

Reed and Cooley published the first summary of their plant disease survey in the 1909 and 1910 Va. A.E.S. Annual Report (pp. 99-119). Procedures for the survey were described under 1909 accomplishments. Diseases of 26 hosts were included. Some diseases not previously mentioned in Virginia literature that were discovered during the survey include on apple, fly speck (Leptothyrium pomi) - statewide; sooty spot (Phyllachora pomigena) - statewide; on asparagus (Macrosporium sp.) - Blacksburg and Botetourt Co.; on aster yellows (cause unknown, later thought to be a virus, known now as a mycoplasm-like organism) - 20% in Blacksburg; barley smut (Ustilago nuda) - Wythe and Rockingham Cos.; beet leaf spot (Cercospora beticola) - widespread; cabbage black spot (Macrosporium brassicae) - minor but widespread; corn leaf blight (Helminthosporium turcicum) - considerable damage in Montgomery Co.; leaf spot (Cercospora crenata) - statewide, worse in eastern Virginia. [Note: C. crenata is a pathogen of leguminous plants; it is probable that either C. sorghi or C. zeae-maydis was misidentified. C. zeae-maydis may have been present but it was not described until 1925 (Sprague, 1950)]; cucumber blight (Peronoplasmopara cubensis) - Norfolk, Alleghany, and Washington Cos.; eggplant blight (Phyllosticta hortorum) - Newport News; oak anthracnose (Taphrina coerulescens) (Note: The proper common name should have been leaf curl or blister, only one specimen, source not given, it was followed by Pestalozzia taphrinicola); oats crown rust (Puccinia coronata) - severe in Montgomery Co.; onion downy mildew (Peronospora schleideniana) - Smyth Co.; on peach, bacterial leaf spot (Bacterium pruni) - Warren Co., shot hole disease (Phyllosticta prunicola) - source unknown, scab (Cladosporium carpophilum) - widespread, frosty mildew (Cercosporella persicae) - Frederick Co., powdery mildew (Sphaerotheca pannosa) - Westmoreland Co.; pear leaf blight (Entomosporium maculatum) - Montgomery Co., frog-eye leaf spot (Phyllosticta pyricola) - Montgomery Co.; phlox powdery mildew (Erysiphe communis) - Shenandoah Valley; on plum black knot (Plowrightia morbosa) - statewide, brown rot (Sclerotinia fructigena) - statewide and very damaging, twig hypertrophy (Exoascus pruni) Roanoke and Montgomery Cos.; rhubarb leaf injury (Vermicularia polygoni-virginica) - source not stated; sweet pea, anthracnose (Gloeosporium sp.) - Montgomery Co., very serious; tobacco frenching (cause unknown) - Brunswick, Halifax, Lunenburg, and Nottoway Cos. up to 10% loss; tomato leaf blight (Septoria lycopersici) - widespread, worse in southwestern Cos., point rot (probably blossom end rot) widespread.

Since the foregoing list includes only diseases that were not mentioned in Virginia literature before, it seems strange that no cotton, strawberry, rye, alfalfa, clover, peanut, ornamental shrubs or forest trees except oak were included, that no ear rots of corn were recognized, and that only frenching was reported on tobacco. Note: Frenching was first mentioned by John Clayton in a letter written at Wakefield, Yorkshire, Virginia, May 12, 1688, to the Royal Society of London. According to F. A. Wolf in "Tobacco Diseases and Decays" (Duke Univ. Press, 1957), he wrote as follows:

"French-men they call those plants whose leaves do not spread and grow larger but rather spire upwards and grow tall. Those plants they do not tend, being not worthy their labor; were they so critical I believe they might guess what plants were likely to turn French-men, by observing whether the roots of the plants run downwards as those branches are aptest to spire upwards. For though I have not made positive proof thereof, I have something more than bare fancy for my conjecture; I have pulled up some of these French-men and compared them with the roots of some other plants and found them much larger than others; and 'tis observable, loose soil and sandy ground are more subject thereto than stiff land." (Wakefield is in Sussex Co. now.)

Several events of significance in the Reed era happened in 1911. Cooley was awarded an M.S. degree, and was appointed Assistant Plant Pathologist. G. Flippo Gravatt and C. H. Crabill earned B.S. degrees in Horticulture and Agriculture, respectively, and both enrolled for graduate study in plant pathology. Both were named Assistant in Plant Pathology.

Barruss published in 1911 that different varieties of a host, bean, could be used to distinguish strains of a pathogen in this case, Colletotrichum lindemuthianum, with different pathogenic capabilities (Phytopathology 1:190-195). Eriksson had done this using different species of hosts. This was the true beginning of "physiologic specialization."

The first volume of Phytopathology was published and Reed contributed an abstract therein entitled "The effect of the club root disease upon the ash content of cabbage root." (Phytopathology 1:169-163). Reed and H. S. Stahl, who taught plant physiology, published a paper entitled "The erepsins of Glomerella rufomaculans and Sphaeropsis malorum", (J. Biol. Chem. 10:109). This was the fourth paper Reed published while in Virginia that showed his continuing interest in physiology.

The Southern Planter in 1911 published some lengthy letters pertaining to plant diseases. Reed himself penned one on "Peach leaf curl and what causes it." (Sou. Planter 72:774-775, July). He described the early symptoms of leaf curl and detailed its development until it induced leaf-fall. He described overwintering of the fungus in buds and how different weather sequences affected the prevalence and severity from year to year. He described how a late winter dormant spray with lime sulphur would virtually eliminate leaf curl and San Jose scale.

A gentleman named E. Y. Wead from Washington, D.C. wrote a chatty, interesting but accurate account of pear fire blight under the title "The battle with blight" (May, p. 575). He emphasized the need to prune frequently and summarized with "Cutting out blight once or twice in the season is a waste of time and an injury to the orchard. It it is not profitable to take it out as fast as it appears, one cannot afford to grow fruit."

A student a V.P.I., S. C. Nottingham, contributed a two-part letter "Diseases of the potato" and "Diseases of the tomato" (May, pp. 575-576). He discussed potato early and late blight, dry rot and scab. He erred by saying "acid conditions of the soil are favorable for this disease," where in fact we now grow potatoes in an acid soil to control scab. He discussed damping-off of tomato (Rhizoctonia), Septoria leaf blight, and winter blight which was the name for late blight.

In August (p. 862), Reed discussed "The present epidemic of potato blight" attributed to Macrosporium solani, which was predisposed by leafhopper burn and Colorado beetle damage. He recommended Bordeaux sprays and crop rotation.

The Enquirer's Column had only one plant disease question, this about cabbage rot. The editor attributed it to club root or black rot. Each was described. Alkaline soil and a 3 to 4-year rotation was advised.

In the Plant Disease Reporter, some first reports of plant diseases are recorded: Bean anthracnose, 1909 (2:2), bean bacterial blight, 1910 (2:258), southern bacterial wilt, Bacillus solanacearum, 1910 (2:253), bean rust, 1910 (2:261), tomato anthracnose, 1911 (2:264).

White pine blister rust had been discovered at Geneva, N.Y. in 1906. It was first found in Virginia in Clarke Co. in 1911 (W. O'Byrne, 1950. Agenices destructive to the forests in the James River Basin. In The James River Basin: Past, Present, and Future. James R. Proj. Comm. of the Va. Acad. Sci., Richmond, Va. pp. 413-423).

At the 15th Annual Session of the Virginia State Horticultural Society January 11-13, 1911, W. M. Scott of the U.S.D.A. described his work in 1910 with "Lime-sulphur sprays for apple diseases." (pp. 174-184). He concluded that to prevent fruit russeting lime-sulphur rather than Bordeaux mixture should be used for the early sprays of apple. This spray was found to control scab, fruit spot, leaf-spot, and cedar rust as well as did Bordeaux mixture, but did not control bitter rot. Bitter rot was controlled by resorting to Bordeaux mixture beginning about June 15. The members thoroughly discussed Scott's presentation.

M. B. Waite of the U.S.D.A. discussed "Further experience with fungicides and spraying apparatus" (pp. 184-190). His discussion of fungicides generally paraphrased that of Scott's paper. Waite described the assembly and operation of a compressed air sprayer for orchards. Users had reported excellent results; a smaller amount of equipment needed to be hauled through orchards with this applicator.

Reed followed Scott and Waite with a discussion of his own experiments and results. Experiments were conducted in Bedford and Rockingham Cos. (pp. 190-200). He acknowledged the assistance of A. W. Drinkard, Assistant Horticulturist. (Drinkard would become Experiment Station Director in July 1916 and remain as such until December 1945). Reed emphasized foliage diseases because failure to control them led to impoverished, poor yielding trees in following years. Again, there was much discussion about russeting, poor control of rust and making lime-sulphur sprays. Of the three presentations above only Scott's was published in the Virginia Department of Agriculture Annual Report, 1911 (pp. 81-88).

The Commissioner of Agriculture, G. W. Koiner, published in the 1911 annual report an item, "How to control the chestnut bark disease" (Va. Dept. Agri. Rept., 1911, pp. 164-170). He stated, "The chestnut forests of Virginia are doomed unless prompt action is taken. The forests are worth over $10 million. Scattered infections are known to the southern Virginia border." Comments on control were extracted from U.S.D.A. Farmers' Bulletin 467. Control methods included scouting for and destroying infected trees; the state involved must stand behind the procedure (to avoid litigation). When advanced infection centers are found, infection-free zones must be established. Downed trees must be debarked. Bark and unused branches should be burned. Wood should be used for lumber. Commissioner Koiner concluded the item with, "Let every farmer assist in asking for an appropriation from the Legislation for the protection on our valuable chestnut forests in Virginia. Unless something is done we may lose every chestnut tree in our State." It came about that the Legislature did appropriate funds for scouting and destroying blighted chestnut trees.

At the Virginia Truck Experiment Station, Director Johnson published Bulletin 5, "Spraying Cucumbers and Cantaloupes," in which he described efforts to control downy mildew and anthracnose. He found that Bordeaux sprays increased yields and profits. In 1912, Reed and Cooley continued the plant disease survey, results of which he published in 1913. With J. T. Rogers, they published Va. A.E.S. Bul. 195, "Foliage Diseases of the Apple" in which they discussed frog-eye spot, scab, and rust, and a spray program.

Reed published a poser, "Is the Phytophthora of the potato identical with that of the tomato?" (Phytopathology 2:250-252). He concluded from field experiments and cross inoculations that the same fungus attacks both hosts.

Chestnut blight was such a worrisome disease that caused an apprehensive Virginia General Assembly to appropriate $5,000 early in 1912, to establish and operate a Chestnut Blight Laboratory in Blacksburg. The objectives were to locate and eradicate infected trees. G. Flippo Gravatt was placed in charge.

Blight had been found in Virginia in 1911 (V.P.I. Bul. V (3):40). In view of the experiences of the northern states only determined, but naive politicians could have believed that an appropriation of any size would stop the blight. By 1924, blight would occur in all the chestnut areas of the State and the noble trees of Virginia forests would be doomed to near extinction. The white pine blister rust fungus, Cronartium ribicola, would because of its complex life cycle, spread much more slowly over the State. Yet, it is ironic the Federal Plant Quarantine Act of 1912, was primarily precipitated not by chestnut blight but by white pine blister rust. Pine knots were more important to lumbermen than were chestnuts roasting on the hearth or the value of chestnut for lumber and tanning. Apprehension about potato wart was also a factor. Certainly plant pathologists played a major role in gaining this Federal legislation, but the specific documentation of those who played a significant role, is obscure in plant pathology literature. We could find no evidence that Virginians played a role. However, Reed may have helped fruit growers lobby for a State cedar eradication law.

In 1912, cedar-apple rust caused a loss of fruit estimated at one-half million dollars. "The actual loss was much greater than this, however, if the consequent weakening of the tree and lowered vitality of fruit buds be taken into account" (Va. AES Tech. Bul. 9, 1915). Reed published an article, "Control of cedar rust," in The Southern Planter, September, 1912 (pp. 969-970), in which he noted that the severity of rust in orchards was directly related to the proximity of red cedar. Thus, "the most satisfactory method of controlling this disease is the destruction of red cedar trees, which are absolutely necessary for propgation of the fungus which causes the rust," and further, "Our spraying experiments show that if spraying is done thoroughly and at the right time especially just before the blossoms open the most serious effect may be largely avoided". Reed promoted "cedar-cutting week" in Frederick and Augusta counties "while the object lession of yellow and defoliated apple trees is still before the fruit growers."

In The Southern Planter, May 1912 issue (pp. 559-560), G. W. Chappelear, Jr., a graduate student in Agronomy, wrote on "Some fungous diseases of the potato and tomato." His article was similar to that by Nottingham in 1911 (Sou. Planter 72:575, 1911). Chappelear wrote about early blight and late blight of both crops, dry rot, scab, and blackleg of potato and leaf spot (Septoria) of tomato. (with respect to Septoria leaf spot, the editors printed "Tea spot or blight of the tomato - Septoria Tycopersici." Such is the problem of typesetting and editing.

Reed published a popular, illustrated article on "The satisfaction of aster raising" (Sou. Planter July p. 765, 1912), and Cooley described the 7th Congressional District Agricultural High School at Middletown, Frederick Co., where the Cedar Rust Laboratory was housed (Sou. Planter, July, p. 780, 1912).

There was only one disease discussed in the Enquirers Columns of The Southern Planter for 1912. A query about fire blight came from Appomattox Co. (July, p. 828). Director Johnson wrote about scab control in "Truck Crop Potatoes" (Va. T.E.S. Bul. 7, 1912). He stressed the production of scab-free potatoes in acid soils and disinfection of seed tubers with bichloride of mercury. Since calcium must be added to soils, lime should be added one year before potatoes are cropped. L. L. Corbitt, Truck Crop Specialist, gave a "Preliminary Report on Tomato Culture" (Va. T.E.S. Bul.

8, 1912). He mentioned that leaf spot was best controlled by Bordeaux mixture sprays and the wilt (probably Fusarium) was controlled by planted in "disease-free soil."

On July 1, 1912, E. A. Back resigned as State Entomologist and W. J. Price again served as Acting State Entomologist, July 1 to September 1, 1913.

In the Annual Report of the Virginia Department of Agriculture and Immigration "a comprehensive and valuable spray calendar" was published (V.D.A. & Imm. Ann. Rept. 1912:82-88). It included 24 diseases of 14 vegetable crops, 14 diseases on 7 small fruits (including white pine blister rust on Ribes spp.), 35 diseases on 7 orchard tree species, 25 diseases on 15 ornamental plants (including black stem rust on barberry). There was a review of Va. A.E.S. Bul. 195 "Foliage Diseases of the Apple" (Reed, Cooley, and Rogers, 1912), and of Bulletin 188, "Use of Lime-sulphur Sprays in the Summer Spraying of Virginia Apple Orchards" (W. M. Scott, 1910). The review probably also incorporated comments by Scott and M. B. Waite made at Virginia State Horticultural Society meetings in January 1911 and 1912. The V.D.A. & Imm. review was titled, "Types of spray injury on fruit" (V.D.A. & Imm. Ann. Rept. 1912:107-109).

Apparently, Waite also published a talk he gave to West Virginia fruit growers in the V.D.A. & Imm. Annual Report, "Collar blight and other collar and root diseases of the apple" (V.D.A. & Imm. Ann. Rept. 1912:143-150). Collar blight was described as a form of fire blight on trees just above the ground line. Cracks at the tree base provided entry of bacteria and ensuing development of the disease. In Golden Grimes, Waite suggested cutting out diseased areas and in severe cases, bridge grafting to save the trees. He also suggested grafting Golden Grimes scions to stocks of Stayman Winesap, Mammoth Black Twig, or Red Astrachan, varieties which rarely blighted. He pointed out paradoxes of fire blight control; namely, that factors favoring fruit production also favor blight and vice versa. Waite gave a brief summary of crown gall, hairy root and root rots.

M. B. Waite was a regular participant in the annual meetings of the Virginia State Horticulture Society. At the January 1912 meeting, he spoke on "Further results of spraying experiments (Rept. of 16th Ann. Session, V.S.H.S. for 1911:54-65, March 1912). He discussed most of the diseases of economic importance to apple production in Virginia and described what Bordeaux mixture and lime-sulphur could or could not do. As always, members interrupted to question Waite, but he always fielded the questions with pertinent answers. Both Waite and the membership seemed to enjoy these informal presentations.

At the same meeting Reed spoke on, "Spray injury and some of the factors which favor it," (76th Ann. Session Rept. 1911:277-289). Some subtitles were, "Cause of spray injury," "Types of spraying injury to leaves," "Types of spraying injury on fruit," "The chemical properties of the spray mixtures," "The effect of climate conditions on efficiency and spray injury," "Effect of concentration," "Effect of adding insecticides," and finally a summary on "Prevention," where in he emphasized dangers of overspraying, that cloudy days were best for spraying but not always available, and to use properly prepared sprays at the proper concentrations. It was obvious that Reed, who was interested in crop physiology was in his realm as he presented this paper.

Whenver time permitted, the lesson was open for the "Question Box". Many queries addressed fungicides and plant diseases. Reed participated actively in the discussions.

Other events of significance in 1912 included the establishment of experiment stations at Charlotte Court House for studies on dark fired tobacco and at Williamsburg for alfalfa and soil fertility research. J. S. Cooley left V.P.I. to pursue graduate work under B. M. Duggar at St. Louis; C. H. Crabill replaced Cooley in the survey and cedar rust work. K. E. E. Quantz became a graduate student in Plant Pathology.

In the Virginia Agricultural Experiment Station Annual Report for 1911, 1912 (why not biennial report?) published in 1913, Director S. W. Fletcher lists projects related to plant pathology in the Department of Plant Pathology:

1. Relation of parasitic fungi and bacteria to their host plants.
2. Principles of infection by uredinious fungi.
3. Plant disease survey of Virginia.
4. Field experiments on plant diseases (apple foliage diseases, spinach mildew, tomato blight, cedar rust).
5. The cause and control of peach yellows (In cooperation with State Entomologist and Pathologist).

The project "Control of cabbage club-root" was completed and discontinued.

The Horticulture Department had a project on "Control of fire blight" begun in 1910 to test the effects of heavy mineral fertilization in checking the incidence and severity of fire blight in pears. A crossing program between blight resistant Keiffer and the susceptible varieties Anjou, Laurence, and Bartlett had resulted in 1,500 seedlings for observation and selection.

Reed and Crabill summarized the second installment "Plant diseases in Virginia in the years 1911 and 1912" (pp. 35-50), in which 55 diseases on 21 economic plants were listed. It was difficult to single out newly discovered diseases. One of Virginia's oldest crops was missing from their list - tobacco. Cotton, clover, peanut, oats, barley, rye and corn were also absent. Fruit diseases, those of apple, cherry, grape, peach, pear, plum, quince and brambles were thoroughly covered, as were bean, cabbage, cucurbits, potato, tomato, and wheat. Only maple anthracnose was listed among the tree diseases, even though white pine blister rust had been found on pine in Clarke Co. in 1911. Anthracnose of sweet pea was the only disease of floral plants to be mentioned. A quick inspection of the topics in "Fungous Diseases of Plants" the textbook by Duggar being used in courses taught in the Department should have provided clues for diseases to be encountered in a survey. One should not criticize too severely the efforts of Reed and his colleagues. After all, there was a heavy teaching load and a commitment to several, perhaps more important, projects and they solicited information rather than making personal surveys. Reflect on how easy a roadside survey may be made nowadays as compared to 1909-1915 when both automobiles and roads were primitive.

Reed summarized "The enzyme activities involved in certain fruit diseases" (Va. A.E.S. Ann. Rept. for 1911, 1912:51-77), with emphasis on the apple bitter rot fungus, Glomerella rufomaculans (now G. cingulata). Enzymes were produced in part from cultures and in part in decaying apples. Those studied were amylase, invertase, cytase, inulase, emulsin, lipases, protease, erepsin and amidase (there was no zymase). Thus, the fungus digested carbohydrates, proteins and fats. Juice of rotted apples was less favorable to growth of the fungus than that of healthy apples. Presumably, tannin in rotted fruits was inhibitory.

Reed also published "The effect of Diplodia zeae and some other fungi upon some phosphorus compounds in maize." (N. Y. Medical Jour. 94:1-8, 1913).

With F. S. Holmes, Reed conducted "A study of the winter resistance of the uredospores of Puccinia coronata Cda." (Va. A.E.S. Ann. Rept. for 1911, 1912:78-81). The fungus was monitored through the winter of 1909-10, Nov. 1 to Apr. 1. On oats that lived through the winter, activity of the fungus was correlated with temperature and growth of the host. Viable uredospores were found at all dates of sampling (1st and 15th each month). Site of the plot was not given but it is presumed to be at Blacksburg.

With Cooley, Reed published "The effect of Gymnosporangium on the transpiration of apple trees" (Va. A.E.S. Ann. Rept. for 1911, 1912:82-90). It was observed that trees subjected annually to cedar rust were stunted and produced frew or no sound fruits. Infected leaves transpired less than health leaves. Intercellular spaces were diminshed and stomata were obliterated by aecidia; thus, transpiration was reduced. Growth rate and transpiration being directly correlated, trees became stunted.

Reed and Cooley also studied "The effect of the cedar rust upon the assimilation of carbon dioxide by apple leaves" (Va. A.E.S. Ann. Rept. for 1911, 1912:91-94). The rate of carbon dioxide assimilation in diseased leaves was found to be about one-half that of healthy leaves. Different varieties behaved similarly. Thickening of parenchyma and obliteration of stomata in diseased leaves was presumed to account for the difference.

Charles H. Crabill, B.S., V.P.I., Agriculture, received the M.S. degree in 1913, and after having been an Assistant in Plant Pathology from 1911 to 1913, was upon graduation appointed Assistant Plant Pathologist. For his M.S. thesis, he studied frog-eye leaf spot of apple (Published in 1915, Va. A.E.S. Bul. 209). He found that Sphaeropsis malorum, the black rot fungus, also caused frog-eye leaf spot. Coniothyrium pirinum and Phyllosticta pirina, which were frequently isolated from frog- eye spots, were not pathogenic but were secondary colonizers of spots; he regarded them as facultative parasites (Crabill, G. H., 1913. Studies on Phyllosticta and Coniothyrium occurring on apple foliage. Va. A.E.S. Ann. Rept. for 1911, 1912:95- 115). Crabill also published a note on "The production of secondary sporidia by Gymnosporangium" (Phytopathology 3:282, 1913). The phenomenon was illustrated later in Va. A.E.S. Tech. Bul. 9:29 (1915).

The year 1913, was the 25th since Alwood had been employed by the Virginia Agricultural Experiment Station and was the year E. B. Fred resigned to leave for Wisconsin. As a result, Bacteriology was combined with Plant Pathology and Reed became head of the Department of Plant Pathology and Bacteriology. Cyrus H. Chilton, B.S., V.P.I., 1912 was named Assistant in Plant Pathology to aid Reed in teaching. The year began with the annual get together of fruit growers at Lynchburg.

At the January 1913 annual meeting of the Virginia State Horticultural Society, H. L.

Price, Horticulturist at V.P.I., spoke on "Some measures for the control of orchard diseases," after stating that, "The question of disease belongs to another department, but the question of control of them has been one of my puzzling problems for a number of years" (Rept. of 17th Ann. Session, Va. State Hort. Soc. for 1912:209-217, 1913). Price fingered a long-time problem between plant pathologists and horticulturists (and sometimes agronomists), that being deciding where one's turf begins or ends. It is written the province of pathologists to find ways to control plant diseases, but after having done so, must they forever hold a tight rein on the procedure? Sometimes routine control procedures become a part of crop management and thereby are within the province of horticulturists or agronomists to discuss them in talks or writings. Jealous or zealous pathologists today insist that is a no-no; the way pathology is moving today (1994), if producers do not receive advice on disease control from non- pathologists, they receive none. That having been said, here is the essence of Price's 1913 talk. Two general measures are practiced in orchards, spray treatment and sanitary measures; Price spoke about the latter only. He covered six classes of sanitary measures, quoted here:

1. Removal of affected host to prevent further spread of diseases.
2. Removal of affected part of plant to prevent disease from becoming general.
3. Removal of complementary host where the parasite lives on more than one plant.
4. Destruction of diseased foliage, fruit or wood, as a possible source of infesting a new crop.
5. Stimulation of weak plants by cultivation or feeding with a view of rendering them more resistant to disease.
6. Selection of resistant varieties.

Under 1, he cited trees infected with peach yellows; under 2, he cited black knot of cherry and plum and fire blight of apple and pear; under 3, he cited cedar-apple rust; under 4, the removal of fruit mummies and pruned wood; under 5, the use of phosphate-potash fertilizers but not nitrogenous fertilizers in apple and pear orchards; and under 6, he mentioned not resistant varieties, but the very susceptible ones to avoid, for example, York Imperial and Rome where cedars occur. The ensuing question session centered around cedar rust and bitter rot.

Reed was to present a paper "The cedar rust problem in Virginia," but he was in Europe so he had C. H. Crabill read the text (Rept. of 17th Ann. Session, Va. S.H.S. for 1912:218-227, 1913). Certainly Crabill was competent to present the paper and lead the discussion because he was assigned to the cedar rust research laboratory at Middletown. Reed's paper covered life history of the fungus and disease cycle, impact of rust on trees and fruit, sprays that had been tested and, "Why the cedar trees should go." Here was a gentle but firm urging to eliminate cedars near orchards on neighbors property by persuasion and cooperation. Reed did not actually urge legislation to allow removal of cedars; this was done in Bulletin 203 a year later, but Price speaking earlier had said, "The orchard industry should be protected by law from this menace" (p. 211). Reed's advice was, "A word of warning to the man who is going to stir up his neighbors to cut their trees. That man should be exceeding careful to have all of his own cedars cut before he even passes a hint to his neighbors" (p. 227).

Some odds and ends for 1913 include a report by Flippo Gravatt on the spread of chestnut blight in the second year after it was found in Virginia (Va. Dept. Agric. & Imm. Rept. 1913:154-155). It had been found in Clarke, Fauquier, and Loudoun Cos. in northern Virginia and at Fontella, Bedford Co. Centers of infection had been found and eradicated. It was not yet known in virgin chestnut forests.

W. J. Schoene had become State Entomologist and Plant Pathologist on September 1, 1913. In his report for 1912-1913 (Ninth Rept. of the State Entomol. Va. Crop Pest Comm. p. 20, 1914), he described how the Crop Pest Commission, the Department of Plant Pathology, Virginia Agricultural Experiment Station and the Virginia Truck Experiment Station had joined to study peach yellows. Western Virginia had much yellows but eastern Virginia seemed to be free of it. An experimental orchard had been planted on the Truck Station property to facilitate an investigation of distribution of the disease.

In the V.P.I. catalogues the Department had changed Laboratory Mycology from 2 laboratories/wk in winter and 3 laboratories/wk in spring for 1910 and 1911 to 2 laboratories/wk in winter to 5 laboratories/wk in spring. Agricultural Microscopy was discontinued in 1912.

From The Southern Planter, volume 74, we find several items related to Virginia plant pathology. G. F. Gravatt, formerly at V.P.I., now (1913) with the U.S.D.A., reported on a conference concerning, "Utilization of Blight Killed Chestnut Trees," held at Trenton, N.J., in an item, "Timber from chestnut blight killed trees." Lumber from blighted trees was found to be as strong as that from healthy trees for lumber, poles, or posts. The impact of blight had not yet been felt in Virginia (May, p. 532).

S. A. Loyd, B.S., V.P.I. '13, published his thesis, "Important Bacterial Diseases of the Apple and Pear," in the May issue (pp. 535-537). He discussed crown gall (Pseudomonas tumefaciens), giving details of symptoms, host range, conditions favoring, treatment and methods of control, and the effect of inoculation into animals. In the latter item, he pointed to experiments where several animals were injected with P. tumefaciens; several fish and frogs developed tumors, cancers, and some died. No doubt this was the work of E. F. Smith and his colleagues who devoted a tremendous amount of effort trying to relate crown gall to human cancer. For pear blight, Loyd discussed history, distribution and appearance, susceptibility of host plants, infection and progress treatment and methods of control including cultivation, pruning and cleaning up the orchard. He emphasized that bacterial diseases are the most difficult to control and that spraying is relatively ineffective because the bacteria lie deep in the plant tissues and toxic substances would destroy only those organisms which are superficial.

J. T. Rogers of Blacksburg reported "Blister cankers found in Virginia apple orchards," caused by Nummularia discreta, had been found in apple orchards in Albemarle, Culpeper, Loudoun, Madison, and Orange Cos. (July, p. 746). He described symptoms and stated that the fungus is a wound parasite, meaning it enters only through wounds. All diseased parts should be cut out and burned. (Note: Reed and Crabill, Va. A.E.S. Tech. Bul. 2, 1915, reported it was also found in Frederick and Montgomery Cos. Apparently they did not communicate with Rogers).

The October issue (pp. 1072-1073) contained an article from the Maine Farmer on "Controlling Blackleg in Potatoes" by C. D. Woods. No doubt it was reprinted because of outbreaks of blackleg in Virginia potato fields in recent years. Woods emphasized that the bacterium is carried over from year to year in tubers. In Maine, the organism does not survive in soil as it does in the South; therefore, "disease-free tubers may be produced by soaking sound ones in a formaldehyde solution (1 pt. in 30 gal H20). During cutting, tubers with discolored areas are to be discarded and the knife is to be sterilized. Seed pieces may also be treated in this manner without inducing injury. The Maine Experiment Station conducted the work and made the above recommendations.

From Orange Co., came the complaint that watermelon vines died after fruit had set. Director T. C. Johnson of the Virginia Truck Station responded that either downy mildew or anthracnose was the cause. He mentioned that watermelon wilt (Fusarium sp.) was present in Virginia and that the center of a tap root from a wilted plant will have a yellowish cast, whereas those with mildew or anthracnose will be white (May, p. 610).

Reed ended the year with "Virginia Experiment Station Notes" (December, p. 1202) by announcing a forthcoming bulletin on the cause and control of the cedar rust disease of apple. The bulletin "will contain results of spraying experiments, involving the use of several new spray mixtures and the effect of each upon the control of the disease, the effect on the fruit and possible injury to foliage. The question of timeliness of spraying was found to be one of the important factors in the control of the disease ... The question of the cedar tree and its destruction is treated. It must be admitted that in many ways the axe treatment is one of the most successful which has been tried in the control of this disease." "The bulletin when issued will be illustrated with pictures taken by the writers during their study of the disease, and will show several very striking results which have been obtained from the use of the remedies to be described." (Reed is referring to: Reed, H. S., J. S. Cooley, and C. H. Crabill, 1914. Experiments on the Control of the Cedar Rust of Apples. Va. Agri. Expt. Sta. Bul. 203). When the bulletin actually appeared, it also contained a list of resistant and susceptible apple varieties. A copper-lime-sulfur spray was found to provide better protection from rust than did Bordeaux mixture but either spray had to be used until June 10. The eradication of all cedar trees within one-half mile of orchards was advised and any cut after March 1 should be burned or they could produce a crop of spores. There was a section "What is the status of the cedar tree?" in which the authors seemed to be laying the ground work for controversial legislation. They wrote "The proposal has frequently been made to list the red cedar as a pest, and to seek legislation empowering its destruction where it is a menace to orchards. Some such measures would undoubtedly be desirable in cases where apple growers suffer from farms on which apples are not grown commercially. Many instances are known in which the owner of cedars has refused to cut or even sell the privilege of cutting cedar trees which are of no commerical value whatever" ... "This is undoubtedly an unjust state of affairs" ... "It cannot be denied, however, that in recent years the loss to the State from this disease has amounted to a far greater sum than the value of the neighboring cedars, and that a measure bringing suitable relief would be most welcome in many quarters. In the meantime, in the absence of legislation, much might be done to alleviate the trouble by cooperation among apple growers to educate the general public upon this question and to create a sentiment in favor of checking this disease. It ought certainly be the desire of every one to increase the general prosperity of his community in this way." (Va. Agri. Expt. Sta. Bul. 203:pp. 26-27). Thus, the bulletin dated January 1914, ushered in a momentous year in which the Virginia General Assembly would respond to pressure from growers and enact the cedar rust law, and the Smith-Lever act of Congress would bring into existence the state-federal Cooperative Extension Service.

Considerable space in the Virginia State Horticulture Society Report for the 18th Annual Session was devoted to cedar rust of apple. M. B. Waite's talk "Cedar rust of the apple" (pp. 37-54) and "the text of the cedar rust law as presented to the legislature" (pp. 236-241) were published in full. Waite's "just plain talk" was comprehensive, comprehendable, informative, and interesting. He gave a history of the fungus adapting to cultivated apple (an introduced species) mostly beginning in 1908, although it had been noticeable since 1888. He compared it with the introduction of pests into areas where they had not previously existed (Phylloxera on grapes into Europe, and San Jose scale into North America; he did not mention chestnut blight but it would have been timely to do so.) In this case a host was introduced where the rust parasite already existed but was slow to adapt from native species to an introduced cultivated species, by his reckoning over 200 years (actually nearly 300). He gave a detailed account of its 2-year cycle, pointing out why it was in alternate years mild and severe. He also explained why its control by spraying (with materials then available) could succeed or fail. Finally, he pointed out that eradication of cedar trees had been urged by the U.S.D.A. since 1888 as the primary means of control but that growers were reluctant to be convinced. Even as he spoke, the Virginia General Assembly was holding the session that would enact the bill declaring cedars near apple orchards a public nuisance and enabling their removal (pp. 236-241). Mr. T. W. Steck of Winchester was its patron.

Specifically, the cedar eradication law ordered owners of cedar trees to destroy them if they were within one mile of a commercial orchard. The State Entomologist was empowered by destroy trees within two miles of an orchard. Thus, there was a controversial discrepancy from the outset making the law difficult to enforce. It would be challenged at all levels of courts up to the U.S. Supreme Court. (Fulling, E. H., 1943. Plant life and law of man IV. Barberry, currant and gooseberry, and cedar control. Bot. Rev. 9:483-592). The law was amended in 1920 to remove the discrepancy; owners of cedars were required to remove them within two miles of orchards.

Reed and Crabill both must have played a major role in conceiving, through their talks and writings, the cedar eradication law. From previous talks on the subject by H. L. Price and Reed of V.P.I. (Va. S.H.S. 1913), and M. B. Waite of the U.S.D.A. (Va. S.H.S. 1914), growers must have been persuaded to propose a bill for the 1914 Virginia General Assembly. A full text of the law appears in Circular No. 9 of the Virginia State Crop Pest Commission, Blacksburg, Virginia, and in the Report of the 18th Annual Session of the Virginia State Horticulture Society for 1913:236-241, 1914.

Reed published an article in 1914 that clearly stressed further his interest in physiology and biochemistry of plant disease, namely. "The formation of hexone and purine bases in the autolysis of Glomerella" (Jour. Biol. Chem. 19:257). There would be another in 1915. He also summarized "Peach yellows investigations" (Ninth Rept. State Entomologist and Pathologist Va. 1912/1913:20), and described "York spot and York skincrack" at the Annual Meeting of the American Phytopathological Society (Phytopathology 4:405, 1914, abstr.). "Notes on plant diseases in Virginia observed in 1913 and 1914" appeared in the Experiment Station Annual Report for 1913 and

1914 and was published without change of pagination as Technical Bulletin 2, April 1915. Its contents will be reviewed later. Reed's involvement in teaching bacteriology is clearly recognized from the fact that in 1914 he published a "Manual of Bacteriology for Agricultural and General Science Students" (Ginn and Co., New York, 1914). Hugh L. Thomson was Assistant in Plant Pathology for the 1914-15 session; he taught Laboratory Bacteriology, Plant Pathology and Laboratory Plant Pathology. That session Reed started Biochemical Microbiology, 3 laboratories/wk, winter quarter, once again demonstrating his interest in physiology.

A few items published in The Southern Planter for 1914 related to plant pathology and the Department. The usual spray calendar with comments appeared in the March issue (pp. 212-213); there was nothing new but orchardists were advised to cut cedar trees in winter. It being March it was a "Wait til next year" situation. Reed wrote a letter asking for cedar lumber and logs for a firm in Lynchburg (p. 240). Meade Ferguson was listed as Editor of the magazine for the first time. He had been a bacteriologist at V.P.I. and had started investigations into nitrogen fixation; he was also the advisor for E. B. Fred's masters program.

Two items by out-of-state authors related to plant pathology. A. N. Portman of Illinois wrote an account of testing apple and pear varieties for disease resistance (April, pp. 316-317). Fire blight resistance was most applicable to the State but the reaction of varieties to this disease were already known to Virginia orchardists. The Editor wrote a warning that "Powdery scab of potatoes" had been found in northern Maine (May, p. 338). He described symptoms, noted that the pathogen (Spongospora subterranea) contaminates soil and, thus, the disease becomes a perennial problem. Farmers were to beware of potatoes from northern sources. Apparently, the disease never became established in Virginia (Farr et al., 1989).

In 1915, Reed and Crabill published the third summary of the plant disease survey, this time in an Experiment Station Technical Bulletin. (Reed, H. S., and C. H. Crabill. Notes on Plant Diseases in Virginia Observed in 1913 and 1914. Va. Agri. Exp. Sta. Tech. Bul. 2). Some interesting diseases and disorders were described:

- Alfalfa
  - Violet root rot (Rhizoctonia medicaginis, now R. crocorum) was found in Botetourt Co.
  - Yellow tops was described from all over Virginia; the authors did not recognize leaf hoppers or boron deficiency as possible causes but did eliminate fungi and lime deficiency.
  - White spot was found scattered throughout the State; it was described and illustrated but its cause remained unknown. It is known now as a potash deficiency symptom.
  - Anthracnose (Colletotrichum trifolii) was identified from Williamsburg, James City Co.
- Apple
  - Blister canker was reported from Frederick, Loudoun, Montgomery, and Orange Cos.
  - Flap tumor, in which shell-shaped overgrowths of apparently healthy wood extend partly around the branch that bears them. No causal agent was given. Specimens came from Roanoke and Montgomery Cos.
  - Root rot attributed to Armillaria mellea was reported from many orchards

  with trees 10 to 15 years old.
  - Skin crack and York spot were described in detail.
- Bean
  - A snap bean plant of unknown origin with crown gall symptom was pictured.
- Maple
  - Thrombotic disease of silver maple was detected in Frederick Co. in 1913. From the symptoms given, it was probably Verticillium wilt. In 1914, it was found all along the Valley Pike (probably into Augusta Co.).
- Plum
  - Hypertrophied and distorted twigs from Chesterfield Co. were attributed to Phragmidium subcorticum (= P. mucronatum). This is a rust of rose; no further substantiation of this diagnosis could be found.
- Potato
  - Rhizoctonia disease was collected from several fields near Norfolk and on the Eastern Shore. Black sclerotia on surfaces did no harm but growers were advised not to use sclerotium-bearing tubers for seed.
  - Wilt (Fusarium oxysporum) was found in plots at Blacksburg, Montgomery Co. The reactions of 15 varieties ranged from none to all plants killed.
  - Hollow heart attributed to early dry spell and a late spell of abundant rainfall.

Perhaps the most noteworthy publication of the Reed era was Experiment Station Technical Bulletin 9, "The Cedar Rust Disease of Apples Caused by Gymnosporangium juniperi-virginianae Schw.," by Reed and Crabill. The most striking aspects of the bulletin are the several drawings of the host-pathogen relations (figs. 6- 9, 13). The delineator did not inscribe his name but it is presumed to be Crabill. The bulletin is a culmination of studies conducted by the Department since 1910. Much of the work was done at the field laboratory established at the Middletown Agricultural High School in Frederick Co. The authors credit J. S. Cooley, S. F. Coffman, C. H. Chilton, and J. R. DuShane for their contributions to the research. The stated objective of the study "has been the pathology of the host plant. To that end much attention has been devoted to the physiology of the diseased trees. Studies on the transpiration, photosynthesis, respiration, chemical constitution, and reproductive powers of the tree have been made. Since, however, a proper understanding of the nature and conditions of infection is not evident without a knowledge of the infecting organism, considerable attention has also been directed to the fungus, its spore forms, cycle of development, and growth requirements (p. 5). With respect to preventing apple rust, "The application of fungicides has not proven to be a practical means of controlling the disease in places where the red cedar trees stand in the neighborhood of orchards. In such cases permanent relief can be obtained by removal of all red cedar trees in the vicinity" (p. 6).

"Some topics thoroughly explored were development of cedar galls and the sporophytic stages of the fungus from infection of cedar through discharges and germination of sporidia; development of the fungus on apple foliage and fruit including time of infection, immunity of fully expanded apple leaves and nuclear cycle in the fungus; effects of the disease on various functions of the leaf wherein transpiration and photosynthesis rates decreased and respiration increased. In spraying experiments, timing had to be very precise to protect leaves from infection and for copper-containing ingredients, there was the added possibility of injury if wet weather followed spray application. As to cedar eradication, "If all cedar trees can be removed from a territory having a radius of half a mile from the orchard, we have found that the serious epidemics of cedar rust will be avoided, but it is much better to destroy all cedars within a mile of the orchard, and in some cases where the topography is such that winds have an unbroken sweep, two miles is the least distance which will make the orchard safe" (p. 100). The cedar eradication law had already been enacted. Reed and Crabill listed in three classes the behavior of apples toward rust. Susceptible were York Imperial, Northern Spy, Rome, Jonathan, Bonum, and Smith's Cider; moderately susceptible was Ben Davis; and resistant were Northwestern Greening, Winesap, Stayman Winesap, Arkansas (= Mammoth Black Twig), Grimes, and Yellow Newton (= Albemarle Pippen) (p. 102). These varieties were reported to behave differently in other apple producing regions, suggesting that physiologic races of the fungus existed, a concept that was not addressed by Reed and Crabill.

"In conclusion, we would state that the problems of control of the cedar rust are not simple, and that it is necessary for each one to determine the best method of procedure in his own special case. Eradication of the cedars will give effective and permanent relief, spraying is successful under the conditions set forth above, and planting of resistant or immune varieties is much to be commended" (p. 103).

Technical Bulletin 9 was the most comprehensive treatment of a plant disease in the first 25 years of plant pathology in Virginia. The authors cited contributions of workers throughout the world and conducted repetitions of experiments with appropriate controls. Their chief statistic was the mean, and their data stood the test of time without the use of statistical analyses and L.S.D.'s.

Reed and J. T. Grissom, Assistant Chemist for the Experiment Station published on "The development of alkalinity in Glomerella cultures, (J. Biol. Chem. 21:159-163, 1915), giving further evidence of his interest in physiology. He was also senior author with Bruce Williams, Assistant Bacteriologist, of two technical bulletins on nitrogen fixation. Although these bulletins do not relate to plant pathology they demonstrate the versatility of Virginia's first plant pathologist and his responsibility toward the other discipline in his department. They furthered the work initiated by Meade Ferguson and continued by E. B. Fred. In "Nitrogen Fixation and Nitrification in Various Soil Types" (Va. A.E.S. Tech. Bul. 3, 1915), the principle finds were that although cultivated soils showed higher nitrifying qualities than virgin soils, the latter were also more variable. Some soils evinced no power to nitrify. In "The Effect of Some Organic Soil Constituents upon Nitrogen Fixation by Azotobacter" (Va. A.E.S. Tech. Bul. 4, 1915), the authors reported that hydroquinone and salicyclic aldehyde depressed nitrogen fixation but esculin, quinic acid and borneal stimulated it. A number of nitrogenous compounds, urea, glycocall, formamide and allantoin, depressed nitrogen fixation.

Within the Department, Karl E. E. Quantz of Hildenschein, Germany, had become a graduate student probably in 1911, assisted Reed in the 1914-1915 session by teaching Laboratories in Bacteriology and Plant Pathology and apparently was briefly Assistant Plant Pathologist in the Experiment Station 1915-1916. If the records are clear, Quantz was a graduate student until 1916, a period of five years, the longest to date, and he was the first to bring the Department an international flavor, although Fred had earned the Ph.D. in Germany.

Crabill published a study of "The Frog-eye Leaf Spot of Apples" (Va. A.E.S. Bul. 209, 1915), in which he reported, "For a number of years there has been some uncertainty as to what fungus was reponsible for the frog-eye spot. This has been due to the fact that a number of different organisms have been found closely associated in the diseased portion of the leaf. Investigations have shown that both the initial infection and secondary enlargement of frog-eye spot are due to Sphaeropsis malorum ... After the spot is a few weeks old the spores of many species of fungi may be found on its surface (Va. A.E.S. Bul. 209:15). Scott and Rorer (U.S.D.A. Bur. Pl. Ind. Bul. 121, 1908) had demonstrated by artificial inoculation that S. malorum caused initial infections of frog-eye spots but they did not account for the secondary enlargement of the spots. Crabill's work was more definitive.

The final publication on projects executed by Reed was "Some Effects of the Growth and Activity of Bacteria in Milk", by Reed and R. R. Reynolds (Va. A.E.S. Tech. Bul. 10, 1916). Reynolds was a graduate student in bacteriology. Reed was senior author of five of the first ten technical bulletins published by the Experiment Station.

Events which took place at the Virginia Truck Experiment Station during the Reed era might be mentioned, some again, as they are recorded in Va. T.E.S. bulletins. "The Control of Malnutrition Diseases of Truck Crops" (Va. T.E.S. Bul. 1, 1909) was published by L. L. Harter of the U.S.D.A., Bureau of Plant Industry, who found opportunities in plant pathology and a cooperative spirit awaiting him at Norfolk. In bulletin 1, he reported finding retarded growth, change of color, root injury and absence of parasites in several crops. These symptoms could be prevented by liming, adjusting fertilizer composition and maintenance of organic matter. In Va. T.E.S. Bulletin 4, (1910), Harter described "Spinach troubles at Norfolk and the improvement of trucking soils." He mentioned Heterosporium variabile and Peronospora effusa as problems being studied by Reed and Crabill of V.P.I. The emphasis was on rotation and maintenance of organic matter. In bulletin 5, T. C. Johnson, Director of the Station discussed "Spraying Cucumbers and Cantaloupes" (1911). He described annual spray programs to control anthracnose and downy mildew. Johnson also wrote an article "Treatment for scab and early blight of potatoes, mildew on cucumber and cantaloupe" (Va. Dept. Agri. Rept., 1909:119), in which he described experiments conducted in 1908 and 1909.

According to personnel records, from the Virginia Truck Experiment Station, L. L. Corbett was Assistant Plant Pathologist from January 1, 1909 to June 30, 1912; Eubanks Carsner served as Assistant Plant Pathologist for a period in 1914 and 1915. Both of these gentlemen departed for employment with the U.S.D.A. Carsner published in The Southern Planter the first article from Virginia on nematode root knot (Root-knot. A disease of farm and garden crops. Sou. Planter 71:354-355, June 1915). He described the root galling, dwarfing, and wilting of affected plants, illustrated the disease on tomato and cucumber, and stated that it was common in the field from Virginia south. It was universally prevalent as a greenhouse nuisance. He listed 51 plant species as being hosts, a number of which were of economic importance in Virginia. Most truck crops, alfalfa, tobacco, cotton, soybean, and rose were among the vulnerable species. Peanut was not listed among suscepts; it along with corn, small grains, pasture grasses, was listed among the species to be used in 2-3 year rotations to reduce the impact of nematode infestations. In greenhouse, steaming the soils was recommended. His article was based upon U.S.D.A. Farmer' Bulletin 648, "The Controlling of Root-knot."

In the same Southern Planter, J. J. Taubenhaus of the Delaware Experiment Station started a two-part article entitled "Diseases of vegetable crops and their control" (Sou. Planter 76:350-351, 404-405). He described the Delmarva Peninsula and New Jersey as the kitchen garden of Philadelphia, Baltimore and Washington. However, the hopes and labor of growers were often blasted by a number of plant diseases which reduced yields and profits, and sometimes made it impossible altogether to grow their crops. He described damping off; asparagus rust; bean anthracnose, bacterial blight and rust; cabbage yellows and black leg; cucurbit anthracnose, downy mildew, bacterial and fusarium wilts; eggplant anthracnose and Phomopsis blight; onion blight, anthracnose, and smut; and tomato leaf spot and wilt. He also described a number of insect pests and gave the prevailing methods of control of diseases and insects. Control of soil pH was mentioned as major factor over which the growers had control.

Several other items relating to plant pathology appeared in The Southern Planter for 1915. These included the spray calendar for 1915; a discussion of "Some plant diseases induced by drought" in which C. H. Crabill described punky pulp of Ben Davis apple and skin crack of York Imperial, tip burn of potato leaves, hollow heart of potato tubers, and yellow top of alfalfa (which with tip burn of potato may have been caused by leafhoppers; Mar. 1915:148-149). G. C. Starcher, Assistant Horticulturist, Va. A.E.S., found 50% of a group of 4-year-old peach trees infected with yellows, and replied to a Campbell Co. farmer that apple root and crown rot could only be controlled by removing roots and soil 3 feet from the crown before replanting (June, 1915:362). The editor contributed an article "Treatment of seed grains for smut" (Aug. 1915:444). He suggested: clean the seed, treat with formaldehyde solution, 1 pint in 40-45 gallons of water, mix thoroughly, cover for 12 to 24 hours, spread to dry. Do not use for feed. A Northumberland Co. inquired about treating wheat for smut and was referred to the article above (Oct. 1915:596). Tomato rot in Patrick Co. was called blossom-end rot by Massey.

In the Tenth Report of the State Entomologist for 1914 and 1915 (1916), W. J. Schoene stated that "the fruit growers, realizing that the future profits of the apple orchards were imperiled, succeeded in having a law enacted declaring the cedar a nuisance" (p. 6). The law was of local option nature; county officials had to enact an endorsement of the law in order to implement it. Schoene reported that the law had been tested in Frederick. This resulted in a complete victory for the fruit growers. A transcript of the first case, "Virginia State Entomologist vs. the Glass family and heirs" appears in the Report (pp. 16-29).

Schoene also reported that control of chestnut blight was deemed ineffective and that the federal support had been withdrawn. Chestnut owners were advised to harvest their holdings, the chestnut appeared doomed (p. 7).

The Reed era can best be summarized as the beginning of basic research in plant pathology in Virginia but it was a period of considerable effort in applied research. Obtaining the necessary information for implementing cedar-apple rust control was the highlight of the era. Reed and his associates laid an excellent foundation for the next era, the Fromme era.

The Reed era ended officially in the middle of 1915 and the Fromme era began. When Reed died on May 12, 1950 at Berkeley, California, a committee of the

University of California was appointed to prepare a memorial obituary. Of his tenure at V.P.I. they wrote, "Although Professor Reed's research in Virginia was, by the nature of the position chiefly related to fungi as agents of plant disease, he tended to approach such problems from the physiological point of view and with concern for the relations between the causal organism and the host plant. It was this well-balanced combination of research approaches as well as demonstrated achievement that led to his appointment in 1915 as Professor of Plant Physiology in the Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside." By the time of his death, "he had published some one hundred eighty papers" (as well as a "Manual of Bacteriology" and the 320 page book "A Short History of the Plant Sciences)" since his graduate days at the University of Missouri. These not only attested to his continuing and active research but demonstrated as well a treatment characteristic of a scholarly mind" (A. R. Davis, J. P. Bennett, A. S. Foster. Howard Sprague Reed, 1876-1950. Univ. of Calif. In Memorian pp. 94-97. April, 1958). Amen!

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A History of Plant Pathology in Virginia: The Fromme Era (1915-1928)

Fred Denton Fromme was appointed Plant Pathologist and Bacteriologist and Head, V.P.I., Department of Plant Pathology and Bacteriology, Virginia Agricultural Experiment Station (V.A.E.S.), on July 1, 1915, one day after H. S. Reed's tenure in that position had ended. Apparently, Reed had notified the administration of his impending departure date and it may be speculated that he helped to find his own replacement; certainly, he must have known Fromme from contacts made at the American Phytopathological Society meetings. However, Fromme's appointment was conceived, there was no interim period as Reed and Fromme were Heads of the Department on consecutive days. How efficient; how different from today's entanglement of search committees, interview expenses, faculty politicing, acting heads, and administrative dilly-dallying, much of which is in an effort to meet state and federal guide-lines which did not exist before 1960.

Fromme came to V.P.I. with excellent credentials. He earned a B.S. degree at South Dakota State College in 1911, and a Ph.D. degree under E. B. Olive from Columbia University in 1914. He was Assistant Botanist at Columbia University in 1912 and 1913. He also served as Assistant Botanist at the Indiana Agricultural Station, Purdue University, from 1913 to 1915. There, he worked and published papers on the plant rusts with the renowned uredinologist, J. C. Arthur. His interest in plant rusts would continue throughout his tenure at V.P.I. He had inherited some on-going projects from his predecessor, Reed, but he would need to develop projects around his own interests and capabilities and for solution of some destructive diseases of Virginia crops.

When Fromme arrived at V.P.I., the faculty in the Department consisted of Assistant Plant Pathologist C. H. Crabill, Assistant Bacteriologist Bruce Williams and Fromme. The next 3 years must have been somewhat frustrating because Fromme was continually accepting resignations and hiring replacements. Both Crabill and Williams resigned on September 1, 1915, only two months after Fromme became Department Head. Karl E. E. Quantz, who had been a student assistant under Reed was immediately appointed to replace Crabill as Assistant Plant Pathologist. T. J. Murray was also hired as Associate Bacteriologist on September 1, 1915, to replace Williams. On December 13, 1916, Quantz resigned to take a position in Brazil. Meanwhile, H. E. Thomas was appointed Assistant Plant Pathologist on July 1, 1916 but he stayed only 8 months and resigned on February 28, 1917, to accept a position at the Puerto Rico Experiment Station. Not until Fromme hired S. A. Wingard on July 1, 1917, as Assistant Plant Pathologist was there any stability achieved in the plant pathology faculty. Indeed, Wingard would remain at V.P.I. until he retired on November 1, 1964. Murray remained until February 5, 1918; his replacement, A. B. Massey, was appointed Assisant Bacteriologist on June 1, 1918. Now in both disciplines, stability had been achieved as Massey would remain on the faculty until he retired on June 30, 1959, although in various other capacities during his tenure.

Projects initiated under Reed, which Fromme deemed necessary to continue included the survey of plant diseases and control of tomato diseases by dusting and spraying. He initiated a project to study the black root rot disease of apple that Reed and Cooley had described, and started experiments for control of cedar rust of apple and peach scab by dusting. Before reviewing Fromme's research, his responsibilities to teaching for the 1915-16 session should be recalled.

As Professor of Plant Pathology and Bacteriology, Fromme inherited a considerable teaching load from his predecessor, Reed. The courses listed were General Bacteriology, 3 hr, I; Laboratory Bacteriology, 5 x 3 hr, I (= five three-hour labs./wk. Fall qtr.); Bacteriology and Clinical Diagnosis, 5 x 3 hr. II; Biochemical Microbiology, 3 x 3 hr, II; these were taught by T. J. Murray.

Fromme taught Plant Pathology 3 hr, I, II; Laboratory Plant Pathology 2 x 3 hr, II, in which he used as a textbook Duggar's "Fungous Diseases of Plants." He was assisted at first by Quantz and Thomas. Fromme also taught Systematic Mycology 3 hrs. I, II; and Laboratory Mycology 2 x 3 hr, II and 5 x 3 hr, III, in which Steven's "The Fungi Which Cause Plant Disease" was the textbook; and Applied Mycology 3 hr, III, in which "Lafar's Technical Mycology" was the textbook. Journal Club 1 hr. I, II, III was also led by Fromme. Thus, it appears that Fromme was responsible for 39 contact hours of plant pathology and mycology per year. How much was delegated to Thomas is hard to say but when Thomas departed in February 1917, Fromme was saddled with II and III quarter courses for the remainder of 1916. In addition, he served on the College Entrance Requirements Committee from 1915 to 1920.

The first publication during Fromme's tenure was by C. H. Crabill, The Frog-eye Leaf Spot of Apples, Va. A.E.S. Bul. 209, December 1915. This, of course, was the culmination of Crabill's work that had been the subject of his M.S. thesis. It is difficult to say whether Crabill and Fromme had a congenial relationship; they co-authored no publications. Crabill may have decided to become a farm manager before Fromme was hired but it appears that Fromme must have encouraged Crabill to publish notes on three diseases he had studied. With H. E. Thomas, Crabill published a note that bitter pit or stippen was a physiological problem and not due to spray injury (Phytopathology 6:51-54, 1916). He described white spot of alfalfa but did not recognize its cause (Phytopathology 6:91-93). It is now attributed to potassium deficiency. Reed and Crabill had first reported on root rot of apple in the 1913 Annual Report of the Va. A.E.S. and they thought that one or more mushroom fungi might have caused it. In Crabill's final note on the subject, he concluded that it was caused by *Trichoderma koningii* (Phytopathology 6:159-161). Fromme investigated root rot after Crabill's departure and in collaboration with H. E. Thomas, found that a *Xylaria* sp. Was the probable cause. They isolated *X. hypoxylon*, *X. polymorpha* and a species resembling *X. cornu-damae*. After a series of pathogenicity studies, they attributed apple black root rot to *X. hypoxylon* (Jour. Agri. Res. 10:163-173 + 3 plates 1917). Fromme would later rename the fungus *X. mali* (Va. A.E.S. Tech. Bul. 34, 1928).

At the end of 1916, Fromme gave a brief review of the work on root rot at the 21st annual session of the Virginia State Horticultural Society (Va. Fruit 5:212-214: Rept. 21st Ann. Session. V.S.H.S., Dec. 5-7, 1916). He was referred to as "Dr. Froome" in the proceedings. He made these points: The cause of root rot is a fungus. Loss of trees begins at age 7 and may run as high as 25 percent of the original planting. The disease occurs in any type of soil. Tree foliage yellows and thins, trees bear heavily, tilt and then uproot. There is no resistance. Cultivation is the chief agency in the spread of root rot as rows of infected trees almost invariably follow the lines of cultivation. Worming (removal of flat headed or round headed apple tree borer larvae) may contribute to spread of root rot; therefore, if worming is practical, sterilize the knife between trees.

At the same meeting, Charles Brooks spoke to the Society on bitter-rot and York-spot control. For York-spot, he recommended the control of rosy aphids, but he ignored bitter-rot and spoke instead on the control of a fruit rot caused by *Phoma pomi*, also known as Brooks spot. Any fruit spray after July 1 would control it. (I found it, named it, I promote its control).

About two weeks before Fromme arrived in Blacksburg, J. A. McClintock was appointed Assistant Plant Pathologist at the Virginia Truck Experiment Station (V.T.E.S.). He had earned a B.S. degree at Michigan State College in 1913, and an M.S. degree from the University of Wisconsin in 1914. He had worked on control of nematode diseases as a Bureau of Plant Industry Agent at Michigan State and had published a bulletin on the subject but published nothing about nematode diseases during his three years at the V.T.E.S.

A number of diseases new to Virginia were reported in 1915, in some cases whether by Reed, Fromme, or McClintock is uncertain. These include bean Rhizoctonia root and stem rot (Plant Dis. Reptr. 2:264); Stewart's wilt of sweet corn (Pl. Dis. Reptr. 2:214); peanut wilt caused by *Sclerotium rolfsii* found by McClintock at the V.T.E.S. (Jour. Agri. Res. 8:441-448); and violet root rot of alfalfa caused by *Rhizoctonia crocorum* found in Botetourt Co., 1914 and 1915 (Fromme, Phytopathology 6:90, 1916).

In the Virginia Agricultural Experiment Station "Annual Reports", it was customary to publish fullblown papers, some of which were duplicated in station bulletins. Three such plant pathology papers appeared in the 1915-1916 "Annual Report".

Fromme and H. E. Thomas under the title "Dusting for cedar rust" described futile attempts to control rust on apple (pp. 179-183). The work was done on the G. F. Blandy farm at White Post, Clarke Co., a farm which eventually became the Blandy Experimental Farm of the University of Virginia. None of the various dust treatments with sulphurs, coppers, and their combinations proved feasible. On the other hand, Thomas found sulphur and lime dusts effectively controlled peach scab, (*Cladosporium carpophilum* (Dusting for peach scab, pp. 184-186). The various experiments with dusts were precipitated by the manufacture of new, finer dusts and light-weight dusting machinery.

Fromme summarized the results of the plant disease suveys for 1915 and 1916; newly recognized diseases or new sites were:

- Bean stem crack, *Rhizoctonia solani*, Henrico Co., plants lodged, photo. (See also Plant Dis. Reptr. 2:214, 1915).
- Lima bean downy mildew, *Phytophthora phaseoli*, Blacksburg Gardens, 1916, photo.
- Beets, root knot, *Heterodera marioni*, scattered gardens, state wide, photo.
- Cabbage, black leg, *Phoma oleracea*, Greene Co., known previously from Norfolk

area, photo.

- Crimson clover, stem rot, *Sclerotinia trifoliorum* Nottoway Co. (see also Va. Dept. Agric. Imm. Rept. 1916:50-52).
- Cotton anthracnose, *Glomerella gossypii*, Brunswick Co., 30% damage in one field.
- Cowpea wilt, *Fusarium vasinfectum*, Isle of Wight, Louisa, and Nottoway Cos.
- Grape rot, *Pestalozzia uvicola*, Blacksburg, on one variety, 1915; did not repeat in 1916.
- Peanut wilt, *Fusarium* (?) probably *vasinfectum*, Isle of Wight Co., 1916.
- Tomato wilt, *Fusarium lycopersici*, new locations were Botetourt, Dinwiddie, Halifax, Henrico, New Kent, Nottoway, and Roanoke Cos.

Fromme and Thomas summarized experiments conducted in Blacksburg in 1916 in "Spraying and Dusting Tomatoes" (Va. Agri. Expt. Sta. Bul. 213, 1916) by stating the results "are in substantial agreement with those previously reported from this station. Septoria leaf spot and late blight developed in the experimental plots. Late blight but not leaf spot was controlled by both liquid and dust applications of copper materials; sulphur dust was virtually useless for both diseases."

Bulletins and annual reports issued by the Virginia Department of Agriculture and Immigration were rich sources of miscellanous plant pathology. Although it was clear that the Department did not generate most of the information, it passed on much practical, accurate news to its subscribers. Items published in 1916 included, "Corn smut and its control" in which losses of 5-10%, disease cycle, and possible methods of control were discussed. Farmers were comforted by the statement that it is unlikely that smut spores affect livestock (Bul. 111:6-7). Farmers were admonished to cut down cedar trees that bear rust galls and use the trees for fence posts (Bul. 112:8). Watermelon anthracnose was described and called a troublesome disease preventable by spraying. Host range included watermelon, cucumber, canteloupe, and squashes. Implementation of an accompanying Bordeaux mixture spray schedule was said to prevent the disease (Bul. 113:6-7).

An unusual notice was published warning that seed infestations may be a means of spreading stripe rust, *Puccinia glumarum*, into eastern wheat regions. Growers were warned not to purchase seed produced west of the 104th meridian (Bul. 113:14). Introduction of stripe rust is highly unlikely because hot growing seasons are unfavorable to this cool climate disease. Although the warning was issued over 75 years ago, stripe rust is still unknown east of the Mississippi River.

In an article entitled "Tobacco Growing" there was a section on "Diseases of the growing plants" (Va. Dept. Agri. & Imm. Ann. Rept. 1916, p. 92). The entire paragraph is quoted here:

"There is probably no crop produced of the same magnitude that suffers so little from disease as tobacco, and many of these diseases may be avoided by proper care in the selection of the soils, in the judicious application of manure and in the cultivation of the crop. The greatest number of diseases to which the crop is liable come from a want of drainage in the soil. These diseases rarely affect more than a fraction of one percent of the plants in a field." Perhaps this explains why there were so few references to tobacco in Virginia plant pathology literature.

In another brief item, "Blight," the twig blight phase of fire blight is discussed (Va.

Dept. Agri. & Imm. Ann. Rept. 1916, p. 108). The article ends with:

"To sum up: Cut out blighted wood early in the spring and burn. Treat tools and wounds with disinfectant. Watch for appearance of blighted limbs in pear and quince as growth begins and throughout season. Remove promptly and burn. As buds are swelling, spray thoroughly apple, pear, and quince with strong Bordeaux mixture."

G. C. Starcher of the Va. A.E.S. Horticulture faculty published in the Virginia Department of Agriculture Report an article entitled "Peach Growing in Virginia" (Va. Dept. Agri. & Imm. Ann. Rept. 1916, pp. 42-49); he described yellows, rosette, little peach, curl, scab, and brown rot. He emphasized lime-sulphur sprays which would control curl, scab, brown rot, curculio, and scale insects.

J. A. McClintock published "Crown rot of clovers, a serious disease caused by *Sclerotinia trifoliorum*" (Va. Dept. Agric. & Imm. Ann. Rept. 1916, pp. 50-52), in which he described finding a rot on clover in Hampton (City) and Accomack Co. in early April and May 1916, respectively. He described the disease cycle, listed clovers and alfalfa as the hosts, advised farmers not to move soil as was the practice to assure that *Rhizobium* would be present, prescribed a two-year rotation between winter legumes and suggested that cowpeas or any other warm season legume be planted in the rotation. The disease described in Delaware in 1890, had been long-known in the eastern states. Fromme reported its occurrence in Nottoway Co. (Va. A.E.S. Ann. Rept. 1915-1916).

Powdery scab caused by *Spongospora subterranea* had been found in eastern Canada and Maine in 1913. During the period 1913 to 1915, it was reported from New York and Florida and some western states (Walker, J. C. Plant Pathology, McGraw-Hill Book Co. 1950, p. 164); thus, it was a threat to the Virginia potato industry. McClintock discussed aspects of the disease in an article titled "Is powdery scab of irish potatoes a disease to be feared in Virginia?" (Va. Dept. Agri. & Imm. Ann. Rept. 1916, pp. 133-134), also Phytopathology 7:72, abstr.). A federal quarantine had been enacted against Maine on August 1, 1914, for control of powdery scab. In the spring of 1915, federal workers planted powdery scab infected potatoes at the Va. T.E.S.; the subsequent crop was free of scab. Thereafter, the quarantine against powdery scab was discontinued in late 1915. Again, to reaffirm the decision, scabby tubers from Maine were planted at Norfolk and at Tasley on Eastern Shore without treating the seed-pieces. No scabby potatoes were produced and it was concluded that the pathogen was not adapted to Virginia.

McClintock's first Experiment Station bulletin was a description of "A Disease of Coldframe Parsley (Caused by *Sclerotinia libertiana*)," (Va. Truck Expt. Sta. Bul. 18, 1916). Parsley growers in the area reported losses and McClintock made a quick survey-study and found the fungus causing the problems. He suggested formaldehyde treatment or steaming of the soil to prevent its occurrence. Diseased plants were to be removed and the infested area should be treated with formaldehyde. During the growing season, the frames should be ventilated as frequently as possible. Growers should be careful not to include diseased plants in boxes to be shipped.

Next, McClintock prepared a bulletin, "Sclerotinia Blight, A Serious Disease of Snap Beans Caused by *Sclerotinia libertiana*, Fckl." (Va. T.E.S. Bul. 20, 1916). In November 1915, a farmer in the Norfolk area complained about a snap bean disease that had cost him about one-third of his crop or a loss of about $2,250. McClintock ascribed the disease to *Sclerotinia libertiana* which also caused lettuce drop in the Tidewater, Virginia area. He conducted greenhouse experiments with the fungus in the winter of 1915-1916 and in 1916 field experiments. He found green-podded varieties to be susceptible and wax varieties to be resistant. McClintock recommended that bean fields be burned after harvest, then deep-plowed, and that crops not usually attacked by the fungus be grown; he listed corn, Irish potatoes, sweet potatoes, kale, and spinach. The growers were advised not to grow cucumbers, lettuce, beans, and eggplant on infested land for "several" years. McClintock published a technical report, "*Sclerotinia libertiana* on snap beans" (Phytopathology 6:437-441, 1916) and followed this with an abstract of a paper given at the 1917 annual meeting "Economic hosts of *Sclerotinia libertiana* in Tidewater Virginia" (Phytopathology 7:60). He listed as hosts snap bean, tomato, parsley, cauliflower, lettuce, and eggplant.

Based on some observations made in 1915 and 1916, McClintock raised the question, "Is cucumber mosaic carried by seed?" (Science (N.S.) 44:786-787, 1916). He observed that growers planting seed from a common source had considerable mosaic. He was able in two years to show that seedlings protected from outside sources of mosaic developed the disease and suggested that virus-free seed were essential if growers were to avoid the disease.

The Southern Planter for 1916 had numerous articles and items on plant diseases, some contributed by out of state scientists. In January, James Johnson of the Wisconsin Agricultural Experiment Station, for many years Wisconsin's tobacco pathologist, contributed an article "How to steam tobacco beds" (Sou. Planter 77:11). He described the inverted pan method, construction of the pan, and general use of steamed tobacco seed beds. The editors added that steaming is an alternative to burning as practiced in Virginia.

In the same issue, W. J. Schoene, Acting Director of the Virginia Agricultural Experiment Station, published a note, "Campaign to combat fire blight," in which he reported on a gathering of experiment station representatives at the Bureau of Plant Industry in an effort to formulate a practical plan for eradicating fire blight. It was proposed that information on the nature of the disease and methods available be distributed on posters for display at post offices and stores everywhere in apple growing country. The Va. A.E.S. had started a number of blight eradication experiments around the state. "The Agricultural College and the Experiment Station stand ready to assist growers and provide information. The success of the campaign will depend largely upon what each grower does in his own community" (Sou. Planter 77:15-16).

G. S. Ralston, Field Horticulturist at V.P.I. provided a note, "Need of better orchard sanitation," in which he proclaimed sanitary measures to be an effective supplement to spraying. The removal of mummies, decayed fruit, and dead or cankered wood is essential to the control of bitter rot. "This is one of the most effective and least expensive forms of insurance against disease that the grower can have" (Sou. Planter 77:54). In February (Sou. Planter 77:75), the annual spray calendar was printed without changes from 1915, but with the note appended that all materials prescribed were commercially available.

In the Truck, Garden, and Orchard section of the March issue, an anonymous article, "Sweet potato diseases," was published in which the writer gave credit to T. C. Johnson, Director of the Virginia Truck Experiment Station, for advice in preparing the article. The author described stem rot, black rot, foot rot, and scurf and addressed the practices useful in controlling sweet potato diseases. These included detailed instructions for preparing uninfested seed beds, selection of disease-free seed roots, disinfection of the roots with corrosive sublinate, and crop rotations essential to reducing pathogen inoculum in fields.

In addition, there were brief articles on "Potato blight," by F. C. Werkenthin of New Mexico State College (Sou. Planter 77:75); "Summer spraying for apples and peaches," by C. J. Hayden of North Carolina Agricultural Experiment Station (pp. 308- 309); "Bordeaux and the bluestone question," by G. C. Starcher of the V.P.I. Horticulture Department (pp. 357-358); and "Treat wheat for smut," by the editors (pp. 537-538). In the Inquirer's Column, growers from various counties showed a diversity of concerns. One from Buckingham Co. asked about controlling wheat smut (pp. 480- 481), one from Loudon Co. had cabbage losses apparently caused by Fusarium wilt (p. 530), one from Roanoke Co. was wary of northern seed potatoes because of black stem (= black leg) and was advised to use fall-grown seed of local origin (p. 580), and a Warren Co. grower wanted relief from bean rust and anthracnose for which Fromme described resistant varieties, Bordeaux sprays, crop sanitation, and use of disease-free seeds, (p. 638).

In the Tenth Report of the State Entomologist and Plant Pathologist of Virginia, 1914-1915 (published in 1916), W. J. Schoene summarized the cedar rust law and its impact (p. 6).:

"The fruit growers, realizing that the future profits of their apple orchards were imperiled, succeeded in having a law enacted declaring the cedar a nuisance."

"The cedar rust law, which is given on page 19 of this report, is a local option measure. It presupposes, first, that the cedar has no real value, and, second, that the cedars are to be removed by the fruit growers without using the law, whenever possible. The law is intended only as an emergency measure, to be used when other means have failed."

"A few person, however, have refused" (to allow cedars cut from their property) "and, as a last resort, the law had to be called into use. The first case was tried in Frederick County. This resulted in a complete victory for the fruit growers." The entire court case of the Virginia State Entomologist vs. The Glass Family of Winchester is recounted under "Court Decision Upholding the Cedar Rust Law." The case was heard in the Frederick County Circuit Court beginning February 2, 1915, Judge E. S. Turner presiding (pp. 16-29).

Schoene also reported on the "Control of the Chestnut Bark Disease" (p. 7), summarized as follows:

In 1912, an appropriation was made to the Virginia Department of Agriculture and Immigration by the state legislature, an amount which was doubled in a federal appropriation, for the purpose of checking the spread of chestnut blight. Cooperation was established between the Division of Forest Pathology of the USDA and the State of Virginia and a survey was conducted for 3 years. Chestnut blight was found throughout northern Virginia and as far south as Bedford City. By end of 1915

Congress stopped the appropriation and the state gave up the effort as hopeless. Chestnut blight could not be thwarted.

In 1917, there would be several significant events in Virginia plant pathology, among which was the resignation of H. E. Thomas on February 28, after only 8 months at V.P.I. Although Thomas had graduated from V.P.I. in 1915 and had earned an M.S. degree there in June 1916, he participated actively in the research project work of the Department of Plant Pathology and Bacteriology and was co-author of six publications and author of one other. The most important of Thomas' papers were "Black root rot of the apple" (Fromme and Thomas, Jour. Agri. Res. 10:163-174, 1917) and "Spraying and Dusting Tomatoes" (Fromme and Thomas, Va. Agri. Expt. Sta. Bul. 213, 1916). Thus, he was a valuable asset to the Department. He later earned a Ph.D. from Columbia University and became Professor of Plant Pathology in the California Extension Service. Thomas was succeeded by Samuel A. Wingard on July 1, 1917. In that position, stability was achieved for Wingard would remain on the faculty until he reached retirement age in 1964, 47 1/3 years later.

Fromme devoted much of his early 1917 research time to the preparation of publications on black root rot of apple. In preliminary reports, Fromme and Thomas gave evidence that a *Xylaria* sp. was the probable cause (Science (N.S.) 45:93, 1917; Phytopathology (abstr.) 7:77, 1917), and in a detailed account (Jour. Agri. Res. 10:163-174, 1917), they attributed the disease to *X. hypoxylon*. Thus, they refuted the evidence by Crabill (Phytopathology 6:159-161, 1916) that *Trichoderma koningii* was the causal agent.

Another significant event in 1917, was the discovery of the wheat gall nematode at Dovesville in Rockingham Co. Fromme described the situation, "The correspondent stated that he had sown the same seed wheat for about ten years. At first only an occasional head was affected, but within the last six years or so the infection has become so general that he had searched for a remedy. Thinking it a form of smut, he tried both the formaldehyde and hot water treamtents, but with no noticeable success. He estimates the loss this year at about 25 percent on ten acres."

"The presence of this disease in the state had not been recognized prior to the fall of 1917, at which time a specimen of wheat containing nematode galls was sent to the Experiment Station from Rockingham County" (Fromme, Va. Agri. Expt. Sta. Bul. 222, 1919). This led to a comprehensive survey for infested areas wherein the disease was found in 33 counties. A quarantine against Virginia wheat was threatened but not enacted. The diseased received special attention from Bureau of Plant Industry scientists (L. P. Byars, U.S.D.A. Bul. 842, 1920; R. W. Leukel, Jour. Agri. Res. 27:925- 956, 1924). Shakespeare, in 1594, had written in "Love's Labour's Lost," act IV, scene 3, "Sowed cockle, reap'd no corn." In 1743, a Catholic clergyman, J. T. Needham found nematodes in the cockles. Thus, the cockles mentioned by Shakespeare had come bearing nematodes to Virginia. The growers' complaint suggested the gall nematode had been present in Virginia by 1911.

A new disease of tobacco, blackfire, was discovered, "through complaints from tobacco growers in Halifax County in 1917, the disease having appeared there in a very destructive form.... Little information as to the history of blackfire prior to 1917 is available but there seems to be little doubt that it has existed in Virginia for a number of years.... Another closely related but entirely distinct disease was first described as occurring in North Carolina in 1917 under the name of wildfire. This disease also occurs to a limited extent in Virginia" (Fromme and Wingard, Va. Agri. Expt. Sta. Bul. 228, 1922. (Va. Agri. Expt. Sta. Tech. Bul. 25, 1922) The disease caused extensive losses to growers in the Halifax Co. area in 1917. Fromme, T. J. Murray, and others spent the next three years developing a technical description of the bacterium causing blackfire and methods for controlling it. It seems to be a strange coincidence that both diseases appeared in 1917. Distinction between the wildfire and blackfire bacteria in culture is very difficult, therefore, one might have arisen as a mutant of the other. The blackfire bacterium lacks the ability to produce the halo-inducing toxin.

In 1917, Drinkard listed the project "The relation between parasitic fungi and their host plants" (Adams Fund) and stated that "This is largely a study of the resistance of varieties of beans to the bean rust fungus, *Uromyces appendiculatus*." Fromme and Wingard were the principal investigators and they were the first to study resistance to rust in beans. Fromme, having been trained to study rusts, had initiated the project in 1915 and Wingard would continue this project for more than 40 years. The first publication from this project would appear in 1918.

During 1917, Fromme reported for the first time that *Physoderma zeae-maydis* occurred on corn in eastern Virginia (Plant Dis. Bul. 2:215, 1918). Other diseases reported as causing losses in 1917 were oat smuts, 8%; oat rusts, 5% (P.D.B. 2:7) wheat bunt, 5%; loose smut, 5%; rusts 1.5% (P.D.B. 2:3); corn smut 2% (P.D.B. 2:9); potato late blight and Fusarium wilt, 0.9% (P.D.B. 2:11); sweet potato stem and black rots, 7% and storage rots, 15% (P.D.B. 2:14); peach brown rot, 15%, leaf curl, 5% (P.D.B. 2:17); corn rust was first reported in 1917 doing only local damage (P.D.B. 2:220); bean rust, very severe in 1917 (P.D.B. 2:261); tomato Septoria spot, very severe in 1917 (P.D.B. 2:267). Tobacco ringspot was first found in 1917, but a study of it was deferred into the late 1920's (Phytopathology 17:321-328, 1927).

The Virginia Department of Agriculture and Immigration published reminders to its bulletin subscribers to spray tomatoes to control fruit rots (Bul. 117:5, 1917); control smuts in wheat by treating seed with formaldehyde and to use seed produced in smut- free areas (Bul. 119:3-5, 1917); and how to make self-boiled lime sulphur for fruit disease control (Bul. 120:18, 1917).

The Southern Planter had similar items; the annual spray calendar appeared in February (vol. 78:71); farmers were reminded to control wheat smuts and that the formaldehyde treatment will work 100% of the time except for a few locations where the soil is polluted with spores (vol. 78:482). (Note: Could this indicate dwarf bunt might be present in the East, or was this misinformation gleaned from experiences of western farmers who had the as yet unrecognized dwarf bunt?) The Enquirer's Column featured a question from New Kent Co. on the control of potato scab with a response to soak seed potatoes for 2 hours in a solution of one-half pint of formalin in 15 gallons of water; from Warren Co. one wished to know why cabbage wilts and dies early in the season. Fromme replied that it appeared from his examination that it was black rot and he recommended that the seed be soaked in 1;1000 mercuric chloride solution for 10 minutes then be dried thoroughly. He also recommended crop residue destruction and a rotation of 3 years or more.

From the V.P.I. Agronomy Department two bulletins were published featuring sections on disease control. In "Wheat Culture" by T. B. Hutcheson and T. K. Wolfe (Va. Agri. Expt. Sta. Bul. 216, 1917), the authors illustrated smutted wheat heads and described procedures for control of both loose smut and stinking smut (pp. 8-10). In "Potato Culture" (Ibid 217, 1917), the same authors described potato scab, early blight and late blight and their control measures. The procedures described were well established.

From the Truck Station came several publications by McClintock, who began the year with a bulletin on "Sweet Potato Diseases" (Va. Truck Expt. Sta. Bul. 22, 1917). Nine diseases were described and experiments on control of foot-rot were discussed. The diseases and their pathogens were white rust, *Albugo ipomoeae-panduranae*; leaf spot, *Septoria bataticola*; leaf spot, *Phyllosticta batatas*; soft-rot ring-rot, *Rhizopus nigricans*; soil pox, cause unknown, later shown to be a *Streptomyces* sp.; scurf, *Monilochaetes infuscans*; dry rot, *Diaporthe batatatis*; black rot, *Sphaeronema fimbriata*; foot-rot, *Plenodomus destruens*; and stem-rot, *Fusarium hyperoxysporum* and *F. batatatis*. The foregoing are listed merely to document their presence in Virginia by 1917.

McClintock gave three papers at the 1916 annual meeting of the American Phytopathological Society. The abstracts were published in the January 1917, Phytopathology. The papers "Economic hosts of *Sclerotinia libertiana* in Tidewater Virginia" (7:60), "Lima bean mosaic" (7:60), "Will *Spongospora subterranea* prove serious in Virginia?" (7:72); all have been mentioned previously. He also published a note in *Science* (N.S.) 45:47-48, (1917) entitled "Peanut mosaic" in which he described observing on September 28, 1915, a single peanut plant bearing a single mottled shoot. He established the plant in the greenhouse and attempted by various methods to transmit a virus from the symptomatic shoot. He could not infect other peanut or pea plants, seeds from the symptomatic plant produced only healthy plants, and the plant matured and died before additional shoots developed symptoms. Since 1961, two peanut virus diseases have been found widely distributed on peanut in Virginia, namely, peanut mottle and peanut stunt. McClintock was a competent virus worker for his time. Had he found peanut mottle?

Finally, McClintock published his experiences with "Peanut-wilt caused by *Sclerotium rolfsii*" (Jour. Agri. Res. 8:441-448 + 2 pl, 1917). He first observed the disease at the Truck Station in 1915. He described the disease, concluded it survived in soil three years or more, and found 'Virginia Runner' to be "practically immune." Apparently, McClintock's paper was the first on the disease as a stem rotter, and certainly was the first indicating some peanut varieties were resistant to *S. rolfsii* (Note: The Compendium of Peanut Diseases, A.P.S. 1914, makes no mention of resistant cultivars as a means of controlling the disease).

In 1917, the federal quarantine against *Ribes* spp. and movement of five- needled pines was extended to include Virginia. This quarantine was implemented to protect commercial stands of pine from white pine blister rust, *Cronartium ribicola*. A survey for the rust was conducted in 1917 under the leadership of A. B. Moore. From May 15 to September 1, pine stands were inspected and in August a search for *Ribes* spp. revealed the presence of wild plants at Luray, Hot Springs, Basic (?), and Mountain Lake. No rust was found (11th Rept. State Entomol. and Pl. Pathol. of Va., 1916-1917:11-12, 1918).

By 1917, the Cooperative Extension Service was functioning fully in Virginia. Most county offices were staffed and there were some specialists on the faculty at V.P.I. However, there was no extension plant pathologist. Fromme and Wingard responded to inquiries about plant diseases.

The United States had declared war on Germany on April 6, 1917, and on April 16, President Wilson in a proclamation had appealed to southern farmers to increase production of food crops and cotton (Sou. Planter 78:289). There was nothing in plant pathology literature to indicate there was a crisis until the report of the 1917 annual meeting of the American Phytopathological Society appeared (Phytopathology 8:178-186, 1918). A resolution was adopted at the December 28, 1917-January 1, 1918 meeting to the effect that botanists be mobilized for war work and to the effect that those who had already been called to military duty be detailed to special agricultural duty and botanical work essential to prosecution of the war. The same resolution was adopted by the Botanical Society of America and the American Association for the Advancement of Science. The pathologists formed a War Emergency Board to cooperate with corresponding committees of other societies. Fromme would serve as secretary of the Central East region of the Board (Phytopathology 8:242-243, 1918). During 1918, J. A. McClintock resigned from the staff at the Virginia Truck Experiment Station on January 31; his position remained vacant into 1919. Arthur Ballard Massey was appointed Associate Plant Pathologist and Bacteriologist for the Virginia Agricultural Experiment Station on June 1. He was the son of W. F. Massey of Raleigh, N.C. who wrote numerous popular articles on agriculture for the *Southern Planter*. Ralph C. Thomas continued his graduate work in plant pathology until February 28, 1918, when he enlisted in the Medical Corps of the U.S. Army. Although he had been a cadet at V.P.I., there is no report of him having been a commissioned officer in the army.

Fromme began a 3-year term in January 1918, as associate editor of Phytopathology; his editorship was the first service rendered to the American Phytopathological Society by a Virginian.

As noted previously Fromme and Wingard were investigating the rust disease of bean and late in 1918, they published their first detailed account of their studies (Bean Rust: Its Control Through Use of Resistant Varieties, Va. Agri. Expt. Bul. 220, 1918). According to the authors, "Bean rust is one of the most destructive of the several common diseases of beans in Virginia .... Losses have sometimes amounted to the complete destruction of the crop." Farm and garden "production has increased considerably during the past two years as a result of the high prices and increased demand incident to the war, and the increased importance of home food production." The experiments consisted of testing of most available bean varieties for resistance to rust. Four categories of response were used to describe varieties, namely, rust-free, few or no pustules; rust-proof, more pustules but little or no injury; rust-enduring, moderate infection and some defoliation; and rust-susceptible, heavy rust infection, severe leaf fall, poor yield. Production and degree of resistance were highly positively correlated. Lists of dry-shell varieties, pole and bush wax and green beans were given in each response category. The four categories differed slightly from those described at the Pittsburgh annual meeting of the American Phytopathological Society. There, Fromme described the resistance responses as "A decrease in the number of infections, the production of flecks indicating the early death of the mycelium and invaded tissue, a decrease in the size and spore producing capacity of the sorus, and the early production of teliospores." The flecking was called hypersensitivity in studies of other rusts but this term was not applied by Fromme to bean-rust reactions (Phytopathology 8:76 (abstr.), 1918).

During studies on the epidemiology of the cedar apple rust, an automatic spore trap was invented whereby spore deposition over a 12-hour period could be monitored. A disk attached to the hour hand movement supported a petri dish poured with agar which was divided equally into 12 pre-shaped segments. The disk rotated under another disk with a pie-shaped opening equalling one-twelveth of the area. When exposed, time of spore deposition could be approximated (Phytopathology 8:242-244, 1918).

In 1918, pathologists organized their War Emergency Board into regions. On February 12, 1918, The War Emergency Conference of Plant Pathologists of the Central East, met at Washington, D.C.; Fromme was secretary. Cooperation between states, and with federal workers was emphasized. Research and Extension on diseases of crops of vital importance in food production were emphasized. A united assault would be made upon diseases of potatoes, sweet potatoes, tomatoes, cereals, and fruits. A manpower census was also to be conducted (Phytopathology 8:242-243, 1918).

The Great Plains Plant Pathologists, among other things, launched their barberry eradication campaign. All the regional War Board Conferences joined in aiding agricultural specialists to obtain a deferred classification. Procedures to be followed when local draft boards would not grant deferment were published (Phytopathology 8:374-375, 1918).

During the War, pathologists were urged to report their observations on the incidence and severity of plant disease to the USDA Bureau of Plant Industry, Plant Disease Survey. In volume 2 of the *Plant Disease Bulletin* for 1918, reports on the situation in Virginia were made by Fromme unless otherwise noted.

No. 6, July 15 - Fire blight, "severe locally but probably not so general over state as commonly found" (p. 83). Apple scab, "unusually prevalent and the most destructive disease to date" (p. 84). Cedar-apple rust, "destructive locally" (p. 84). Bean anthracnose, "locally more destructive than last year ... first reported June 28, ... excessive rainfall has contributed to the infection" (p. 86). Bean bacterial blight, "not so prevalent as anthracnose, but rather common. First appearance June 20" (p. 87). Potato scab on a Virginia shipment according to a Boston inspector, 15% infection in 200 barrels, some as high as 50% (p. 92). Potato rot, according to a Pittsburgh inspector, 5 carloads, as high as 35% decay (p. 94). Wheat bunt, "Not so widespread as loose smut, ... as much as 25% in some fields, will average 3% in state" (p. 96). Wheat loose smut "Fields without a trace hard to find, 2 to 3% is the common amount found but occasionally 10 to 15%. The amount for the state may average 15%" (p. 96). (Note: the amount probably should have been 1.5%; in any case, not 15%). Wheat scab, "Unusually severe in southwestern Virginia where excessive rainfall occurred during heading. First reported June 15 from Pulaski" (p. 97). Wheat stem rust, "Sporadic" (p. 98). Oats smut, "... Not severe, ... 3 to 4% on an average" (p. 105). Oats crown rust, "Disease common" (p. 105). Peach leaf curl, "Very severe in southwestern Virginia ... to the extent of about 95% of the leaves" (p. 106). Peach brown rot, "Heavy infections in Petersburg and Appomattox section" (p. 107). Rye ergot, "Ergot rare" (p. 111). Rye leaf rust, "Common" (p. 112). Rye anthracnose, "Common and causing the injury of possibly 3 to 5% (p. 112). Tomato leaf spot, just getting started (p. 114). Watermelon stem end rot and anthracnose, 40 and 100%, respectively, of melons in one carload at New York (Inspector, p. 136). Cabbage black leg only in home gardens at Blacksburg (p. 142). Cabbage black rot, "Reported from Henrico County about June 15" (p. 142). Cabbage yellows, "Reported from Mecklenburg and Southampton Counties ... June 10" (p. 143). Various potato rots were found in potato shipments from Virginia received at northern markets resulting in 5% or more loss (pp. 155-157). Sweet potato stem rot and wilt, "Found in abundance on eastern shore ... also from King George County" (p. 159). Sweet potato foot rot "Found in abundance on eastern shore" (p. 159). Sweet potato black rot, "Found in abundance in the eastern shore and also reported from Chesterfield County" (p. 160). White rust, "Reported from Henrico County" (p. 160). Tomato Fusarium wilt, "Reported from four counties with losses varying between 5 and 20%" (p. 162). Septoria leaf spot "As usual, the most prevalent and generally destructive tomato disease" (p. 163). Tomato bacterial wilt, "Caused a loss of 30% on three acres in Roanoke County" (p. 164). Tomato late blight "Is reported from Dickenson County only" (p. 165). Watermelon Fusarium wilt "Reported from Franklin and Charlotte Counties" (p. 167). Cotton wilt, "Reported from Mecklenburg County" (p. 179). Cucumber bacterial wilt, "First reported from Manassas July 8. Seems to be generally prevalent throughout the state and to be the cause of the greatest losses to cucumbers" (p. 181). Corn bacterial wilt "Prevalent in gardens in Blacksburg. As high as 15% infection observed. One report, 1915," was the only previous report (p. 214). Corn smut, "Common but rarely more than 1% (p. 217). Corn leaf rust, "Common but comes late in season and does little or no damage." Reported previously only in 1917 (p. 220).

H. S. Stahl, V.P.I. Biology Department, was appointed by the Plant Disease Survey to make a special survey of root and stalk rots of corn in several midwestern states and Virginia. Most of his survey in Virginia was in counties west of the Blue Ridge Mountains and northeast of Montgomery county. He estimated 10% of the plants were symptomatic, having fallen stalks with rotted roots (p. 223) (Stahl was a plant physiologist).

Continuing the diseases reported by Fromme: Apple bitter rot, "Not nearly so destructive as in previous years" (p. 227). Apple blotch, "Scattered over state on early apples and Ben Davis" (p. 227). Apple black rot, "Perhaps the most serious disease this season ... Heavy defoliation has resulted in some orchards by the middle of July" (p. 228). Apple scab, "Unusually severe in southwestern Virginia" but not elsewhere (p. 228). Apple blister canker, "Becoming more prevalent ... in orchards of ten years or older" (p. 228). Cedar apple rust, "Common throughout the Valley and southwestern Virginia." (p. 228). Fire blight, "Very slight" (p. 229). Apple black rot, "Caused greater loss of trees than any other agency, with mice injury as a close second" (p. 229). Market inspections of carloads of cabbage and onion at various destinations had 20 and 6 to 10% loss, respectively (pp. 231, 233). Peanut stem rot or wilt, "has been reported from several places ... a *Fusarium* is suspected (p. 235). Market inspectors at Pittsburgh reported up to 20% bacterial decay in some carloads of potatoes from Virginia (p. 237). Potato late blight occurred only in "Wise and Dickenson counties (SW) in home gardens" (p. 236). Bean anthracnose, "Locally more destructive than in 1917. Reported from Bland, Montgomery, and Nelson Counties. A 10% loss" (p. 255). Bean bacterial blight, "Rather common. Not so prevalent as anthracnose. 5% loss." (p. 238). Bean rust, "General and very severe. 100% of crop injured with a loss of 10% ... 1917 very severe" (p. 261). Tomato Septoria leaf spot, "General and very severe. 25% estimated loss and 85% plus of crop injured" (p. 267). Tomato early blight, "More than usual" (p. 269). Bacterial wilt

"Local, causing a 10% loss (p. 271). Tomato Fusarium wilt, "General and severe. Epidemic in Roanoke and Henrico Counties" (p. 272).

The foregoing list may seem a bit facetious but it gives a general picture of the plant disease situation in Virginia during World War I. Some noteworthy absences are Septoria glume blotch of wheat, Helminthosporium diseases of corn and small grains, powdery mildew of small grains, tobacco and hay crop diseases, and ear rots of corn. These diseases were not only absent from Virginia reports, they were absent from other state reports also. Why were they not listed? All must have been known.

The first Experiment Station publication to mention a peanut disease appeared in 1918. E. T. Batten, Superintendant of the Holland, Nansemond Co. Station prepared "Peanut Culture" (Va. Agri. Expt. Sta. Bul. 218, 1918), in which he stated "The peanut crop is remarkably free from disease. One of the most common diseases is the leaf spot (*Cercospora personata*)... The disease usually attacks the plant so late in the season that it does not interfere seriously with the yield ... The disease ... is most probably spread by seed." No control was known except crop rotation (p. 16). Eventually, control of peanut leaf spot would become a major effort at the Holland Station.

Early in 1918, W. J. Schoene, State Entomologist and Plant Pathologist of Virginia, in the 11th Report, 1916-1917, published "Results of the Cedar Rust Law in Virginia" (p. 8-10). He reviewed the effects of cedar eradication on apple, costs of rust to growers, tax on orchardists to support cedar eradication, opposition to the law and resulting court action, and a review of cedar rust work in other states. Schoene had given the same report at the December 1917 meeting of the State Horticultural Society (Proc. 22nd Ann. Convention Va. State Hort. Soc., pp. 130-134. Va. Fruit 6:130-134, 1918).

Fromme also gave a review of the cedar rust situation at the 1917 meeting of the Virginia State Horticultural Society (Ann. Report of the Society 23:106-114, 1918, Va. Fruit 7:106-114). In "Cedar Rust," Fromme emphasized the commonality of cedars by citing ten Virginia post offices beginning with "cedar", Cedar Bluff, Cedarville, etc. The rust on cedar was found by Schweinitz in 1825 in North Carolina. Later he found the same fungus on wild crab apple but did not recognize that the fungi on the two unrelated hosts were actually one and the same. Cedar rust did not come into its own until the commercial apple orchards were developed. What really brought the rust to the forefront was the extensive planting of the very susceptible varieties 'York Imperial' and 'Ben Davis'. The York loses its foliage to rust while the Ben Davis fruit are spotted reducing them from grade no. 1 to grade no. 2. Outbreaks of rust in 1910 and 1912 precipitated passge of the Cedar Rust Law on March 4, 1914. Fromme described the benefits of cedar eradication on Frederick County and adjoining Berkeley County, W.Va., and the destruction yet incurred by rust in Augusta, Rockingham and Shenandoah counties. He said, "Cedar eradication is the cheapest form of orchard insurance you can buy. The cost on the average is less than the cost of a single spray application." He provided figures to prove the above statement. Near the conclusion of his presentation, he stated that, "I have admitted no argument as to whether cedar trees are necessary for cedar rust on apple. There is none. If there were no cedar trees there would be no apple rust." As it is now "There are thousands of trees waiting for the axe." Fromme's address was sprinkled with subtle humor.

At the same December 1918 meeting of the Horticultural Society, B. R. Leach and J. W. Roberts of the U.S.D.A. Bureau of Plant Industry spoke on "Dusting vs. spraying apples in northern Virginia." (Va. Fruit 7:150-155). Most of the effort was devoted to control of the codling moth but some was devoted to control of apple scab. Dusting proved inadequate for scab, (only 52% apples were scab-free) whereas spraying was economically successful (93% were scab-free). Charles Brooks, also of the U.S.D.A., spoke on "The control of apple scald" (Va. Fruit 7:49-52). He stressed that apples which are fully matured scald less than do under-ripe fruit when placed in storage promptly after harvest under a regime of 40°F for three weeks then at 32° with adequate aeration for the remainder of the storage period.

In the January 1918 *Southern Planter* (vol. 79:9), Fromme diagnosed a field of 1917 corn from Shenandoah County as having had Fusarium root and stalk rot. He recommended that some other crops be grown for three years. In the September and November issues (79:496, 620), two articles were published reporting the discovery of the wheat gall nematode in Virginia. W. F. Massey reviewed U.S.D.A. Circular 114 "A Serious Eelworm Disease of Wheat" by L. P. Byars. Massey discussed the disease cycle, and control measures. Both articles stressed crop rotation, planting nematode-free seed in nematode-free soil, and removing galls by immersing seed in 20% salt solution and skimming off the galls which floated to the surface.

The war ended on November 11, 1918, but there was little in plant pathology literature to indicate that a grave situation had existed. The War Emergency Board evolved into the Advisory Board of American Plant Pathologists at the December 1918 meeting of the American Phytopathological Society (APS). Also at that meeting the Southern Division of APS was formed.

In the Annual Report of the Virginia Department of Agriculture, published as a Year Book, 1917-18, it was stated that "Bordeaux mixture controls pea blight" (p. 49). The article contains recommendations for spraying pea vines. Under "Tomato wilt" (pp. 49-50), the author described the symptoms of Fusarium wilt, how the causal fungus is disseminated, what sanitary measures to practice, and that once the soil became infested with *Fusarium*, only resistant varieties could be grown successfully. A "Leaf spot disease of tobacco" merited considerable discussion (pp. 55-56). Although bacteria were not named as the cause, it is probable that either blackfire or wildfire or both were being discussed. "Apple scald", based on a publication by C. Brooks and J. S. Cooley, was reviewed and measures for controlling it were outlined (pp. 152-153). In a detailed review of U.S.D.A. Farmers' Bulletin 821, "Watermelon Diseases", a key to six diseases was included (pp. 167-174). Those diseases, wilt, root knot, anthracnose, stem-end rot, blossom-end rot, and ground rot, were carefully described and their control measures were outlined. Apparently, the Virginia Department of Agriculture and Immigration reached a number of farmers who depended on this annual publication for a summary of the latest in agriculture. A competent Botanist, G. J. French, selected the material on plant diseases that was published. The war apparently interfered with publication of the 1917 report, and, thus, a 1917-18 "yearbook" was published with a promise of an annual report hereafter.

On December 30, 1918, The American Phytopathological Society was 10 years old and the Southern Division of the Society was organized, probably in the winter of 1918. Thirty years earlier, Alwood had published the first paper from the Virginia

Agricultural Experiment Station related to plant pathology.

Ralph Cleon Thomas received a B.S. degree from V.P.I. in 1917 and immediately became a Student Assistant in the Department of Bacteriology and Plant Pathology. On February 28, 1918, he enlisted in the U.S. Army Medical Corps. He was discharged in May 1919, and received an M.S. degree in Agronomy in July 1919. Thereupon, he was appointed Assistant County Agent in the Virginia Agricultural Extension Service. His primary function was to survey for the wheat gall nematodes. On November 1, he was appointed Assistant Plant Pathologist in the Experiment Station and was assigned to work on diseases of cereals and tobacco.

At the Virginia Truck Experiment Station, Charles T. Gregory was appointed Plant Pathologist on May 15, 1919, but he resigned on May 30 because he could find no place to live. The position of Plant Pathologist remained vacant for another year. Fromme had published a note in 1917 on the occurrence of the wheat gall nematode in Virginia. In 1919, he published "The Nematode Disease of Wheat in Virginia" (Va. Agri. Expt. Sta. Bul. 222, 1919), the first state publication on the subject. Fromme reported that grain losses due to the disease were frequently 25% and in one case 50%. The survey conducted in 1918 revealed the nematode was present in 33 counties, mostly in the Northern Piedmont, the Shenandoah Valley and southwestern counties. It was found in only two Coastal Plains counties, Charles City and King and Queen. As a boy of nine years, I was shown by my cousin who lived in King and Queen Co. "cockles" in fannings from the wheat grown on their farm. Even though they had never seen them, they told me that cockles were full of little worms. Although it was meaningless at the time, it was my introduction to plant pathology. When it was first detected in Virginia in 1917, Fromme stated, "It appears from the evidence at hand that the disease has been present to some extent in a few localities for ten or more years."

Fromme demonstrated that the disease could be controlled by mechanical separation of galls from seed wheat, and by planting clean seed in nematode-free soil. He suggested that infested soil not be sown with wheat for three years and that legumes and corn be grown in the intervening years. (Note: Although galls may be found in wheat screenings at mills in Virginia even in the 1990's, I have not seen symptoms of the nematode disease in the field since 1947).

There was a threat of a quarantine against Virginia, West Virginia, and Georgia on account of the presence of the wheat gall nematode in these states (Sou. Planter 80 (Aug.):523-524, 1919). A hearing was called on July 15, 1919, before the Federal Horticulture Board in Washington, D.C. The Virginia officials participating included Governor Westmoreland Davis (himself a farmer); J. F. Fooshe, State Director of Markets; J. T. Brown, Chairman of the State Crop Pest Commission; W. J. Schoene, State Entomologist and Pathologist; E. M. Hunter, County Agent, Loudoun County; and F. D. Fromme, Plant Pathologist, Virginia Agricultural Experiment Station. The quarantine, if invoked, would prohibit the shipment of wheat, oats, and rye out of Virginia. Farmers having the problem took a double loss; yields were reduced and because millers could not separate galls from wheat they refused to buy "injured" wheat. Because the "Disease has been reported some years ago to exist in several parts of the country, and it is suspected of being present in a number of States where investigation has not been so thorough as in Virginia," no federal action was taken. The presence of tobacco blackfire or angular leaf spot was first detected in

1917 from diseased plants grown in Halifax County. Fromme and bacteriologist T. J. Murray collaborated and discovered that the bacterium causing it had never been described. In a paper, "Angular leafspot of tobacco, an undetermined bacterial disease," they described *Bacterium angulatum*, now known as *Pseudomonas syringae* pv. *angulata*. They also described the disease and illustrated its symptoms (Jour. Agri. Res. 16:219- 233, 1919).

In 1919, there was a national effort to determine the status of barberry bushes in relation to stem rust in the states contiguous with those where the barberry eradication campaign had been implemented. As cooperators, Fromme and A. B. Massey found aecia of *Puccinia graminis* on *Berberis canadensis* in Montgomery County on May 18. This was the first time the cereal stem rust had been found on native barberry in Virginia, probably because no one had looked for it. Later, infected bushes were also found in Pulaski, Smyth, and Wythe Counties. (E. C. Stakman and L. J. Krakover, 1920, *Puccinia graminis* on native *Berberis canadensis*. Phytopathology 10:305-306). Rust spread only slightly from barberry to wheat in Virginia in 1919.

"Greenhouse Tomato Growing in Virginia" was the subject of Virginia Truck Experiment Station Bulletin 26, by H. H. Zimmerley, Horticulturist. There being no pathologist at the station in 1919, Zimmerley described the disease problems to be encountered and prescribed methods for their control. He listed root knot nematodes (*Heterodera radicicola*, now any of several *Meloidogyne* spp.), leaf mold (*Cladosporium fulvum*, now *Fulvia fulvum*), Fusarium wilt (*Fusarium lycopersici*, now *F. oxysporum* f.sp. *lycopersici*), tomato mosaic, and blossom end rot. For root knot, steam sterilization of soil as deeply as possible was deemed necessary, followed by strict sanitary measures. For leaf mold, aeration and low humidity were required; spraying was of dubious value. For wilt, soil sterilization was also necessary. Knowledge about control of mosaic and blossom end rot was limited; healthy tomato plants should be handled before mottled ones and mottled ones should be removed before mosaic spreads throughout the planting. For blossom-end rot, it was thought drought favored it, and that liming abates it.

Fromme and G. S. Ralston, Field Horticulturist, V.P.I., described "Dusting Experiments in Peach and Apple Orchards," conducted in Albermarle and Botetourt Counties during 1919 (Va. Agri. Expt. Sta. Bul. 223, 1919). They found that dusts containing sulphur gave adequate control of peach scab but not of brown rot. Dusts containing Bordeaux mixture gave excellent control of apple blotch and leaf spots. Neither Bordeaux mixture dust nor sulphur dust controlled bitter rot. Data on apple scab were not obtainable.

On the back of Bulletin 223, was printed a "Note to fruit growers concerning cedar rust," stating that, "The losses from Cedar Rust this year (1919) were the greatest known to the history of apple growing in Virginia." They were estimated at one to one and one-half million dollars, a considerable sum in 1919. The note gave a concise review of the Cedar Rust Law and how it should be implemented.

In the *Southern Planter*, Fromme published a two-part article, "How to control tomato wilt and leaf blight" (vol. 80 (April):256-258), in an effort to stimulate interest in controlling these diseases. Fromme pointed out that recently canneries were closed because leaf diseases and wilt reduced tomato crops to unprofitable levels; the 1918 crop was 15% smaller than the 1917 crop. Fromme described wilt, mode of infection, persistence of the fungus in soil, that it is state-wide but most severe in lighter soils; longer rotations help but do not eliminate the fungus; the only sure method of control is to grow resistant varieties. Norton (R) was compared to Brimmer (S) on a farm near Richmond. Brimmer was a total loss; Norton yielded excellently. In 1919, growers provided testimonials that Norton produced crops where other varieties had failed. Limited supplies of seeds were available from the Plant Pathologist at V.P.I. in Blacksburg, Virginia.

In the second part (vol. 80 (May):333-334), Septoria leaf blight was described. Fruit scald was ascribed to loss of foliage due to leaf blight. Yields were reduced as much as 50%. Bordeaux sprays were not very successful, probably due to inadequate spraying or coverage. Fromme thought the addition of a rosin-fish oil soap as a sticker- spreader would improve the efficacy of Bordeaux mixture. The modified Bordeaux tested in 1918 had given a 33% increase in fruit on sprayed plants compared to unsprayed plants. Fromme claimed a net gain of $23/acre when 5 applications were made. The formula recommended was 4:2:50, copper sulphate:lime:water, plus 3 lb. rosin-fish oil soap. Sun scald was eliminated because the canopy was preserved. According to Fromme, if modified Bordeaux sprays were applied to wilt resistant varieties, commercial tomato production, especially for canning, would be sustained.

Several items of anonymous origin concerning plant diseases appeared in the 1919 *Southern Planter*, vol. 80. In January (p. 2), under "Burning plant beds," the writer suggested steaming was a better alternative because it killed weed seeds and fungus spores (as well as nematodes and insects). Readers were referred to U.S.D.A. Farmer's Bulletin 996, "Steam Sterilization of Seed Beds for Tobacco and Other Crops" (1918). In February, the spray calendar for 1919 appeared unchanged from 1918 (p. 77). The article, "Watch for new potato disease" was a warning that potato wart was found in Pennsylvania in 1918. State and federal pathologists were seeking to contain it in the isolated valleys where it was found. (A Federal quarantine (1912) against this disease was already in effect.) The disease was described and areas of infestation were mentioned. It was described as "One of the most dangerous diseases of Irish potatoes." In August (p. 515), farmers were advised to report any suspicious occurrences of wart.

In the October column, Work for the Month, an urging to "Prevent scabby wheat," appeared (p. 626). The writer stated that the eastern U.S. wheat crop had been severely damaged by scab. No satisfactory control was known because the causal fungus has a broad host range. Three recommendations were given; first, plant clean, formaldehyde-treated seed; second, sow wheat on thoroughly plowed land where corn stalks, wheat stubble, and grass straw are entirely covered; third, burn grasses in fence and hedge rows, and in waste places. "Of those fungi known to cause scab in wheat, the most important one attacks corn." The fungus also attacks rye, oats, barley, and many grasses.

The Virginia Department of Agriculture and Immigration in its "Year Book 1919" also advised its constituency of "A new disease of wheat in Virginia" (pp. 117-120), in an article by G. J. French, Botanist in Charge. French reviewed the wheat nematode gall situation based on information provided by Fromme or gleaned from several U.S.D.A. publications on the subjects. He referred to USDA Bulletin 734, "Nematode Galls as a Factor in the Marketing and Milling of Wheat" which emphasized the need to control the nematode gall disease in order to prevent discrimination at the wheat markets and to prevent further widespread dissemination of the disease.

Under the title, "New and revised methods of seed treatment for stinking smut of wheat and oat smut," French reviewed a bulletin issued by the Michigan Agricultural Experiment Station and written by G. H. Coons (pp. 121-124). The new method involved spraying full strength commercial formaldehyde (= 40% solution), over the grain, covering for 4 hours then spreading to dry and plant as soon as possible. Other items included in the 1919 report were a revised fruit spray calendar (pp. 50-51), a table of "Plant Disease and Remedies" which covered vegetable diseases, and some advice by G. C. Starcher, V.P.I. Horticulturist titled, "Peach growing in Virginia," in which growers were reminded how to control yellows, rosette, little peach, leaf curl, scab, and brown rot.

In the 1919 *Plant Disease Bulletin* (vol. 2) issued by The Plant Disease Survey, several diseases were cited by Fromme as occurring in epidemic proportions. These included apple scab, fire blight, black rot, and cedar rust; wheat scab, leaf rust and Septoria glume blotch; tomato late blight (almost a total loss); rye stem smut and anthracnose; peach leaf curl, brown rot, and scab. Several other diseases were cited as "Common, not serious" or "No damage or losses reported." The *Plant Disease Bulletin*, later The *Plant Disease Reporter* was for many years a log of the incidence of plant diseases. Most of the diseases listed for 1918 and 1919 were listed in the years thereafter. Hereafter, only those of extreme importance or which appear to be new will be mentioned.

During 1920, James F. Eheart was appointed Assistant Plant Pathologist in the Agricultural Experiment Station on March 1, and R. C. Thomas was transferred to the Extension Division on November 1. Thus, Thomas became the first full-time Extension Plant Pathologist in Virginia. At the Truck Station, Fred W. Geise joined the staff on August 16, as Associate Plant Pathologist. He held a B.S. degree from Nebraska. The first Extension Service publication on a plant disease was issued in 1920. This publication, co-authored by R. E. Marshall, Extension Horticulturist, and F. D. Fromme, was devoted to cedar-apple rust, a disease that had received considerable attention in Virginia (Red Cedar Trees and Cedar Rust. Va. Agri. Ext. Ser. Bul. 39:1-8, 1920). A survey was conducted at the request of growers to establish whether cedar removal benefitted apple production. Data presented showed that profit was directly correlated with the distance of cedars from orchards.

Additional notice of the importance of plant diseases appeared in Extension Bulletin 62, June 1920, "The Production of Bright Tobacco," by J. C. Hart, Extension Agronomist. There was a section prepared by Fromme entitled, "Wildfire and angular leaf spot" (pp. 25-31). The disease was described and illustrated and sources of infection were identified. For control, Fromme emphasized disease-free seed from a disease-free crop, seed treatment with formaldehyde, and clean covers.

The Extension Division issued several lesson books on crop and livestock production; one was, "Twenty Lessons on Irish and Sweet Potato Production", June, 1920, (not numbered) by R. E. Marshall, E. C. Magill, and C. Woolsey of the Horticulture Department. Lesson 9 covered, "Diseases of the Irish potato and their control," (pp. 26-29). It summarized the nature of diseases; causes; spread; classification into fungous diseases of foliage, fungous and bacterial diseases of tubers and stems, virous diseases; and control measures such as sprays, seed piece treatments and sanitation. Lesson 17 gave similar treatment to sweet potato diseases with emphasis on control of foot rot, stem rot, black rot, scurf, and soft rot.

At the December 1919, American Phytopathological Society meetings, Fromme discussed "The development of loose smut of wheat as modified by soil fertility" (Phytopathology 10:53, 1920). This was the first publication showing his continuing interest in the wheat smut problem. Fromme reported that the poorer the soil, the greater the percentage of smutted heads. Conversely, as the soil was enriched by fertilizer applications, smut percentages declined. Fromme attributed this "To total or partial elimination of the smut fungus by the greater vigor of the growth of plants on the more fertile soils."

Fromme, G. S. Ralston (Field Horticulturist), and Eheart collaborated to publish "Dusting Experiments in Peach and Apple Orchards in 1920" (Va. Agri. Expt. Sta. Bul. 224, 1921.). Their experiments with peaches were summarized in the statement, "Dusting materials have given very satisfactory control of scab, and ... the data with respect to the control of brown-rot and curculio are insufficient for drawing conclusions." With apples, they found that copper-lime mixtures had no value for the control of bitter rot. "There seems to be no justification for the use of any of the copper dusting mixtures in Virginia apple orchards." (In short, keep spraying!) The data in bulletin 224 were accumulated by Eheart and appear in his thesis for the M.S. degree in Plant Pathology and Horticulture.

There were no other research reports published from the Department at V.P.I. in 1920. There was considerable research underway and there were other activities in plant pathology around the state. At a Washington, D.C. meeting of the Advisory Board of American Plant Pathologists, January 29-31, it was voted to hold a summer field meeting emphasizing fruit diseases. Fromme was elected chairman of the Arrangements Committee (Phytopathology 10:258). This, the second such summer meeting, convened August 3, at Staunton, Va., where there was an "Inspection of interesting demonstrations of apple root rot and cedar rust, and comparative dusting and spraying experiments for control of various apple diseases." The party spent August 4 in Berkeley Co., West Virginia (Phytopathology 10:496-498). As a sidelight, the secretary, G. R. Lyman, reported that, "Scenically, the Shenandoah Valley and the Blue Ridge Mountains are famous throughout the world. Historically, every foot of ground traversed is of interest from Staunton on the south to Gettysburg on the north and the party was able to make special pilgrimages to the battlefields of Antietam and Gettysburg."

At the Truck Station, Loren B. Smith, Associate State Entomologist, published a summarizing paper on "Breeding Mosaic Resistant Spinach and Notes on Malnutrition" (Va. Truck Expt. Sta. Bul. 31 and 32, 1920). In this publication, Smith described the extensive work with plant pathologists which led to the recognition of mosaic, and the discovery that aphids could transmit it. He compared the symptoms of malnutrition and mosaic; this allowed growers to recognize which problem was damaging their crop. He detailed the botanical characteristics of 'Manchurian' spinach, resistant to mosaic and susceptible 'Savoy' and the hybrids from them. From progeny was selected 'Virginia Savoy' which outyielded commercial types then in production. This project, initially in collaboration with J. A. McClintock, restored the spinach production industry in eastern Virginia.

Smith co-authored with H. H. Zimmerley, Horticulturist, "Relation of Pressure to

Effectiveness in Spraying Tomatoes" (Va. Truck Expt. Sta. Bul. 33 and 34, 1921.). Target diseases were Septoria leaf spot and Cladosporium leaf mold. They applied Bordeaux mixture at 75, 140, and 200 lbs p.s.r. Results were somewhat garbled. Either 140 or 200 lbs gave the best yields but results varied from one variety to another. They did not recommend that tomatoes be sprayed at a particular pressure. At the December 1920 meeting of the Virginia State Horticultural Society, W. J. Schoene, State Entomologist and Plant Pathologist, presented a report on cedar tree litigation (Va. Fruit 9:36-38, 1921). Opposition to the cedar rust law had arisen in Shenandoah County in 1917. Attorneys for the opposition admitted the presence of cedar rust and damage it caused to orchards but opposed the constitutionality of the act. The Circuit Court at Woodstock ruled in favor of the orchardists and the Judge awarded ample damages and ordered the cedars cut. The case was carried to the Court of Appeals where it was questioned whether the Crop Pest Commission had authority to fund legal services. Thereupon, the directors of the State Horticultural Society, since the Society had "fathered" the act, arranged to finance the contest in the Court of Appeals at Staunton. The ruling of the lower court was upheld. Schoene reminded the Society that it was the place of the orchardist being injured to seek permission and to finance removal of cedars on neighboring property. Upon meeting opposition the State Entomologist is empowered to push for a settlement.

The *Southern Planter* magazine began a twice monthly publication schedule in 1920. There was a corresponding increase in items about plant diseases. In volume 81, pages were not numbered continuously as before, thus reference is made to each date of publication.

The Spray Calendar format was changed; instead of one big chart, four charts were presented, one each for apples, stone fruits, grapes, and brambles (Jan. 15, p. 6.). Extension Horticulturist R. E. Marshall pointed out that, "Spraying has been talked and written until it would seem that all (fruit growers) ... would be familiar with the best practices in ... spraying," yet the losses in 1919 caused by pests controllable by spraying amounted to one 1 1/2 million dollars. The losses were attributed to insuffcient number of sprays, improper dilution of sprays, ill-timed sprays, and inadequate coverage of fruit and foliage. These are age-old problems.

Mycologist F. A. Wolf of North Carolina Agricultural College presented an article, "Forage poisoning from water grass" (Jan. 15, p. 14.), in which he describes effects of Claviceps infections of Paspalum spp. on livestock. From the description the fungus is *Claviceps purpurea*; however, it was most probably *C. paspali*, as the latter is widespread on *Paspalum* spp., but even today C. purpurea is known on *Paspalum* spp. only from Georgia. Watergrass is *P. dilatatum*, or dallis grass and is common in Virginia. Sclerotia of *C. paspali* frequently occur on dallis grass in Virginia. Animals poisoned by ergot appear to have chills; they tremble, are wild-eyed, have high pulse rates, are easily excited, and fall or stumble headlong. Near water, they may fall and drown. Animals must be separated from the ergot source or they will die. To avoid animal losses, Wolf advised farmers to clip pastures during the period August to October.

In the May 15 issue (Sou. Planter 81 (10):30-31), Fromme described "Angular leaf spot and wild fire" of tobacco, and stated that the diseases were caused by bacteria, rather than by unfavorable weather, fertilizer injury, or poor soils as was previously thought. From the research that had been conducted since 1917, Fromme recommended that:

1. Seed beds be on new ground and that drainage should be away from them.
2. Old covers should be boiled.
3. There should be no old tobacco refuse near seed beds.
4. Growers should remove spotted plants from seed beds.

Since the diseases occurred on seed pods, it was suspected that they were seed-borne, but Fromme was not yet willing to recommend seed treatments. However, in the December 15 issue (Sou. Planter 81 (24):5.), C. F. Phillips, Amelia County Extension Agent contributed an article, "Control measures for wildfire and angular-spot of tobacco," in which he described additional procedures:

1. Seed treatment - soak in formaldehyde solution (1 oz. Formalin in 1 pt. H_2O and dry.
2. Old covers - as noted above or soak in 1:1000 $HgCl_2$ solution.
3. Burn new ground seed beds.
4. Practice a rotation, 2 years between tobacco corps. No doubt, Fromme had furnished him information.

Reminders to control cereal smuts appeared several times [Sou. Planter 81(12):22; (16):4; (19):30; (20):3-4]. All recommended copper sulphate or formaldehyde soaks to control wheat bunt and two described hot water treatments for wheat loose smut. In Rockingham County, a community hot water treatment center was set up in a creamery. Other articles included "Control measures for bacterial wilt" of curcurbits for which control of the cucumber beetles was recommended and "Spray for leaf-spot of tomatoes" [Sou. Planter 81(12): 6; (12):36]. The Inquirer's Column responded to questions on tomato blight in Montgomery Co. [(7):30-2], summer sprays for peaches, plums and apples in Campbell Co. [(10:32], grape mildew and black rot, peach summer sprays, and rose mildew in Pittsylvania Co. [(13:22], and whether red cedars caused tomato plants to die. Fromme suggested Fusarium wilt was the probable cause [(3):34]. (Note: Walnut toxicity was also a possibility but had not yet been recognized.)

In the 12th Report of the State Entomologist and Plant Pathologist, W. J. Schoene reported that a survey of white pine stands revealed no blister rust in Virginia (Quarterly Bul. Va. State Crop Pest Comm. 1:14-15, 1920). [Note: Wilbur O'Byrne stated white pine blister rust had been found in Clarke Co. In 1911. (Agencies destructive to the forests, pp. 413-423, *in* The James River Basin, Past, Present, and Future. Va. Acad. Sci. Richmond, VA. 1950]. Schoene also reported that apple growers were organizing from Botetourt Co. northward to eradicate cedars. Apparently, they had been somewhat passive or not willing to antagonize their neighbors (p. 15). For the first time take-all of wheat had been identified in Virginia; it was found in Roanoke Co., probably in June 1991 (p. 22).

When the Cedar Rust Law was enacted in 1914, owners were authorized to destroy cedars within one mile of their ochards and the State Entomologist was authorized to do so within two miles of an orchard. In 1920, the Legislature removed the discrepancy and cedars within two miles of orchards could be destroyed by growers. This was a local option law and county supervisors had to ratify it in order that cedar eradication could be implemented on farms adjacent to orchards in their county.

In the *Plant Disease Bulletin*, Fromme reported on occurrence of numerous cereal, fruit and vegetable diseases. It was noted that cedar rust was severe in most orchards except those in Frederick County where cedars had been virtually eliminated (4:15, 1920). Fusarium wilt of cabbage caused considerable losses in the Marion area of Smyth County (4:1195, 1920). In Roanoke County, Fusarium wilt of tomato took a toll except where the resistant varieties Marvel and Norton were grown (4:90, 1920). Septoria leaf spot severely damaged tomatoes in western Virginia (4:89-90, 1920). On tobacco, black root rot was very damaging in Charlotte County (4:52, 1920). Fromme reported that, in general, the fruit crop was little affected by plant diseases in 1920.

Fromme completed a 3-year term as Associate Editor of *Phytopathology*, and a 5-year term on the V.P.I. College Entrance Requirements Committee. He served on the Bulletin Committee from 1919 to 1922 and the Physical Welfare Committee for two sessions, 1919 to 1921. He was inclined to be an "involved" professional. Further evidence of this was shown in 1921, when Fromme began a 3-year term as a member of the Board of Control of the Crop Protection Institute which was organized at the December 1920 meeting of the A.P.S. "The Institute is the outcome of the spontaneous desire --- of plant pathologists, economic entomologists, and certain business men to secure united attack on certain problems. It has been organized under the auspices of the Division of Biology and Agriculture of the National Research Council" (Phytopathology 11:198, 1921).

At the same December meeting, Fromme and Wingard read a paper on the "Treatment of tobacco seed and suggested program for control of wildfire and angular-spot" which was the basis of Phillips article in the December 15, 1920 issue of the *Southern Planter*, previously noted (Phytopathology 11:48-49, 1921).

Early in 1921, Fromme and Wingard published an article, "Wildfire and angular- spot" of tobacco (Sou. Planter 82(2):8-9, 18, 1921), which was a summary of their work on these diseases. They stated that serious losses due to these diseases had been sustained in the four seasons, 1917-1920. Spread had been rapid in wet weather and growers attributed the diseases to weather. Fromme and Wingard sought to convince growers if they controlled the disease in seed beds, it would be no problem even in wet weather. The emphasis was on disease-free seed, and disease-free seedlings. Methods for obtaining healthy seedlings was stressed.

In the April 15 issue, Fromme reviewed Experiment Station Bulletin 224 "Results of Peach and Apple Dusting Experiments in 1920" (Sou. Planter 82(8):5, 1921). He stated that sulphur dust was superior to self-boiled lime-sulfur for control of peach scab but not for brown rot. Sulfur dust was acceptable for control of apple scab but any copper dust was worthless for other apple diseases.

Fromme conducted tests with cabbage in Smyth County. To determine the value of two yellows-resistant varieties for Southwest Virginia. (Fromme, F. D. 1921. The Yellows Disease of Cabbage in Southwest Virginia. Va. Agri. Expt. Sta. Bul. 226). Regional losses to yellows had amounted to 25% with losses of 90% in a few cases. It was estimated the 50% of the cabbage lands were infested with *Fusarium conglutinans* and growers in some cases had been forced to abandon cabbage production. Fromme obtained seed of 'Wisconsin Hollander' and 'Wisconsin All Seasons' from J. C. Walker at the University of Wisconsin, where the two varieties had been bred for resistance to yellows. Tests in 1921 proved both varieties would restore cabbage production to "yellows sick" soils.

Fromme and Wingard reported on an intensive study of reactions of bean varieties to rust, *Uromyces appendiculatus* (Varietal susceptibility of beans to rust. J. Agri. Res. 21:385-404 + 4 pl. 1921). They described techniques developed, types of reactions, and variations in incubation period, and correlated reactions with plant type and seed color. They worked primarily with one isolate originally collected at Blacksburg but did some comparative work with an isolate collected in California. They recorded differences in reaction for the two isolates and, thus, recognized for the first time physiologic forms of *U. appendiculatus*. This was also the first work with physiologic races of any pathogen in Virginia. They concluded that pole beans were generally more susceptible than bush beans, green beans were more susceptible than wax beans, white-seeded varieties were more susceptible than colored, and plants producing marrow type seeds were resistant while pea and kidney varieties were apt to be susceptible. Some varieties appeared to be heterogeneous for rust reaction but reactions of individual plants were uniform. Greenhouse tests could be used to predict field performance.

Although Fromme and Wingard clearly recognized the existence of races of the rust fungus, their statements to that effect are largely overlooked. In 1957, Zaumeyer and Thomas stated, "The inheritance of rust resistance was shown by Wingard in 1933 to be dependent on a single dominant factor. His work was conducted before the discovery of various physiologic races of the organism" (A Monographic Study of Bean Diseases and Methods for Their Control. U.S.D.A. Tech. Bul. 868, 1957). Thus, if you want to be recognized for a discovery, you have to say to the world, "I was the first to ..., etc." In retrospect, Chupp in 1925 acknowledged that, "There is some indication that there are at least two biologic forms of *U. appendiculatus*," an apparent reference to Fromme and Wingard (Chupp, C. 1925. Manual of Vegetable-Garden Diseases, Macmillan Co. 647 pp.).

In other studies, Fromme noted that the "Incidence of loose-smut in wheat varieties" varied from 0 to trace in Leap (= Leap Profilic) in 52 fields and from 0 to 10% (av. = 3.6%) in 74 fields of Stover wheat in 1921 (Phytopathology 11:507-510, 1921). It was not determined whether Leap was resistant or escaped infection. Bearded varieties generally had more smutted heads than beardless types. This was the beginning of studies and a breeding program for resistance to smut at V.P.I. that would last another 25 years.

James F. Eheart was awarded the M.S. degree in Plant Pathology and Horticulture on June 10, 1921. He had written two theses for his degree requirements; the first was, "Dusting and spraying experiments with apples and peaches," approved by Fromme and H. L. Price. This work was published in Experiment Station Bulletin 224 and has already been reviewed. For his minor thesis, Eheart studied the "Enzymatic activity of *Xylaria digitata* and the cultivation of *Penicillium pinophilum* in nutrient salt solutions," approved by A. B. Massey and H. L. Price. Eheart held the position of Assistant Plant Pathologist in the Experiment Station from March 1, 1920 to March 1, 1921. From June 1919 to March 1920, he had been a Student Assistant in Plant Pathology and Bacteriology where he assisted A. B. Massey in teaching bacteriology courses. After March 1921, Eheart was Assistant (Agricultural) Chemist in the Experiment Station.

In Extension Bulletin 67, June 1921, "Bush Fruit Culture," C. Woolsey, Horticulturist, described briefly crown gall, anthracnose, cane blight, double blossom, spur blight, yellows, leaf spot, and yellow late rust of brambles, and leaf spot, anthracnose, powdery mildew, and cane blight of currants (pp. 14-16).

At the 1920 meeting of the Virginia State Horticultural Society (Va. Fruit 9:170- 172, 1921), there was an interesting discussion between Mr. Vance and Professor Alwood. Fromme had advised Vance to use lime around some trees apparently infected by the black root rot fungus and to pull soil away from the roots to expose them. This the grower did and in addition fertilized them with nitrogen. The trees recovered. Thereupon Alwood declared he had discovered the same treatment and it had worked for him and he advised others to use it on symptomatic trees.

Loren B. Smith had for several years served in the dual role of Associate State Entomologist (and Plant Pathologist) and Entomologist for the Truck Station. Smith's contributions to control of spinach mosaic have been described. On April 1, 1921, he resigned to study Japanese beetles in New Jersey. He had prepared an article on, "Control of spinach leaf mold (downy mildew) by spraying" for the Quarterly Bulletin of the Virginia Crop Pest Commission [3(1):pp not numbered, April, 1921] in which he described and illustrated the disease, lamented the difficulty of estimating losses, and stated that it was most destructive from October to December following wet warm spells. He compared 2 strengths each of copper sulphate and Bordeaux mixture, with and without fish oil soap. Copper sulphate, 1/4%, plus fish oil soap was superior. With H. H. Zimmerley, Smith had co-authored bulletins 33 and 34 (published under one cover, January 1, 1921), previously noted. Smith had contributed greatly to the betterment of truck farming though both entomology and plant pathology. Apparently, the Crop Pest Commission felt that his replacement, W. S. Hough, was needed more in fruit work; they stationed him at Winchester, July 1, 1921. Although Hough was the first professional at Winchester, he was not the first Experiment Station employee there.

Three presentations relating to apple diseases were made at the December 10- 12, 1921 annual session of the Virginia State Horticultural Society (Va. Fruit 10(2), 1922). W. J. Schoene, State Entomologist and Plant Pathologist gave "A progress report of cedar rust litigation." He reviewed the initial efforts of the Society to have the cedar law enacted. "The first legal fight occurred in Woodstock at the September term of court in 1919. This case was promptly carried to the Court of Appeals by the cedar owners. This case resulted in favor of the fruit growers, and shortly afterwards the cedars were cut under the discretion of the State Entomologist. It was thought at the time that this would end all cedar rust litigation. However, ... the cedar men ... announced that the next case would be carried to the United States Supreme Court" [Va. Fruit 10(2):44-48. 1922]. At the time (Dec. 1921) the ruling of a circuit court judge was pending.

John W. Roberts of the U.S.D.A. gave a discussion of "Apple scab control" in which he described carefully his work with spray programs and the need to make four applications of lime-sulphur specifically timed to control the fungus. There was much discussion on the preparation of lime-sulphur (Va. Fruit 10(2):159-169). G. S. Ralston, Horticulturist at V.P.I., presented a discussion of the "1922 spray recommendations," which was somewhat redundant to that by Roberts. However, it was more detailed; he described in detail nine spray applications giving details for mixing ingredients, and carefully defining the target pests of each spray. He also condemned the spray gun as an inadequate tool for the apple grower, giving reasons. There was a very lengthy, lively discussion following Ralston's talk [Va. Fruit 10(2):179- 194.]

The *Southern Planter* continued to publish timely reminders of farm operations for plant disease control. The annual spray calendar was reduced to sections on apple and peach pest control [82(5):6-7, 21]; an item on treating tomato seed with $HgCl_2$ solutions to control bacterial spot was authored by C. G. Woodbury based on information from Max Gardner of Indiana [82(6):7]; Floyd H. Keister, Associate Horticulturist at the Truck Station described a seed-potato treatment for controlling scab [82:(6):7-8] and methods for controlling sweet potato "seed"-borne diseases [82(9):6]. In the column "Work for the month" the editors twice emphasized treating seed wheat to control stinking smut and loose smut; in the first they described formaldehyde and hot water treatments [82(16):3]; in the second they described the formaldehyde and the copper sulphate-lime liquid treatments aimed at stinking smut [82(20):4]. In March, the losses from dodder were highlighted [82(5):19] and methods for controlling it were detailed. Suscepts listed were clover and alfalfa; not susceptible were corn, soybean, cowpeas, and small grains.

Numerous diseases were reported in the plant disease survey for 1921 to occur in Virginia (Pl. Dis. Bul. Of Pl. Dis. Survey 5), Noteworthy reports were wheat nematode disease in Wilkes Co., N.C., traceable to seed lots purchased from T. W. Wood Seed Co. of Richmond, Va. (p. 8); leaf rust of wheat was the worse than Fromme had ever seen (p. 24); angular leaf spot of tobacco was present in 70% of the beds examined, seed treatment and new or boiled covers controlled it very well (p. 65); Granville wilt of tobacco was more common because farmers were hunting for it (pp. 65-66); a bacterial soft rot of tomato caused a 50% loss in Blacksburg area gardens (p. 84).

Two other major events occurred in Virginia plant pathology in 1921; on April 19, Curtis Roane was born and on November 1st, Martha Kotila Roane was born!

In 1922, the structure of plant pathology research in Virginia changed significantly; the first sub-station or field station plant pathologist was employed. Felix J. Schneiderhan was appointed as Assistant Plant Pathologist on March 14, and assigned to Winchester. There he joined W. S. Hough, Assistant State Entomologist, who had preceded him by a few months and who was an employee of the Virginia Crop Pest Commission. Thus, Schneiderhan was the first Experiment Station employee at the Winchester Station and was placed in charge of the laboratory. It was Hough, however, whose pleadings to the Horticulture Society and Crop Pest Commission for pathology help that precipitated Schneiderhan's appointment. The apple scab outbreak in 1921 had overwhelmed growers and interfered with Hough's codling moth and aphid research. Schneiderhan was to study apple scab, bitter rot, black root rot, cedar rust, and any other apple disease that attracted his attention and to focus on control of these diseases. He grasped quickly the magnitude of his task and presented to the State Horticultural Society a very convincing picture of why the profit of growing apples was unnecesarily narrow. That report will be reviewed later.

Perhaps the most significant publications issued by the Department in 1922 were two on tobacco bacterial leaf diseases. A popular bulletin entitled, "Blackfire and Wildfire of Tobacco and Their Control" (Va. Agri. Expt. Sta. Bul. 228, 1922), and a technical bulletin entitled, "Blackfire or Angular leafspot of Tobacco" (Va. Agri. Expt. Sta. Tech. Bul. 25.), appeared almost simultaneously in April. The former was issued to aid farmers in the control of the two diseases named, and the latter was a comprehensive account of the history and research conducted on blackfire since its discovery in 1917. There was an Experiment Station "first" in bulletin 228. It contained two color plates in which blackfire and wildfire were compared. In the technical bulletin, the authors, Fromme and Wingard, reviewed the history of blackfire, regional distribution, losses, comparison of blackfire with other leaf diseases, symptoms, the causal agent (*Bacterium angulatum*) and its cultural characteristics, epiphytology and procedures evolved for its control. Much effort was devoted to developing seed treatment with formaldehyde and $HgCl_2$ and demonstrating that used covers must be boiled if they were to be reused. The simplified recommendations which appear in bulletin 228 were seed selection (from disease-free plants), disinfection, plant bed sanitation (clean covers, plant beds on new ground), and field sanitation (practice rotation and destruction of tobacco crop residue).

Fromme reported on "Experiments in Spraying and Dusting Tomatoes" from 1918 to 1922 (Va. Agri. Expt. Sta. Bul. 230). The 1918 experiments were to compare the efficacy of soap Bordeaux and standard Bordeaux; soap Bordeaux was superior in that it reduced the incidence of fruit rot and Septoria leaf spot. After the 1919 experiments were completed, Fromme stated, "Spraying with soap Bordeaux mixture provides a satisfactory control of leaf blight and softrot." In 1922, tests were conducted to determine the value of copper-lime dust for control of diseases in the Blacksburg area. Late blight was the most destructive disease encountered. Dusting gave excellent control of late blight fruit rot and its use was encouraged.

Fromme read a paper at the December 1921 American Phytopathological Society meetings on "Susceptibility of apple root-stocks to black root rot" (Phytopathology 12:54-55), in which from inoculation experiments, Northern Spy-rooted trees was found to be superior to seedling-rooted trees. Nurserymen were encouraged to shift to Northern Spy for rooting material.

At the same meetings, Wingard read a paper on "A yeast parasitic on lima beans." A *Nematospora* sp. was reported to cause infections on cotyledons, pods, and seeds (Phytopathology 12:47, 1922). Late in 1922, Wingard published an account of his experiments and declared that the causal agent, *N. phaseoli*, and the yeast-spot disease of lima bean and cowpea were hitherto undescribed (Wingard, S. A. 1922. Yeast-spot of Lima beans. Phytopathology 12:525-532). He illustrated fungous vegetative cells, an ascus and ascospores. Most vegetative cells were oval but some were "in the shape of tennis rackets and walking sticks." Specimens from which cultures were made came from Essex, King and Queen, King William, and York Counties in the Coastal Plain and Dinwiddie, Albemarle, and Henrico in the Piedmont.

Wingard took an educational leave in September and went to Columbia University to study under R. A. Harper, eminent Botanist-Mycologist. There he studied further the Nematospora disease and embodied the study into a dissertation.

At the Truck Station, Fred Geise collaborated with H. H. Zimmerley and C. R. Willey to publish "Dusting Vegetable Crops, Preliminary Report" (Va. T. E. S. Bul. 35 and

36, 1922, published under one cover). They explored different procedures; there was no progress with diseases because droughty conditions prevailed and fungi were inactive. Geise reviewed conditions for "Storing and Bedding Sweet Potato Stock" (Va. T. E. S. Bul. 39 and 40, 1922). No doubt this had been inspired by Schoene's comment that 40% of the stored sweet potato crop is lost to disease (Quarterly Bul. Va. State Crop Comm. 3(4), including 13th Rept. of the State Entomologist and Plant Pathol., 1920-21). Geise's bulletin emphasized conditions to be maintained in storage houses and the care of handling the roots to induce disease-free sprouts.

Late in 1922, the station published bulletin "Spraying and Dusting Vegetable Crops in 1922" (Va. T. E. S. Bul. 41, 1922.) Here Geise, Zimmerley, and Spencer described experiments aimed at control of eggplant fruit rot (*Phomopsis vexans*), tomato leaf spot (*Septoria lycopersici*), and cantaloupe and cucumber downy mildew (*Peronospora cubensis*). This was a follow-up of bulletins 35 and 36. Dusts produced higher crop yields than sprays; the dusts were dehydrated copper sulphate, calcium hydroxide, insecticide mixtures.

Geise, who had joined the Truck Station staff in August 1920, resigned on December 31, 1922, to take a position in Maryland.

R. C. Thomas contributed very little to the plant pathology literature in the years he was Extension Plant Pathologist, November 1, 1920 to September 1, 1922. He was co-author of the bulletin, "Orchard and Garden Insects and Disease and Their Control" (Ralston, G. S., F. A. Motz, and R. C. Thomas. Va. Ext. Div. Bul. 68, June 1922). The bulletin included about 42 diseases of fruits and 46 diseases of vegetables, procedures for preparing fungicides, descriptions of application equipment and spray calendars. Soon after, Thomas resigned on September 1 and James Godkin was named Assistant Plant Pathologist in the Extension Division.

Fromme contributed an item to the *Southern Planter*, "Recommendations for the control of wildfire and blackfire of tobacco" [83(4):8, Feb. 15, 1922.] in which he reviewed the procedures he and Wingard had developed and which were described in Virginia Agriculture Experiment Station Technical Bulletin 25 and Bulletin 228. Fromme, in the item, emphasized that the grower could not omit any of the control measures and expect success. An interesting sidelight is that Fromme and Wingard developed the seed treatments with bichloride of mercury and formaldehyde between 1919 and 1922. George B. Lucas in his book "Diseases of Tobacco" 3rd edition, 1975 (p. 407), credited James Johnson and H. F. Murwin for developing a silver nitrate treatment in 1925 but ignored Fromme and Wingard's earlier procedure. Another contribution from Virginia had fallen through the cracks.

Much of plant pathology is the constant reminding growers to carry out plant disease control measures at the right time. For this purpose, popular farm magazines were the medium most often used in the 1920's. *The Southern Planter* excelled at providing timely reminders for Virginia growers. The annual spray calendar for fruits usually appeared in February (for ex. 83(3):6, Feb. 1, 1922), and exhortations to treat seed wheat for smut control usually appeared in early fall (ex., 83(19):4, Oct. 1, 1922). Since procedures had not changed for several years, these were stereotyped articles. Occasionally Virginia farmers were alerted to diseases occurring elsewhere that had the potential of damaging their crops. Flag smut of wheat appeared in the St. Louis area and was found on 72 square miles in 1921, and 700 in 1922 [83(16):5, Aug. 15, 1922]. Among the soft red winter wheat varieties grown in

Virginia and found to be highly resistant or immune were Stoner, Marvelous, and Fulcaster. In 1922, Virginia growers were not threatened by the disease but were alerted to look for it. "The flag smut situation was further described in the *Plant Disease Bulletin* (6:2-4, 1922).

Fromme reported that numerous diseases occurred in Virginia in 1922 (Plant Dis. Bul. 6:9, 10, 53, 62, 75, 83, 157). Powdery mildew of red clover caused a crop failure in much of Virginia. It was epiphytotic in the whole eastern United States (6:9, 10). Fromme and Schneiderhan reported on the cedar rust situation as follows (6:75): "Cedar rust is epiphytotic wherever cedars and apples occur in proximity. Frederick County is the only Valley county which will not suffer severe losses. Systematic cedar eradication has been in progress there for several years. Leaves are beginning to fall and the fruit is showing the dwarfing which follows (as of July 19). Many of the York orchards appear to be burned and discolored. In many cases there is premature defoliation" (July 24).

The report that take-all of wheat occurred in Roanoke county in 1919 apparently shook pathologists. A reinvestigation of the site revealed no take-all. The false report was attributed to an incorrect diagnosis by a federal plant pathologist (Schoene, W. J. 1922. Thirteenth Rept. State Entomol. and Pl. Pathol. 1920-21 *in* Quarterly Bul. Va. State Crop Pest Comm. 3:12-13). In that same report (p. 12), Flippo Gravatt reported finding Verticillium wilt of maple at Leesburg in 1921. Reed and Crabill had called it thrombotic disease when it occurred in Roanoke about 10 years earlier. Thombosis was an early name for Verticillium wilt.

An item in *The Southern Planter*, "Disease resistance in varieties of wheat" [83(10):16, June 1, 1922] was prepared by "the Extension Specialist in plant disease, V.P.I.," that being Thomas. The writer described his findings on the incidence of loose smut in Leaps Prolific and Stoner wheats. The smooth-headed Leaps Prolific had only a trace of smut in 52 fields observed in 1920 and 1921, whereas bearded Stoner and others averaged 7% in 74 fields. Fromme had credited Thomas for making this observation in his 1921 report (Phytopathology 11:507-510, 1921) and should have made him co-author but didn't.

Schoene, the State Entomologist and Plant Pathologist, spoke to the Virginia State Horticultural Society at its December 1922 meeting on "The past, present, and future of the cedar situation." [Va. Fruit 11(2):2-4, 1923]. He pointed out that the law enacted in 1914 was met by growers with mixed feelings. Before and after enactment some growers favored its passage and vigorously pursued cedar eradication, some opposed its enactment, some refused to accept the rust theory and some well known orchardists claimed that cedars did not interfere with the production of Yorks (the most susceptible variety), and they were willing to testify in court to that effect. After its passage, the Crop Pest Commission was expected to enforce it but no funds were set aside to conduct court cases. People who were at first unsympathetic toward the law changed markedly and by 1920, supported the law. Schoene endorsed organized efforts to eradicate cedars in a neighborhood and cited the success attained in Frederick County. Such a program was underway in Augusta. The practice of paying damages to cedar owners was opposed by Schoene. A resolution to that effect was proposed and there was some opposition (pp. 206-207). Schoene explained the reason for the resolution. People who have cedars want them cut, "And they are waiting for the fruit growers to come and cut them. And what else? They want damage. When the fruit grower comes along and cuts their cedars, they put in a claim to the court for damages. And ... in every case but one the court has given damage. If the Society would put up a fight, there won't be but one case come up, just one case, that is all. As soon as these cedar people find that this Society is not going to stand for damages, they are not going to ask for any more damages." Schoene cited a case in Frederick County, where once legal fees to support a damage petition had to be paid by cedar growers, petitions were no longer presented to the court. Thus, by fighting one case, Frederick County growers no longer had to pay damages. After the statements by Schoene, the resolution that the Society opposed damage payments was passed.

Additional accounts of the cedar eradication program and litigation over cutting cedar trees may be found in the *Quarterly Bulletin of the Virginia State Crop Pest Commission* 3(4):20, 1922; 4(2):3, 1922; 5(1):not numbered, 1923.

In addition to the interesting discussion on cedar eradication, Schneiderhan, after only nine months on the job at Winchester was invited to speak to the Horticultural Society on, "Scab and other things" [Va. Fruit 11(2):153-174]. He exposed his philosophy of disease control as being an effort by the fruit grower to make more profit for himself. He first showed a photograph of a million pound pile of apple culls, one of 22 such piles in Winchester. That was 22 million pounds that should have made growers money. Schneiderhan said, "When I stood on top of that rotten pile of apples, I felt that I was on top of the pathological situation of the world." He pointed out that scab was the most serious disease for Virginia growers because cedar rust, which was number one in the growers mind, was only temporary. Cut down the cedars and it would go away but scab would still be there; it accounted for 30.9% of the culled apples. Schneiderhan harangued them for being under-equipped, for under-spraying, and under-estimating disease potentials. He showed them the effects of omitting particular sprays recommended in the calendar; the results were dramatic. A full spray program of eight sprays was the only alternative. He also showed them the need to have an accurate hydrometer for measuring the strength of lime-sulphur and he described a new wound dressing. In his first year and in his first address, Schneiderhan made quite a splash. It was obvious he was going to have a very favorable impact on Virginia's apple industry in the seven years he would be at Winchester.

Another important December meeting for pathologists was that of the American Phytopathological Society. The meetings were between Christmas and New Year; as a consequence, the proceedings appeared after March of the next year. The report of the 1922 meeting showed that F. D. Fromme was elected Vice-President of A.P.S. for 1923, that he was a member of the Auditing Committee for 1922, that he was to assist J. C. Arthur in the preparation of a book on plant rusts, that he was a co-leader of the A.P.S. project on dusting, and that he was a representative for A.P.S. on the Board of Governors of the Crop Protection Institute. Thus, Fromme was heavily involved in A.P.S. affairs, the only person from Virginia to be so, thus far (Phytopathology 13:188- 198, 1923).

Some staff changes occured in the V.P.I. Department of Plant Pathology in 1923. Robert H. Hurt was appointed Assistant Plant Pathologist on June 5, and assigned to establish a field station at Crozet, Albemarle Co. Hurt had just earned his B.S. degree in Biology from V.P.I. He was to work on diseases of peaches, apples, and small fruits. His "laboratory" was a garage in which he stored the paraphernalia for doing orchard spray experiments. He had the backing of the State Horticultural Society, so presumably his laboratory was equipped with sprayers, mixing tanks, and a microscope. The records I find don't say.

Sam Wingard returned in May or June from a term of graduate study at Columbia University. Thereupon, he was promoted on June 5 to Associate Plant Pathologist. With Wingard recently on leave, Massey heavily committed to teaching, and Fromme involved in A.P.S. and departmental administration and Schneiderhan relatively new at Winchester, no research publications were issued by the department in 1923. There were brief notices on the incidence and severity of diseases in the *Plant Disease Reporter* in 1923, the new name for the *Plant Disease Bulletin*. Fromme and Schneiderhan independently reported on apple diseases (P.D.R. 7:42, 56, 57). Cedar rust in 1923 was rated at 5% in the Valley, compared to 100% in 1922. Godkin invited F. E. Kempton, federal officer-in-charge of barberry eradication, to visit Wythe, Carroll, and Pulaski Counties to see the devastation of wheat adjacent to native barberry bushes. They reported that grain up to 10 rods from bushes was shrivelled but further away grain was plump even though 10% severity of rust was encountered at 50 rods.

Fromme had indicated that Godkin would be assigned to intensify extension work on hot water treatment of wheat for loose smut control. The *Extension Pathologist*, a publication of the federal extension service, first appeared in November, 1923. Godkin published an account of "Cereal seed treatment in Virginia" [Ext. Pathol. 1(1):15, 1923], in which he cited the intensive effort to treat wheat in Botetourt County. The availability of tomato canneries in the county with their ability to supply hot water made the program successful.

Fromme made use of the second issue to describe the "Spray service for fruit growers in Virginia" [Ext. Pathol. 9(2):10-11, 1923]. He stated the service was started in 1922, and that in a coordinated effort by the Departments of Entomology, Horticulture, and Plant Pathology, with personnel stationed at Winchester, Leesburg, Crozet, and Blacksburg, information and advisories for current conditions were disseminated as soon as the information became available. A calendar for spraying had long appeared in *The Southern Planter*.

In 1922, the Experiment Station and Extension Division had cooperated to start the "Spray Service" by which growers were notified in advance by mail to apply certain sprays. In subsequent years efforts were made to expand the mailing list for this service. A significant step was taken when the Extension Division undertook the publication of a spray calendar (Orchard Spraying in Virginia, 1923. Va. Agri. Ext. Div. Publ. E-198). This was the first of such annual publication that would be continued by the Extension Division and the Experiment Station.

Another service of *The Extension Pathologist* was to publish a list of extension bulletins. (For example, James Godkin. 1923. Loose Smut of Wheat and its Control. Va. Agri. Ext. Bul. 210). I would have missed this publication without it having been listed [Ext. Pathol. 2 (7 and 8):81, 1924].

The Annual Report of Extension Work July 1, 1921 to November 30th, 1922 (Bulletin 82, 1923), indicated that Godkin emphasized treatment of tobacco and wheat seeds, rag doll tests with corn seed, and demonstrations on control of cabbage, watermelon, potato, and tomato diseases. He travelled 1140 miles by rail and 1870 by "car and other means."

Just before F. W. Geise resigned from the Truck Station on December 31, 1922, he prepared a bulletin, "Experiments With Inoculated Sulphur, Preliminary Report" (Va. T. E. S. Bul. 42, 1923). The bulletin was in two parts, (1) For control of potato scab (2) Effect on subsequent crops. At Norfolk, there was some scab reduction when 300, 450, or 600 lbs was incorporated into the soil just before potatoes were planted. At Onley on Eastern Shore, 300 lbs/ac gave very good control of scab and caused least reduction of corn yields and rye growth. Growing potatoes in acid soils has been practiced since the bulletin was published, but with some modifications.

Howard Zimmerley, Horticulturist, and Herbert Spencer, Entomologist wrote, "Hot Water Treatment for Nematode Control" (Va. T. E. S. Bul. 43), summarizing 10 years of experiments aimed at controlling root knot nematodes in greenhouses and cold frames where steam was not available. Formaldehyde, calcium cyanamide, sodium cyanide, and carbon bisulphide were ineffective. Boiling water applied at the rate of five gallons per cubic foot of soil gave satisfactory control when administered in midsummer and the soils were already warm. A boiler of high capacity for producing boiling water would be needed. (I don't recall that the method was widely practiced). On June 1, Ray J. Davis filled the position of Plant Pathologist that Geise had vacated five months before. He collaborated immediately with Zimmerley and Spencer to produce the bulletin, "Spraying and Dusting Cantaloupes" (Va. T. E. S. Bul. 45), which was a summary of experiments conducted during the 1919-1923 growing seasons. Dusts were not applied until 1921. They found that with sprayer pressures of 75, 125, and 200 lbs., the two higher pressures damaged the vines, that both Bordeaux mixture and copper lime dusts damaged vines but controlled downy mildew, Alternaria leaf spot and anthracnose. They advised growers not to apply fungicides until fruit were setting.

Dr. E. C. Stakman, of the University of Minnesota and the U.S.D.A., contributed an article to *The Southern Planter*, "Europe controls wheat rust through barberry eradication." He cited his experiences in Europe and stated that black stem rust was completely eliminated as a result of laws in most countries that made rust susceptible barberry bushes illegal. In England, however, farmers took the matter into their own hands and eliminated barberry bushes without the aid of laws [84(2):19, Jan. 15, 1923]. There was no mention in the article about the efforts in midwestern states to eradicate barberry; Stakman had been a champion of that cause.

In February, the annual spray calendars was reproduced, and G. S. Ralston hammered away at the importance of adhering to the schedule and doing a thorough job [84(3):6-7, Feb. 1, 1923.] No dusts were recommended even though Fromme had found them useful for peaches.

Professor W. F. Massey, longtime contributor of articles on agriculture and respondent to inquiries about farm and garden problems died on March 3, 1923 [picture, 84(8):1, Apr. 15, 1923]. His son, A. B. Massey was Assistant Plant Pathologist at V.P.I. For those of us who knew A. B. Massey, the father-son likeness is readily apparent.

J. F. Jackson, Contributing Editor of *The Southern Planter*, wrote an eulogy to W. F.

Massey in the May 1 issue [84(9):20]. He credited Massey with having conducted experiments with legumes for soil enrichment at the North Carolina Agricultural Experiment Station and for extolling the virtues of legumes in crop rotations. Jackson describes him as "One of the greatest benefactors of Southern farmers and truckers on record." Massey had written many articles on plant diseases. He was 84 years old.

"Control of tomato diseases by spraying and dusting" was a subject in the "Trucking, Gardening and Orchard" column in May [84(9):8, May 1, 1923.] This was a review of Experiment Station Bulletin 230 by Fromme. Five sprays with soap Bordeaux mixture were profitable where the price per bushel of tomatoes exceeded thirty cents. Dusting rather than spraying was recommended for gardeners especially in the mountains where late blight was apt to occur. In this area a copper-lime dust was recommended.

In "Note from Virginia College of Agriculture" [84(9):2, Oct. 1, 1923], Fromme described the new seed treatment with copper carbonate for wheat bunt control. It required no wetting, and was less damaging to the wheat. Although it was effective against wheat bunt, it was not as good as formaldehyde for oat and barley smuts. Chestnut blight had spread throughout Virginia. It was found in 1923 penetrating northern Georgia and southwestern North Carolina [84(20):8, Oct. 15, 1923]. Fromme published an item that workers in Kentucky had discovered that blackfire and wildfire may be introduced into tobacco seed beds by workers who chewed tobacco and spit into the beds. He warned growers not to allow the use of tobacco products while working with seedlings [84(24):7, Dec. 15, 1923].

At the 1923 annual meting of the American Phytopathological Society, Fromme was elected President for 1924 (Phytopathology 14:200-210, 1924). It would be 70 years before another V.P.I. pathologist would become A.P.S. president; that honor would go to Sue Tolin in 1994. President Lyman, Fromme's immediate predecessor, appointed Fromme to a committee to study the character of the winter meetings. The committee met before the business meeting and prepared a report which was adopted by the membership. Abstracts would be continued as a part of *Phytopathology*; there would be a program committee consisting of the president, secretary, and chairman of the Advisory Board; and the concepts of symposia and discussion sessions emerged. With Fromme presiding, the minutes of the 1924 meeting will be carefully examined.

The A.P.S. presidency must have been time consuming because Fromme did not publish again until 1926. Then too, changes in faculty must have added a burden to his administrative and research load. Massey was assigned to full-time teaching after July 1. Wingard returned to Columbia University in the fall for the 1924-25 session. In the fall of 1924, Fromme was the sole Experiment Station Plant Pathology person in Blacksburg; field station personnel outnumbered the Blacksburg staff. At the end of August, Ray Davis of the Truck Station resigned to take a teaching position at Ricks College, Rexburg, Idaho. His position was not filled for five months. Although he was at Norfolk for only a year and three months, he contributed significantly to bulletins published during his tenure. In January 1924, the Truck Station summarized tomato disease control work (R. J. Davis, H. Spencer, and H. H. Zimmerley, 1924. Dusting and Spraying Tomatoes. Va. Truck Expt. Sta. Bul. 46). Dusts were more effective than sprays; both dusts and sprays controlled leaf spot (*Septoria lycopersici*) and leaf mold (*Cladosporium fulvum*), the most common tomato diseases in the area.

Davis and others published a summary of diseases and insect control experiments on eggplant for the period 1918 to 1923 (Spencer, Zimmerley, and Davis, 1924. Dusting and Spraying Eggplants. Va. Truck Expt. Sta. Bul. 47). Phompsis blight (*P. vexans*) was the disease targeted by the experiments. Either sprays or dusts containing Bordeaux mixture and calcium arsenate gave top yields. Control of flea beetles was more important than the control of blight.

Frank P. McWhorter replaced Davis but there is some question as to when he joined the Truck Station staff. According to the *American Men of Science* (vol. 5, 1933), it was 1923; according to personnel records of the Station, it was March 1, 1925; however, he prepared a Truck Station bulletin dated October 1, 1924; he was probably appointed in September 1924. Regardless of the date of his appointment, he prepared a bulletin, "Black Rot of Kale" (Va. Truck Expt. Sta. Bul. 49, 1924), based on literature, yet nothing was cited. The disease was described and illustrated. Seed treatment with $HgCl_2$ and crop rotation were the control measures stressed.

Two extension bulletins addressed plant diseases in 1924. The departments of Entomology, Horticulture and Plant Pathology collaborated to produce, "Orchard Spraying in Virginia (for) 1924 (Va. Ext. Div. Bul. 88). Spray schedules were charted; there was discussion of schedules and methods of preparing spray materials. This became an annual publication beginning in 1923. The spray service was briefly described. *The Southern Planter* published copies of the spray calendar [85(3):5].

Wingard and Godkin issued, "Tobacco Diseases in Virginia and Their Control" (Va. Ext. Div. Bul. 90, 31 pp.), in which ten problems were discussed; nine pages were devoted to blackfire and wildfire. They were by Virginia researchers the most thoroughly studied diseases in the State. Detailed descriptions were given, accompanied by six photographs of symptoms. The section ended with a list of eleven recommendations for controlling them. In the discussion of mosaic, it was stated that, "Its cause is as yet undetermined." There was no mention of "virus" even though Allard had called the cause of tobacco mosaic "virus" in 1916 (Jour. Agri. Res. 6:649-674, 1916.) Black root rot, root knot, Granville wilt, frog-eye leaf spot, frenching and lightning injury were discussed. There was a claim that black shank had been found in specimens from "several fields" in 1923. Later, Wingard stated that black shank was first introduced into Virginia in 1937; he made no reference to the statements in Extension Bulletin 90 (Plant Dis. Reptr. 23:369-370, 1939). *The Southern Planter* published notes regarding control of blackfire and wildfire with the admonishment "Don't spit on the plants" [85(3):34-5, (9):2, 20-1.].

In 1957, S. B. Fenne wrote a history of the Extension Plant Pathology program in Virginia, 1923 to 1957. Since early Extension publications are not always available, Fenne's annual summaries will be quoted. "For 1924, one of the most important tomato projects was the control of sleepy disease (Fusarium wilt). A certified potato seed production program was started in the mountain areas of Southwest Virginia. Sixteen thousand pounds of salt were used in the eradication of barberry bushes." (S. B. Fenne. 1957. The plant pathology extension program in Virginia from 1923 to 1957. Unnumbered mimeo.) Fenne was quoting from Godkin's annual report.

Godkin published two notes on "Wheat and barley seed treatment in Virginia" (Extension Pathologist 2:104, 144. 1924). "I think that I have personally supervised hot-water treatment of about 200 bushels of wheat and 100 bushels of barley, the work being done in Warren, Augusta, Botetourt, and Appomattox Counties. We could have done a great deal more from our office here if we had had additional time and assistance." Photographs accompanying this article were not printed but they showed how streams were used for presoaking the grain.

In *The Southern Planter* column "Work for the Month", the item "Treat wheat seed for smut" urged growers to use formaldehyde or copper sulphate-lime liquid treatment; it did not mention copper carbonate dust which was replacing the others in 1924 [85(19):4.]. No reference was made to Godkin's work. In news from V.P.I., Godkin was cited as having urged tomato growers to dust their seed beds with copper-lime dust plus an insecticide to control diseases and flea beetles [85(11):2.].

The 28th annual convention of the Virginia State Horticultural Society was held in late January 1924 rather than early December 1923, the usual time. A report on "Cedar rust control" was presented by W. S. Campfield of Staunton. He began with, "The Cedar Cutting Project which was undertaken and completed in Augusta County during the winter of 1922 and 1923 is said to have been the largest, most thorough and least expensive piece of cedar eradication accomplished in the State." Campfield, as Secretary of the Augusta County Fruit Growers Association, handled details of the project. As he outlined the project, there were payrolls, contracts, and warrants against the County Treasurer for payments to cover the payrolls and reimbursements to the County from a levy laid against the fruit acreage. Mr. C. R. Willey, Assistant State Entomologist handled the contested cases. Most difficulties were encountered for cutting cedars from church yards, cemetary lots, and private yards. The cost was computed at about eight cents per acre for 150,000 acres or about $12,500. The 1923 apple production was increased in value by $250,000. The growers were assessed at the rate of $1 per acre per year until the County had been fully reimbursed. Growers received many times that from increased apple production (Va. Fruit 12(2):33-38, 1924.).

Schneiderhan spoke to the Society on "Research on fruit in 1923" [Va. Fruit 12(2):125-136, 1924]. He carefully outlined the steps that orchardist must take to reduce the size of cull piles. Scab accounted for 31% of the culls in 1922, but only 2.3% in 1923. It was dry early in 1923 and worms caused more damage than fungi. In his harangue to growers to produce fewer culls, his ability as a humorist prevailed. "If you apple growers are aiming to become cull raisers it might be advisable to organize a new cooperative association and name it The Amalgamated Order of Modern Moonshiners. That is the only outlet for profitable cull raising. But the records show that eventually, sixty per cent of all moonshiners are apprehended and that forty per cent go to jail so please take my advice and raise more barreled apples and thus eliminate the danger of going broke or to jail." Schneiderhan introduced to peach growers the dry-mix (of sulphur and lime). At a ratio of 8-4-8, sulphur, hydrated lime, and calcium caseinate, the amount of mix required for the whole season could be prepared. It was found in 1923 to be equal to or superior to lime-sulphur for control of peach scab and brownrot. It was easier to prepare than lime-sulphur and had better sticking and spreading qualities.

Judging from the outline of his talk to the Society, Schneiderhan was a very persuasive speaker, and growers were going to heed his advice. He published his first bulletin based on his research at Winchester in March 1924. No doubt, much of what was said at the Horticulture Society meeting had been based on the work, "Apple Scab and its Control in Virginia" (F. J. Schneiderhan and F. D. Fromme, Va. Agri. Expt. Sta. Bul. 236). This was the only publication co-authored by Fromme with a plant pathologist on which Fromme was the junior author while he was Department Head. The bulletin is based on Schneiderhan's work in 1922 and 1923. The authors state that scab infections accounted for one-third of the culled apples in 1922. They described the symptoms, effects, cycle, methods of detecting ascospore discharges, frequency of discharges, correlation between date of ascospore discharge and appearance of symptoms, the effect of omitting one or more of the sprays from the spray schedule and the causes of culling. There were 15 categories of culls; scab ranked first in 1922 but eleventh (due to drought) in 1923. The importance of moisture in bringing about infection early in the season was demonstrated. Due to the variety of causes of culling, they concluded that a full schedule of seven sprays was necessary to produce the highest percentage of blemish-free fruit. The economics of spraying was not considered.

Fromme, having been well educated in uredinology (the study of rust fungi), discovered that cowpea rust was different from bean rust and published his findings in, "The rust of cowpeas" (Phytopathology 14:67-79). After a careful review of the literature and a comprehensive study of its morphology and host range, Fromme assigned the fungus to *Uromyces vignae* Barclay.

Wingard, while working with Fromme on tomato disease control, found that a bacterial rot frequently destroyed ripe fruit. Bacterial rot was particularly destructive to fruit in the experiments where sprays were applied for Septoria leaf blight control. Wingard studied the disease (S. A. Wingard. 1924. Bacterial soft rot of tomato. Phytopathology 14:451-459), and found all varieties tested were susceptible, green fruits were more susceptible than ripe ones, the bacterium entered through cracks and punctures, and its prevalence could be reduced by soap-Bordeaux sprays. A. B. Massey studied the cultural characteristics of the organisms and assigned it to *Bacillus aroideae* Townsend (A. B. Massey. 1924. A study of *Bacillus aroideae* Townsend, the cause of a soft rot of tomatoes and *B. carotovorus* Jones. Phytopathology 14:460-477.). This was the only research article published by Massey at V.P.I. before he became full-time teacher.

An account of the nematode disease of cereals was published by R. W. Leukel, Assistant Plant Pathologist, U.S.D.A. Much of his experimental field work was conducted at the Arlington Experimental Farm, Rosslyn, Virginia, presently the site of the Pentagon Building. He also did some work at Woodstock, Shenandoah Co., and Morrisville, Fauquier Co. By the time he prepared the paper, the gall nematode had been found in 53 Virginia Cos. (Leukel, R. W. 1924. Investigations on the nematode disease of cereals caused by *Tylenchus tritici*. Jour. Agri. Res. 27:925-956 + 5 pls.).

Fromme made numerous reports on disease incidence in *The Plant Disease Reporter* vol. 8. He continued to highlight cedar rust damage in the absence of cedar eradication, especially in Albemarle and Shenandoah Cos. (P. 35, 132.); said apple-scab-induced losses were heavy because rains interfered with spraying in May (p. 38, 131); and reported severe cotton anthracnose in Brunswick and Nansemond Cos. (p. 57, 113). Flippo Gravatt, U.S.D.A., reported severe sycamore blight (*Gnomonia veneta*) in Roanoke, Staunton, Charlottesville and Winchester (p. 14). In addition, tomato late blight, apple bitter rot, and blotch were locally severe (p. 35, 117, 133).

During the interim year between his two sessions at Columbia University, S. A. Wingard prepared two articles for *The Southern Planter*, "Two important diseases of cotton" [85(15):2], and "Bird Eye beans in Southwest Virginia" [85(17):6]. In the former, Wingard described sore-shin whose causal fungus, *Rhizoctonia* sp., incited damping-off of seedlings and a stem canker of older plants. He offered no control measures for sore-shin. He also described anthracnose (boll rot, boll spot) and encouraged the use of disease-free seed and two years between crops of cotton. Disease-free seed was obtained only from fields not displaying symptoms of anthracnose or by storing cotton seed for three years. The anthracnose fungus would die and the seed would remain viable. In an item "Cowpea and soybean wilt", S. "C." Wingard was cited wherein Fusarium wilt of soybean and cowpea could be controlled by very long rotations, in which these crops occurred once in four or five years, or by growing resistant 'Iron' or 'Brabham' cowpeas and 'Black Eyebrow' or 'Brown' soybeans.

The Crop Pest Law regarding cedar eradication was amended in 1924 to enable growers or the State Entomologist to enter properties and destroy seedling or regrowth cedars without being contested in court [Quarterly Bul. Va. State Crop Pest Comm. 6(2): pages not numbered.]. The staff of the Crop Pest Commission undertook a study of the effect of cedar rust on 'York Imperial' apples [W. J. Schoene, C. R. Willey, and L. R. Cagle. 1924. Cedar spots and fruit losses. Ibid. 6(4):1-8.]. One or two spots per leaf allowed fruit to mature but at a reduced weight. Three or more caused significant yield reduction and 8 to 10 spots caused serious reductions and defoliation. (It was noted in a previous study that defoliation retards the growth of trees). Trees previously injured by rust produced fair crops if cedars were removed.

Fromme presided over the 16th annual meeting of the American Phytopathological Society. He is mentioned only twice in the minutes:

"The Society was represented through its president, Dr. F. D. Fromme, at an international meeting, the first Pan-Pacific Food Conservation Conference, held in Hawaii during the first half of August (Rept. of 16th Ann. Meeting, A.P.S., Rept. of the Advisory Board. Phytopathology 15:313. Recall there was no air service to Hawaii, only surface transportation).

It was also noted in the Advisory Board Report Special Research and Investigational Projects that "The Arthur rust project ... has been carried on during the past eighteen months and ... seven of the proposed eleven chapters have been written ... Dr. F. D. Fromme spent the month of January on this work" (Ibid p. 314). (Note: This effort led to the book, J. C. Arthur in collaboration with F. D. Kern, C. R. Orton, F. D. Fromme, H. S. Jackson, E. B. Mains, G. R. Bisby. 1929. The Plant Rusts. John Wiley & Sons, N.Y. 446 pp.).

In an action of the A.P.S. Council, E. C. Stakman and F. J. Schneiderhan were appointed to take charge of the preparation of a report of the Washington meeting. The significance of these appointments is not understood. It appears that the appointees were being asked to serve in behalf of or in lieu of the Secretary, R. J. Haskell. Regardless, this was Schneiderhan's initiation into affairs of the Society.

As immediate past president, Fromme remained as a member of the Council for 1925. This is not recorded in the minutes but appears on the title page of

Phytopathology (vol. 15:iii). Usually in minutes of meetings, the president or chairman, who ever presides is noted by the secretary. It was not so noted.

The Department of Plant Pathology became the Department of Botany and Plant Pathology probably at the beginning of the fiscal year, July 1, 1925. This was precipitated by the retirement of Dr. E. A. Smyth, Jr., Professor of Biology and Head of the Department of Biology. The Biology Department was discontinued; the staff of the new department included:

Professor and Head, F. D. Fromme; Associate Professor H. S. Stahl, instruction, plant physiology and botany; A. B. Massey, instruction, bacteriology and botany; S. A. Wingard, research; Assistant Professors F. J. Schneiderhan, research, Winchester; James Godkin, extension; Instructor, R. H. Hurt, research, Crozet; and Assistant (not Asst. Prof.), C. N. Priode, research (Phytopathology 15:809. 1925).

Carl N. Priode was appointed Assistant in Plant Pathology in the Experiment Station on June 6; he had just earned a B.S. degree in Agronomy at V.P.I. Wingard had returned from an educational leave, having earned the Ph.D. degree at Columbia University in June; he and Priode would work with Fromme on the nature of the agent causing tobacco ringspot. The addition of Stahl to the faculty signaled the beginning of plant physiology as a discipline in the department. Stahl had conducted corn disease surveys for the U.S.D.A. Plant Disease Survey several years earlier while he was in Biology.

Research emphasis at Blacksburg in 1925 was on tobacco ringspot, apple black root rot, bean rust, and cereal smuts; three major publications were issued. Wingard published his Ph.D. dissertation, "Studies on the pathogenicity, morphology, and cytology of *Nematospora phaseoli*" (Bul. Torrey Bot. Club 52:249-290, 1925). Emphasis was on the life cycle, particularly ascosporogenesis and nuclear cytology of the yeast. Although yeast infection of lima bean was clearly associated with stink bug (*Nezara viridula*) punctures, Wingard could never isolate *Nematospora* from the insect.

Massey published "Antagonism of the walnuts (*Juglans nigra* L. and *J. cinerea* L.) in certain plant associations" (Phytopathology 15:773-784, 1925), in which he reviewed toxic effects on tomato, potato, and apple. Massey showed that alfalfa plants were killed wherever walnut roots extended into the alfalfa field, that tomato plants were killed out to the limit of walnut tree roots, and that in water culture, walnut root bark placed in the solution was toxic to tomato plants. He concluded, "It is likely that juglone, or some similar substance, is the toxic constituent of walnut."

Schneiderhan and Hurt collaborated to produce "The Dry-mix Spray for Peaches" (F. J. Schneiderhan and R. H. Hurt. 1925. Va. Agri. Expt. Sta. Bul. 239). They discussed the disadvantages of self-boiled lime-sulphur, the standard peach summer fungicide since 1908. It had to be prepared immediately before it was to be used; it deteriorated if stored; it could not be standardized because lime was not a standard chemical; the temperature of water used in slaking, the method and time of adding sulphur, the period of boiling and time of cooling all had to be carefully managed. To avoid these problems, a dry mixture of sulphur, lime and calcium caseinate was conceived and tested first by Farley at the New Jersey Experiment Station, and later in Ohio and Illinois. Experiments were made in Virginia at Crozet and Winchester in 1923 and 1924 and in commerical orchards in 1924 near Crozet. The dry mix contained 100 lbs of fine dusting sulphur, 50 lbs of hydrated lime, and 6 1/4 lbs of calcium caseinate. The ingredients had to be thoroughly mixed; a spray was prepared by adding 32 lbs of the mix to 200 gallons of water. The product was very satisfactory. The mix could be used beginning with spray no. 4 in the peach spray calendar (about one month after petal fall).

Godkin published a note in *The Southern Planter* "Cereal smuts and their prevention" [86(17):4-5, Sept. 1925.]. He described his surveys of wheat fields having heads with up to 14% loose smut and barley with either or both loose and covered smut up to 5%. For these he recommended hot water seed treatment as follows: Soak seed in bags 4 to 6 hours, immerse bags for 1 minute in water at 120°F, for wheat treat at 129°F (124-129°) for 13 minutes, spread treated seeds to cool and dry. The formaldehyde treatment was recommended for oat smuts.

Many releases to the press were funneled through E. R. Price, the Agricultural Extension Service Editor at V.P.I. They invariably started with "X says". In this manner, Fromme was cited for the item, "Get rid of stinking smut" [Sou. Planter 86(19):21, Oct. 1, 1925.]. Since Godkin did not address the stinking smut (bunt) problem, Fromme thought it wise to do so especially since the treatment was simple and was "dry". He touted copper carbonate and pointed out that because millers recognized that receiving bunt-free wheat was a boon to their business, they supplied the chemical and treated seed free of cost. Loose smut would reduce yields but not affect the quality of wheat. "Smutty wheat" (= bunted wheat) had a fishy odor that was imparted to flour. Fromme pointed out that the Extension Pathologist was devoting most of his time in the fall to control of smuts in cereals.

Price cited others who contributed to the column in *The Southern Planter*, "Notes from Virginia College of Agriculture." James Godkin provided "Directions for control of blackfire and wildfire disease of tobacco" [86(1):27-28, Jan. 1, 1925]; Experiment Station Director A. W. Drinkard described an effort to control fire blight. All holdover cankers should be destroyed in a community, not just in orchards [86(3):2, Feb. 1, 1925.]. Schneiderhan contributed, "Mr. Fruit Grower does your pressure gage tell the truth?" [86(3):29, 1925.]. He said different spray rigs had different pressure requirement in order to reach maximum efficiency. One gauge was 160 lbs off from actual pressure (Note 2 spellings of gauge in the article). Fromme was quoted in "Selecting tomatoes for the home garden" [86(9):2, May 1, 1925.], wherein he described persistence of the Fusarium wilt fungus in infested soil, and he recommended the resistant varieties Norton, Columbia, and Marvel. He reminded growers they would still have to apply fungicides as the varieties were susceptible to leaf diseases. Finally, Fromme described rust resistant and rust susceptible barberry bushes, the effect of susceptible species on wheat near the bushes and how to kill the bushes with salt [86(11):2, June 1, 1925.]. The annual Spray Calendar and the Virginia Spray Service were published in February [86(4):6-8, Feb. 15, 1925.]. Missing was the Inquirer's Column in which numerous plant disease problems were discussed. When W. F. Massey, A. B. Massey's father, died, that column may have died with him.

Fromme made numerous reports on crop disease situations in the *Plant Disease Reporter*. Most diseases reported were locally important; no generally destructive diseases occurred. Wheat stem rust was locally severe near barberry bushes but was not a factor where bushes had been eradicated (P.D.R. 9:29, 1925.). Tomato

Fusarium wilt was more extensive than usual (P.D.R. 9:111), and tobacco mosaic was very prevalent in Amherst Co., 50-60% in some fields (P.D.R. 9:91). Both Fromme and McWhorter at the Truck Station reported blossom end rot of tomato to be very prevalent (P.D.R. 9:90, 112-113); apparently 1925 was a dry year.

Only one paper was presented at the 1925 annual meeting of the American Phytopathological Society by V.P.I. personnel. Fromme discussed "Susceptibility of wheat varieties and selections to loose smut" (Phytopathology 16:86-87, 1926). 'Stoner' had been susceptible in fields; 'Leap' had been resistant. When Fromme inoculated heads, the subsequent crop of Stoner had 35% smutted heads, Leap had 3%. The probability of developing a resistant 'Fulcaster' strain was indicated. In addition to presenting a paper at the meeting, Fromme was Immediate Past President of A.P.S. and was a member of the Council in 1925. He was appointed to an editorial committee of three, E. C. Stakman, Fromme, and H. H. Whetzel, Chairman, to initiate the publication of important classical articles. These "Phytopathological Classics" were to be financially self-sustaining. Fromme was also Chairman of the Resolution Committee for the 1925 meeting (Phytopathology 16:658-659).

As indicated earlier, the personnel records from the Truck Station state Frank P. McWhorter was appointed Plant Pathologist on March 1. His publications suggest he actually had been hired in September or October 1924. He earned a B.S. degree from Vanderbilt University in 1917 and an M.S. degree from the University of Chicago in 1920. He served as botanist and plant pathologist in the Philippines before coming to the Truck Station. Although he issued no formal publication in 1925, he pursued his research assignment vigorously and would publish results in 1927. He monitored diseases in Tidewater and recorded some occurrences in *The Plant Disease Reporter*: Wire stem (*Corticium vagum*) damaged cabbage in cold frames in early spring, black leg (*Phoma lingan*) damaged the spring crop, and downy mildew (*Peronospora parasitica*) caused yellowing of large plants and was mistaken by growers for *Fusarium* yellows (P.D.R. 9:6). Peppery leafspot (*Bacterium maculicola*) was common on cauliflower in March but confined to coldframes at propogation time (P.D.R. 9:7).

McWhorter reported white rot of onions (*Sclerotium cepivorum*) on a farm west of Newport News. The disease had occurred in the same area in 1924. Apparently, the fungus had been imported on sets from Louisiana (P.D.R. 9:5, 1925).

The Virginia spray bulletin for 1925 was prepared by F. A. Motz, Horticulturist, Schneiderhan, and W. J. Schoene, Head of Entomology (Spray Information for Virginia Fruit Growers. Va. Agri. Ext. Div. Bul. 94. 1925). Spray schedules for each fruit crop were charted and discussed. These were reproduced by *The Southern Planter* [86(Feb. 1): ?] and Virginia Department of Agriculture in its bulletin. In addition to instructions for preparing and applying sprays, sections on compatibilities of spray materials, don'ts for fruit growers, interesting facts for growers, and helpful suggestions for growers were added. The insufficiency of spraying was summarized by, "Approximately 40% of the total annual tree crop of Virginia apples goes into the cull pile. Good spraying should reduce this to 10%." (To put it another way, for each lousy apple, only one and one-half good apples was produced. Furthermore, it costs as much to produce the lousy apple as to produce the good ones.-C.W.R.).

Godkin emphasized control of corn root, stalk, and ear rot, through selection of healthy seed ears by ragdoll tests; only 74% of the ears tested were deemed to have plantable seeds. The fungi found were not mentioned. Tobacco and cereal seed treatment increased on farms; T. W. Wood and Sons of Richmond became the first large seed company in the region to install a treating plant and to sell copper carbonate-treated wheat. Cabbage gorwers were controlling yellows with the varieity Wisconsin All Seasons.

Godkin served on an extension committee with Charles Chupp and R. A. Jehle to summarize the Extension Conference held at the A.P.S. meeting in 1924 [The Extension Pathologist 3(1+2:2-5.]. Among the reports summarized were one by Fromme on the apple spray service, and one by Godkin on the hot-water treatment program for wheat in Virginia.

In *Virginia Fruit* for March 1925, the continued fight to eradicate cedar trees in apple country and the litigation resulting from the Cedar Rust Law were reviewed. The legality of the law was threatened by a suit that the plaintiff, Mr. Kelleher, owner of Mt. Airy Estate in Shenandoah Co., threatened to take to the U.S. Supreme Court [Va. Fruit 13(2):30.]. The State Entomologist, W. J. Schoene, reviewed the history of the Cedar Rust Law and recent litigation. The Governor (circa 1920-1) withheld funds from the Crop Pest Commission for attorney fees to handle contested cedar eradication. In 1922, the State Horticultural Society promised financial support for litigation. The case was being prepared for presentation before the Supreme Court, should it reach there (Ibid:40-42.). Mr. Gudebrod thereupon after a long elaboration of the Shenandoah Co. situation proposed that a committee of the Society be appointed to establish a plan for financing future litigation. A committee was later appointed (Ibid:42-47.). It reported to membership the next day. In essence, the Committee proposed that the Society help finance litigation and that amendments to the Law deemed necessary be framed and presented to the Legislature before its next session (Ibid:133-134.). Among the committee members were W. S. Alwood and future Governor, Harry F. Byrd.

Schneiderhan was called upon to speak about "Three years of results from research at Winchester". He was somewhat of a wag and the Society apparently enjoyed his wit and unconventional presentations. He passed out 58 mimeographed questions which he proposed to answer in his allotted time. He covered the fecundity of the scab fungus (8.107 billion ascospores from a 40 x 40' area), duration of discharge (up to 94 days), time on infection, influence of weather, incubation period (15-20 days), secondary infection, control with emphasis on preventing infection, timing and efficacy of sprays, reasons for success and failure, spray injury, efficiency of equipment, use of dry-mix sprays, use on peaches. There followed a lively discussion of subjects issued forth by the members (Ibid:53-70.).

Mr. R. H. Hurt, Assistant Plant Pathologist at Corzet, was called upon to discuss "Control of bitter rot." He reviewed the history of the disease, its discovery in North Carolina in 1867 and its gradual spread and increase through 1880. He discussed varietal reactions, life cycle of the fungus, sources of inoculum, importance of removing mummies and the effect of such action upon the spray schedule (deletion of one Bordeaux application). Alwood who had worked on this 25 years before added, "The point the gentleman has made is such a good one that I want to try and enforce it. The mummies hanging in the trees, I proved conclusively were the chief sources of it...We can very largely control --- not eradicate but control --- this disease" (Ibid:134-141). Fromme was called upon to discuss "Progress and results of research with fruit diseases in Virginia." He pointed out that continuous effort had been difficult until Schneiderhan was hired in 1922 and Hurt in 1923. He emphasized the problem was not of specific disease control but of the production of disease and blemish-free fruit. The research emphasized timing of sprays with stages of twig flower and fruit development and the relation of weather, to various diseases. He presented data showing the effect of mummies on bitter rot incidence. About 10 times as much rot occurred if mummies remained on trees than when they were removed. He described the spray service inaugurated in 1922 as an Extension function based on information obtained by researchers. Since its inception cull piles were reduced from 50% to 15% of the crop, still too much (Ibid:146-156).

From the foregoing abstracts, it is apparent that the Horticultural Society depended heavily upon plant pathologists in planning the annual meeting program. It has continued to be so for many years.

Two major publications were issued by the plant pathologists in 1926, both from field stations, and both as bulletins. R. H. Hurt of Crozet published, "Honeysuckle Eradication in Virginia Apple Orchards," (Va. Agri. Expt. Sta. Bul. 244). While not on plant pathology, it was the first publication on chemical weed control issued from the Station. Hurt acknowledged that a Bureau of Plant Industry, U.S.D.A. bulletin had recommended oils for control of honeysuckle but the applicability in orchards was not discussed. Hurt experimented with sprays, timing, and emulsions and concluded that emulsions of 25% oil sprayed about May 15 to 30, July 15, and in May of the following year would be necessary in orchards. No damage to trees was noted unless the spray was applied to tree trunks.

F. J. Schneiderhan of Winchester wrote about, "Apple Disease Studies in Northern Virginia" (Va. Agri. Expt. Sta. Bul. 245). He described the early physical facilities as being initially "an old barrel shed without such conveniences as running water and electricity. Valuable instruments could not be kept there and very few of the growers knew where the laboratory was located." In 1923, the Frederick County Fruit Growers financed a new building and the Shenandoah Vinegar Company furnished the building site. There followed a detailed discussion of the experiments on apple scab control, epidemiology, and varietal reaction. Both for scab and cedar rust, spore discharge periods and time of apple leaf symptom expression were carefully monitored.

A simple demonstration was prepared to dispell the fallacious belief held by some growers that rust was as inherent phenomenon of apple. A small gall-bearing cedar tree and two young York apple trees were planted in a triangle, three feet on a side. One York tree was covered with fine muslin before leaves opened; on July 19, it was uncovered. No rust was found on its foliage; however, the exposed tree had extremely heavy rust and was partially defoliated. On seeing this, skeptical or unbelieving growers immediately became believers. Schneiderhan investigated spore discharge of the apple blotch fungus from twig cankers and found that the "5-weeks spray" was the most important for intercepting the spores. Pruning and a comprehensive spray schedule were required to control blotch. Bitter rot was controlled by removing mummies and spraying on schedule. "Weather injuries" and spray injuries were studied and described. The toxic effect of walnut was discussed; it was assumed that the toxin came only from living roots and removal of the walnut trees would eliminate the damage to apple trees. The scope of the bulletin indicated that Schneiderhan was meeting the needs of apple growers in Virginia exceedingly well.

Wingard published a note "Black end of apple" (Phytopathology 16:1011-1012), which was observed in Grady, Montgomery Co., Alabama on August 25, 1925, while he was on vacation at his home area. The disease was apparently physiological due to hot dry weather.

Godkin had a fairly lengthy item in *The Southern Planter* on "Recommendations for the prevention of wildfire and blackfire infection in tobacco plant beds" [87(6):20, May 15, 1926.]. To the usual procedures, he added that infected seedlings should be discarded. A new recommendation was that beds should be sprayed or dusted with Bordeaux mixture or copper-lime dust weekly from the time leaves reach dime-size until plants are pulled.

An interesting discussion of red clover anthracnose appeared in "Red Clover Experiments" (T. K. Wolfe and M. S. Kipps. Va. Agri. Expt. Sta. Bul. 252. 1926.). The authors, Agronomists, relied heavily on U.S.D.A. Farmer's Bulletin 1510 and collaboration with Wingard, Godkin, and Fromme. The Station bulletin allotted about 8 pages to the disease because it was considered a major factor in failure of red clover stands. Emphasis was on comparing clovers from nineteen different sources for their resistance to anthracnose. Seed from Tennessee, Michigan, and Ohio produced the most resistant plants.

Godkin's emphasis on tobacco and cereal disease control can be seen in several publications one of which is cited above. Fenne in his review of the extension program 1923 to 1957, states "Apparently wildfire and blackfire were disappearing from the flue-cured area ... No severe outbreaks of wildfire or blackfire came to our attention this year" (1926). Yet Fromme reported that blackfire was severe in Russell Co. on burley. The Virginia Department of Agriculture treated 383 seed lots with corrosive sublimate ($HgCl_2$). On the other hand, work on cereal smuts must have been spurred by the statement, "Delaware, Maryland, and Virginia grain dealers and millers report a decided increase in the amount of stinking smut in the grain harvested in 1925" (The Extension Pathologist 4:19. 1926.). The estimated loss from stinking smut in Virginia was 5-6% in 1926 compared to 1% in 1923. The increase was attributed in part to the later planting dates advised for control of the Hessian fly (Ibid. 6:14-15, 1928). Lower soil temperature in the later planting period is more favorable for infection by bunt fungi.

Numerous statements were printed in *The Planter Disease Reporter* on disease occurrence in Virginia crops in 1926. Some merely stated diseases were observed, some that common diseases were more severe, less severe, or damaging locally; a few first-time reports appeared. *Puccinia graminis poae* was found on *Poa compressa* near barberry bushes at Blacksburg; it was previously known only from Indiana and Michigan (P.D.R. 10:49). *Fusarium conglutinans callestephi* was found in Norfolk on asters by McWhorter and *Sclerotium rolfsii* was colonizing chrysanthemums in Pittsylvania Co. on July 28; this was the first U.S. report (P.D.R. 10:87). The first published report of the occurrence of cowpea scab (*Cladosporium vignae*) in Virginia appeared in 1926. It was identified on specimens from Clarksville. An additional note states that it had been found at New Market in 1918 by Wingard but he had not published its occurrence (P.D.R. 10:64). *Dothiorella* sp. was first found in U.S. on

Rosa setigera in Arlington by G. H. Martin and A. E. Jenkins, May 17 (P.D.R. 10:88). McWhorter stated that previously reported cases of potato late blight from Northampton Co. appear to be false. He had been unable to find *Phytophthora* on any plants considered by growers to have late blight (P.D.R. 10:71).

At the end of 1926, the American Phytopathological Society met with A.A.A.S. at Philadelphia. In joint session "G", Fromme presented a discussion of "Vigor of the host as a factor in the development of disease" (Phytopathology 17:343, 1927 = Minutes of the 18th Ann. Meeting.). Apparently, it was an invitational paper; the text was not published. Fromme was appointed to a 4-year term as A.P.S. representative to the Board of Control of Botanical Abstracts (= 1927-30) and a one-year term to the Division of Biology and Agriculture of the National Research Council (= for 1927). He was elected to a one-year term as chairman of the A.P.S. Advisory Board and associate editor on the A.P.S. committee on Public Information Service. Thus, he continued to be heavily involved in A.P.S. affairs.

In 1926, *The Southern Planter* published a number of items from V.P.I. that were submitted by Agricultural Extension Editor, E. R. Price. Fromme was quoted that dry lime-sulphur was not yet proven as good as liquid for fruit diseases [87(7):2, Apr. 1.]. He was also quoted that fire blight was worse than usual in southern states and in- season pruning was advised only if girdling of main branches was threatened. He also suggested the removal of pears if apples were the main crop [87(13):2, July 1.]. Godkin's cereal smut surveys were cited wherein it was shown how seed treatment benefitted cereal growers (Ibid), and there were testimonials to that effect by several County Agents. Some indicated millers encouraged treatment for bunt control by furnishing treating equipment and even copper carbonate [87(23):9, Dec. 1.]. The fruit spray calendars originating from V.P.I. were reproduced early in the year [87(3):4-5, Feb. 1.].

The Crop Pest Commission was abolished by action of the General Assembly effective June 30, 1926. At that time, W. J. Schoene relinquished his duties as State Entomologist and Plant Pathologist and became full-time Head of the Entomology Department at V.P.I. Effective July 1, his former duties were transferred to the Commissioner and Board of Agriculture and Immigration, more specifically to the Division of Plant Industry. The head of the Division, G. T. French, was then titled Chief Botanist and State Entomologist. The Division thereafter regulated nurserymen, and inspected nursery stock and other plant propagation materials in order to prevent the introduction and dissemination of plant pests. The work was divided into two classes, inspection and law enforcement. "Under law enforcement comes quarantines and their enforcement, and the enforcement of rules and regulations for the eradication and control of dangerous insect pests and diseases. Under this last falls the Cedar Rust Law" (G. T. French, Division of Plant Industry Biennial Report for the Fiscal Years 1926-1927:37-50, *in* Virginia Department of Agriculture and Immigration, Report of the Commissioner 1926-1927. Richmond, Va., 1928). As to cedar eradication, French reported that in 1926-7, much effort went toward cutting sprouts and seedlings where trees had been previously removed." As a whole, the cedar eradication work ... has been very gratifying ... several important court cases were heard with decisions rendered favorable to the cedar rust law ... Sprouting has been done over approximately 200,000 acres, ... which is a good indication that the fruit growers have been benefited by the removal of the cedars and that they aim to keep them down." (p. 47.).

"Eggplant Culture" was the subject of a Truck Station bulletin by M. M. Parker, Horticulturist. He described Phomopsis blight and rot, Verticillium wilt and *Sclerotium rolfsii* blight as being the major diseases in Tidewater (Va. Truck Expt. Sta. Bul. 56, 1926). He acknowledged McWhorter's help in preparing the bulletin.

Both the 29th and 30th annual sessions of the Virginia State Horticultural Society were held in 1925, the former January 27-29, the latter December 8-10. The report of the December meeting was published in the March, 1926 issue. At that time, one of the Society's members, Harry F. Byrd, had become Governor.

A grower, W. H. East, gave a testimonial about the effect of cedar eradication on apple production in Augusta Co. He was skeptical when told the infection came from cedar trees. When convinced, he and others removed cedars on their land and their neighbor's at their own expense, first up to a half mile later to a mile. A factor for getting the citizenry behind the eradication, was that apple production and quality improved, income rose, the tax base increased, and county prosperity improved. East was optimistic that eradication could be accomplished [Va. Fruit 14(2):84-87, 1926.]. Schneiderhan spoke on "Cedar rust studies in 1925" (Ibid:134-140). True to form, he introduced, his talk with some interesting comments:

"Virginia ranks third in apple production in the United States, and first in the losses resulting from the cedar rust disease ... The total loss from cedar rust in Virginia is greater than all of the rest of the United States taken together. If we have been the greatest sufferers from this disease we have also made the greatest efforts to control it. In the cedar eradication, Virginians have expended more money, released more eloquent oratory, broadcasted more cussing, and have lost more good neighbors than any state in the union."

At that time a two-mile cedar-free zone was allowed by the cedar law, yet there were losses from rust. Schneiderhan took data at 10 locations where cedar trees were from 75 yards to 4 miles away. He recorded percentage of leaves with spots (= % infection) and number of spots per leaf (= intensity). At Mt. Jackson the cedars were those which were the subject of the pending law suit. There was an inverse relationship between distance and both infection and intensity. At Clearbrook the correlation was not very good; the 3-mile and 1.5-mile distances were about equal and higher than the 2.2-mile distance which produced lowest scores. From the leaves remaining on trees it was concluded that 5 spots per leaf was a tolerable number and cedars would have to be 2-miles or more from orchards.

At the Crozet station, R. H. Hurt had been experimenting with honeysuckle control and spoke on "Eradication of honeysuckle in Virginia apple orchards." [Va. Fruit 14(2):140-145, 1926.]. Hurt described experiments with various strength oil emulsions. A 25% oil emulsion was found to be the most economical effective strength. It required two seasons to eradicate the weed with sprays of this strength. Hurt had published this work in a station bulletin (R. H. Hurt. 1926. Honeysuckle Eradication in Virginia Apple Orchards, Va. Agri. Expt. Sta. Bul. 244). So far as I can ascertain, this was the first chemical weed research conducted in Virginia.

"The apple root-stock problem "was Fromme's topic for discussion (Ibid:152-155). Sexual and asexual root stock propagation were discussed. The disease problems affected by the choice of root stock were collar rot, root rot, and bitter pit. Uniform root stocks though desirable because of stock-scion relationships has the pitfall of producing uniform susceptibility to disease. Seedling root stock would be more easily managed by nurserymen, but in Virginia the need for root-rot resistance was essential and an extensive root system was needed to reduce the incidence of bitter pit in certain varieties.

The 31st annual session of the Virginia State Horticultural Society was held in December, 7-9, 1926 [Va. Fruit 15(2):1-200, 1927.]. The Secretary, W. S. Campfield, praised the work of the preceding secretary, W. P. Massey, and Judge F. S. Tavenner, Attorney for the State Entomologist, for their splendid efforts in obtaining rulings favorable to fruit growers in the face of well financed suits aimed at upending the legality of the Cedar Rust Law. Cedars on properties in Shenandoah Co. were the bones of contention in two court cases, one of which appeared headed for the U.S. Supreme Court (Ibid.:20).

Professor H. H. Whetzel of Cornell University was the featured speaker at the meetings; he was introduced to speak on dusting apples but his talk turned out to be the basics of fungicide utilization (Ibid.:81-90, Discussion of dusting and spraying, members questioning Whetzel:90-107). Whetzel very lucidly defined fungicide, distinguished between protectant and disinfectant (actually disinfestant), described the toxic activity of copper and sulphur fungicides, compared the effectiveness of sprays and dusts, discussed why dusts stick, pointed out the fine line between fungitoxicity and phytotoxicity and finally concluded by summarizing the attributes of a successful fungicide. Although only copper compounds and elemental sulphur were available, Whetzel's comments apply even to modern fungicides. Interesting as it was, the discussion that followed was very lively and involved friendly sparring between Whetzel and the members. He enjoyed doing this with his plant pathologist peers and was in this manner a superb entertainer-educator. The members seemed to have thoroughly enjoyed the session.

R. H. Hurt was called upon to discuss "Making oil emulsions" (Ibid.:142-144). It seems that preparing cold oil emulsions had caused some problems with growers; Hurt made two points that cleared up the problems. He told them to be sure to add the lime and casein to water first, mix thoroughly and then add the oil. He also suggested the oil be warmed on cold days better to facilitate emulsification. The growers grilled Hurt on the use of oils, but he stood his ground pointing out no problems were encountered if his formula resulting in a 2% oil emulsion was made properly.

Schneiderhan spoke next on "Recent developments in the control of fruit diseases" (Ibid.:145-157). From the beginning it seemed that Prof. Whetzel had come into an arena where the professionals were pro-spray and he had jerked the rug from under them by highly touting dusting. Apparently Schneiderhan was miffed because he felt the Society thought he was against dusting. He felt the need to state his position, that being from all the data available he would recommend what he determined to be best for Virginia growers. He concluded his rebuttal by saying "Speaking in an unprejudiced manner and holding no animus against dusting men (I like them all) I can't conscientiously recommend dust as a scab control under Virginia conditions in a heavy epidemic year." Having gotten that off his chest, Schneiderhan reverted to his prepared talk. He described the effects of black walnut trees on apple and gave a lengthy, detailed discussion of blotch or "cloud" which growers were having difficulty controlling. He emphasized that the 3-weeks, 5-weeks and 7-weeks sprays were the keys to blotch control and careful pruning to remove cankered twigs and provide an open canopy were essential.

Schneiderhan reviewed the conditions conducive to apple scald in storage. Brooks and Cooley of the U.S.D.A. had elaborated 10 points concerning the development of scald. They found that 1 1/2 lbs of shredded oiled paper scattered throughout a barrel would control scald. Schneiderhan had experimented with various oils and found oiled paper to be the solution to date.

He next discussed death of trees and what might be done to control it. Various root problems were mentioned but he admitted control was a difficult problem which had been met by little experimental success.

The annual meetings of the State Horticultural Society have thus far been a fertile source of the history of apple pathology.

There were some changes in the Department's staff in 1927. C. N. Priode resigned on January 1, to take a position with the Boyce Thompson Institute. Everett F. Davis was appointed Assistant Plant Physiologist on August 29; his appointment signaled the beginning of plant physiology research in the Experiment Station.

James Godkin was granted a leave of absence for graduate study about June 1. Sanford B. Fenne was immediately appointed Acting Extension Plant Pathologist. Fenne earned a B.S. degree from V.P.I. in June, 1927 but somehow had served as County Agent in Augusta Co., 1925-1926. Fenne served for one year at V.P.I. then became County Agent in Washington County. During his year at Blacksburg, Fenne emphasized the control of cucumber and tobacco mosaic. In his history of extension plant pathology, Fenne quoted from Godkin's 1926-7 annual report: "During the war a considerable amount of foreign wheat was brought into the U.S...., some of it was used for seed. New strains of bunt were introduced, to which our American wheat was highly susceptible... (It) became the most destructive disease of wheat in this country." Copper carbonate seed treatment became the means of controlling it and enough was used on wheat to seed 134,000 acres (in Virginia). The millers reported a great improvement in wheat flour and production was sustained. "Without help from the Plant Pathology Department it would have been impossible for Virginia farmers to continue growing wheat because of stinking smut." It was Godkin's tribute to his own efforts.

Several important research publications were authored by the departmental staff in 1927. R. H. Hurt and F. J. Schneiderhan published "New Methods of Bitter Rot Control" (Va. Agric. Expt. Sta. Bul. 254), wherein they described efforts "To find methods of control which would supplement spraying and obviate the necessity of so many applications of Bordeaux" (p. 3). They described and illustrated diseased apples and identified sources of inoculum as mummies and twigs with mummied fruits. Mummies produced inoculum for at least two years. Removal of mummies during the dormant period from trees and the orchard floor and spraying with 3-5-50 Bordeaux at five and seven-weeks successfully controlled bitter rot. These procedures had already been presented in talks to the Horticultural Society.

The most significant publication of 1927 was that by Fromme, Wingard, and Priode entitled "Ring-spot of tobacco: An infectious disease of unknown cause" (Phytopathology 17:321-328). They described and illustrated the symptoms and stated that similarly affected leaves had been illustrated in 1904 by Selby of Ohio and in 1925 by Johnson of Wisconsin. It was first observed in Virginia in 1917. Until the current paper appeared no one had suggested it was caused by a virus. Fromme et al. demonstrated the infectious nature by successfully inoculating five species and numerous varieties of *Nicotiana*. They noted that some plants recovered in that the new growth had no symptoms. The asymptomatic leaves were found to be infectious. No vectors could be found.

Schneiderhan published his observations on "The black walnut (*Juglans nigra* L.) as a cause of the death of apple trees" (Phytopathology 17:529-540). He reported evidence that some farmers had recognized the toxic effect of walnut on apple as early as 1897. He diagrammed some of the "toxic courts" of walnut and described 13 instances of toxicity toward apples. In several cases, only one side of an apple tree was affected. Sixteen walnuts caused the death of 48 apple trees and damage to 14 others. The average distance of the toxic court was 50 feet; the maximum was 80 feet. Root contact between walnut and apple was essential for damage. This was the first paper on walnut toxicity to apple although he had briefly discussed the subject in the bulletin. "Apple Disease Studies in Northern Virginia" (Va. Agri. Expt. Sta. Bul. 245, 1926).

The "Manual of Plant Pathology" (F. D. Heald, McGraw-Hill Book Co. 891 pp., 1926) was reviewed by A. B. Massey (Phytopathology 17:341-342, 1927). The book either in the first or second (1933) edition is well known to plant pathologists. Today (1995), it stands as a compendium of phytopathological history. Massey described favorably the content of its four sections but lamented the omission of discussions on vascular wilts, "Principles of parasitism, resistance and susceptibility, inoculation, infection, dissemination, the relation of environment (soil and air temperature, humidity, and soil reaction) to infection and development of infectious diseases, the fundamental principles of control." He added that "Much of this is presented in the book in the consideration of specific diseases but not in a connected form which would be of value and help to the student and instructor." (Note: Even in the "Introduction to Plant Pathology" (1937, 1943), Heald did not heed Massey's very pertinent criticisms. The same material is missing. - C.W.R.)

F. A. Motz, Horticulturist, Schneiderhan and W. S. Hough, Entomologist, continued with the annual bulletin "Spray Information for Virginia Fruit Growers" (Va. Agri. Ext. Div. Bul. ?, 1927). Godkin published "The Control of Corn Rot Diseases by Germination Selection" (Ibid. 101, 1927). At that time, it was believed that selecting fungus-free ears would solve stalk and ear rot disease problems. This bulletin included instructions and diagrams for making a seed germinator and "rag dolls" to contain the seed. There was no mention of the target fungi.

In the 1927 *Plant Disease Reporter*, (vol. 11), several diseases were reported by Fromme either as new diseases or as causing heavy damage in some areas. At or near Blacksburg, wheat leaf rust was severe (p. 15), lettuce downy mildew occurred on wild and garden lettuce (p. 21), oat crown rust was moderately severe (p. 61), *Gloeosporium* (now *Aureobasidium*) *caulivorum* causing red clover anthracnose was severe (p. 64), *Heterosporium gracile* (now *Cladosporium iridis*) damaged iris (p. 52). Elsewhere Fromme found tobacco mosaic to be very prevalent (p. 100), yeast spot of bean occurred in Dinwiddie and King and Queen Cos. (p. 149), wheat gall nematode was damaging in Prince William and King and Queen Cos. (p. 60), *Gnomonia ulmea* defoliated elms near Leesburg (p. 57), and oat crown rust caused total losses in fields in Surry Co. (p. 61), and Schneiderhan reported that 2% Volck oil emulsion stopped powdery mildew on roses after it appears (p. 43).

From the Truck Station came two bulletins addressing plant diseases. Frank McWhorter issued "Control of Beet Seedling Diseases Under Greenhouse Conditions" (Va. Truck Expt. Sta. Bul. 58, January, 1927). The production of early beet crops required the production of seedlings in heated greenhouses or hotbeds. Seedborne *Phoma betae* causing blackleg and soilborne *Rhizoctonia solani* and *Pythium* spp. causing damping-off were the principle problems. McWhorter found that chloro-phenol mercury sold as "Uspulun" and "Semesan" applied in a water solution greatly increased the survival of beet seedlings. This was the first recommended use of an organic mercury compound for seed treatment in Virginia.

McWhorter published a description of "The Early-Blight Diseases of Tomato" (Va. Truck Expt. Sta. Bul. 59, April 1927). All phases from seedling blight to fruit rot and vine killing were described but no control measures were included. This was simply an attempt to educate tomato growers on the identity of early blight symptoms.

McWhorter reported on several diseases in Tidewater in the *Plant Disease Reporter* (vol. 11). Spinach and alfalfa downy mildews were common in the spring (pp. 19, 63); snap bean bacterial blight was common in the Norfolk area (p. 41); *Amerosporium* (now *Aristastoma*) *oeconomicum* caused leaf spot on cowpea in Westmoreland Co. (p. 141); the most destructive case of tomato mosaic ever seen occurred at Diamond Springs (near the Truck Station) on late tomatoes (p. 156); pepper also had mosaic there (p. 157); in two cases, Marglobe tomato was somewhat affected by Fusarium wilt on Northern Neck but was completely resistant at Williamsburg (p. 157); downy mildew was the most prevalent cucurbit disease on cucurbits (p. 158); *Septoria lactucae* occurred on lettuce near Richmond (p. 158); *S. chrysanthemella* required frequent Bordeaux sprays for control (p. 161); *S. divaricata* was damaging to phlox (p. 161); *Coleosporium solidaginis* (now *C. asterum*) occured on aster (*Callistephus chinensis* in Mathews Co. (p. 162).

Both McWhorter (Phytopathology 17:201-202) and Schneiderhan (Pl. Dis. Reptr. 11:43) reported on the use of Volck oil sprays on control of rose powdery mildew. The former reported that some rambler roses that had not bloomed for several years, bloomed profusely in 1926 after having been sprayed three times with the oil emulsion.

Fromme continued to be active in A.P.S. affairs; he was elected to the Council beginning in 1927; he was (for A.P.S.) Representative on the Board of Control of Botanical Abstracts, Representative on the Division of Biology and Agriculture of the National Research Council, Chairman of the Advisory Board of A.P.S., and Associate Editor for the A.P.S. Committee on Public Information Service. Schneiderhan began a 3-year term as Associate Editor. He also served on the *ad hoc* Committee on Publicity for the December 1927 meeting. It was his first involvement in A.P.S. operations. Other than he and Fromme, no plant pathologists from Virginia had served the Society (Phytopathology 17:343-352).

Several items on plant pathology appeared in *The Southern Planter* for 1927. Growers were advised to prune to prevent fire blight [88(1):30, 1927.]; the spray calendar from the Extension Service was reproduced [Ibid.(3):6-7]; Schneiderhan listed the causes of apple tree death in the Shenandoah-Cumberland Valley area as mouse injury, root rots, insects, shallow soil, and weather. 'Northern Spy' root stock offered the best protection against root rot [Ibid.(12):7.]; Godkin wrote a letter to the editor warning that lime wash does not control wheat bunt and urging growers to use copper carbonate [Ibid.(16):4]; the editor then referred to work by Godkin wherein he found that for wheat grown from copper carbonate treated seed, 40 fields had 0 bunt, 4 had 1%; of 66 from untreated seed, 42 had bunt [Ibid.(17):3]; in a tomato Fusarium wilt resistance demonstrations with Stone, Norton, Marglobe, and Columbia varieties; only Stone wilted [Ibid.(23):2].

Apparently, Meade Ferguson, one-time Bacteriologist in the Department, had retired as editor of *The Southern Planter* and T. K. Wolfe, until recently Agronomist at V.P.I., had replaced him. The magazine had a new owner. Was Ferguson retired or axed? [Ibid.(17):10]. He was a member of the V.P.I. Board of Visitors, 1921 to 1925.

At the Horticultural Society meeting on December 13-17, the Secretary reported on further litigation over the Cedar Rust Law. Although plaintiffs Daniel Kelleher and Dr. J. W. Miller continued with appeals, the law was upheld and the Kelleher case was dismissed at the U.S. Circuit Court level. The Miller case had already been placed on the docket of the U.S. Supreme Court. Judge F. S. Tavenner represented the fruit growers and C. R. Willey, Associate State Entomologist provided technical support [Va. Fruit 16(1):16, Jan. 1928; Dept. Agri. & Imm. of Va. Reprt. 1926-27:47-50, 1928]. The Cedar Law was later upheld by the U.S. Supreme Court [Va. Fruit 16(3):Mar. 1928]. At that same meeting, Fromme gave what turned out to be his swan song as a V.P.I. plant pathologist. In the address, "Black root rot disease of apple," he summarized his 12-year study of the root rot caused by a fungus he had named *Xylaria mali* [Va. Fruit 16(1):86-95]. This was a review of the work that would appear in a technical bulletin in 1928. Even after 12 years, he admitted that he had not been able to find suitable control measures.

The Department of Agriculture and Immigration prepared biennial reports. For 1926-27, progress in cedar eradication was summarized. Trees and sprouts were removed on 3059 acres at a cost of $3794.53, or a little more than $1.00/acre. The program included Augusta, Clarke, Frederick, Rockingham, and Shenandoah Cos. All of these counties border West Virginia. The program had been active previously in seven other counties.

The end of the Fromme era came on June 30, 1928. Thus, Fromme participated for the last time as a V.P.I. faculty member in the A.P.S. meeting of December 28, 1927 to January 1, 1928. He presented a paper entitled "Studies of black root rot of apple" (Phytopathology 18:145. 1928), wherein for the first time he used the fungus name *Xylaria mali*. In essence, he summarized the bulletin, probably already at the printer, "The Black Root Rot Disease of Apple" (Va. Agri. Expt. Sta. Tech. Bul. 34, 1928); this will be reviewed later. At the A.P.S. meeting he also was junior author of a paper presented by S. A. Wingard titled "Tobacco ringspot; a virus disease with a wide host range" (Phytopathology 18:133). They extended the host range to 19 genera in 11 plant families and reported that sap remained infectious if diluted as high as 1:10,000. Host range would be a future subject of Wingard's work.

At the banquet of the annual meeting, Fromme gave an impersonation of the ghost of Charles Darwin (Ibid., p. 464). Imagine giving a recapitulation of life on the H. M. S. Beagle, the origin of the species, and the theory of evolution all in a ghostly fashion! Fromme must have had a great sense of humor. In addition to having fun, he continued in 1928 as Councilor, Chairman of the A.P.S. Advisory Board and Representative on the Division of Biology and Agriculture of the National Research Council through 1930.

Before his departure at the end of the fiscal year, Fromme published a summary of all his work on "The Black Root Rot Disease of Apple" (Va. Agri. Expt. Sta. Tech. Bul. 34, March 1928). He reviewed the history of *Xylaria* spp. on apple and pointed out that *X. mali* had previously been confused with *X. digitata* from Europe. There is a comprehensive description of *X. mali* and careful comparisons with 3 other North American *Xylaria* species. He liberally illustrated the fungus and disease symptoms, described infection and dissemination. The role of conidia and ascospores could not be determined. The best control was to use Northern Spy rootstock and not to replant apples where trees had died of black root rot.

Fromme's last Experiment Station publication was "The Control of Cereal Smuts by Seed Treatment" (Va. Agri. Expt. Sta. Bul. 262, June 1928). He made comparisons among all the seed treatment chemicals then available for control of the seedling infecting smuts (oat smuts, barley covered smut and wheat bunt). Formaldehyde soak was best for oats and barley covered smuts. The mercury fungicides were not yet volatile enough to kill spores on hulled grains. Copper carbonate was as effective as other compounds for control of wheat bunt. Most treatments improved germination percentages when compared to untreated checks. During these studies, he had washed bunt infested wheat seeds and found that the percentage of bunt infected heads produced from them was markedly reduced (p. 14-15). He deemed this information worthy of a report in *Phytopathology*. Therefore, in a note titled "The effect of washing seed on infection of wheat by stinking smut" (Phytopathology 18:711-713) he reproduced the data from bulletin 262 without reference to it. A considerable reduction in the spore load was accomplished by washing for 15 to 120 minutes. No other factor was involved; the percentage of infected heads was reduced from 6.48 to a range of 0 to 0.9.

In the June 1928 issue of Virginia Fruit [16(6):4], the announcement of Fromme's departure from V.P.I. appeared. He was to become Dean of the College of Agriculture and Director of the Experiment Station at West Virginia University. The item lamented his departure from Virginia and from plant pathology. "Dr. Fromme leaves with the utmost of good will and best wishes of the fruit growers of Virginia, and may he prosper and succeed in his new field. West Virginia gains what Virginia loses." Fromme's resignation was effective June 30, 1928. However, before he left, on May 17, Wingard was promoted from Associate to Plant Pathologist and Schneiderhan was promoted from Assistant to Associate Plant Pathologist. Wingard was appointed to succeed Fromme on July 1, 1928, thus beginning a new era.

It is difficult to define sharply the research in progress as being in either the Fromme or Wingard era. Any further publications from the Department, the Truck Station or other sources in Virginia will be reviewed in the Wingard era. However, little has been said about the teaching program of Fromme's era. A summary of courses and their instructors follows.

As Professor of Plant Pathology and Bacteriology. Fromme inherited a considerable teaching load from his predecessor, Reed. For his entire tenure he taught Plant Pathology, six lecture credits per year and for 5 years taught Laboratory Plant

Pathology. Afterward, A. B. Massey was responsible for Laboratory Plant Pathology. In the 1921-22 session "Lab" was increased to 3 periods a week for 9 contact hours in the winter and 2 periods, 6 hours in the spring for a total of 21 contact hours and 11 credit hours per year. For 1924-25, this was reduced to 12 hours and 10 credits per year and it remained so until Fromme left at the end of the 1927-28 term. Fromme also taught two mycology courses, 3 lectures per quarter. They were Systematic Mycology, 3 lectures per quarter, fall and winter; and Applied Mycology, 3 lectures in the spring. Fromme taught Laboratory Mycology, 6 hours of laboratory in winter and 15 each spring from 1915 through spring 1921. Thereafter a single course, Mycology, with an attendant laboratory was catalogued in fall, winter, spring for 1920- 21 through 1927 at 2-10-8, 2-20-8, 0-18-2, 0-17-3, 0-14-3, and 0-14-2! (= contact hours). A 5 credit course in Diseases of Crop Plants was offered each spring 1921 to 1924. Several courses in bacteriology were offered by the Department, taught at first by Fromme, then by T. J. Murray, 1916-18, and A. B. Massey from then on.

In 1926, the catalogues for the first time designated the Department as Botany and Plant Pathology. This was the result of the retirement of E. A. Smyth, long-time head of Biology. All botanical courses from Biology were shifted to the newly named department and H. S. Stahl was transferred into the Department from Biology to teach them. Thus, in spring of the 1926-27 session, Plant Physiology was under Fromme's direction. In addition to courses in plant pathology, mycology and bacteriology, the Department offerred Principles of Botany, General Botany, Plant Physiology, Taxonomy of Flowering Plants, and Advanced Botany.

At the beginning of the Fromme era, there were 2 plant pathologists, Fromme and Crabill, and a bacteriologist, Bruce Williams. When Fromme resigned, there were 4 other plant pathologists Hurt, Schneiderhan, Godkin, and Wingard, botanist-bacteriologist Massey, and plant physiologists Davis and Stahl. Thus, during the era the faculty had grown from 3 members to 8; a number that would be maintained through 1935. During the era, Fromme had served as director of plant pathology research in the Experiment Station, Professor of Plant Pathology and Bacteriology, member of the College Committees for Entrance Requirements, 1915-1919; Bulletin (= catalogue), 1919-1922; Physical Welfare, 1919-1922; Marks, Degrees and Honor, 1922-1928; and Library, 1926-1928. From 1926 to 1928, he served as course adviser to undergraduate majors in Biology, Pre-Medicine, and Pre-Dentistry. Thus, with his activities at V.P.I. and in A.P.S., Fromme was well equipped to become Dean of Agriculture and Director of the West Virginia Experiment Station. During his tenure at V.P.I., he had served the College, the agricultural industry, and the profession of plant pathology with distinction.

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A History of Plant Pathology in Virginia: The Wingard Era - I (1928-1935)

When F. D. Fromme's tenure as Department Head ended on June 30, 1928, S. A. Wingard was named Department Head the next day, July 1. The transition was efficient; there were no search committees, interim or acting appointees, no interviews, etc. Presumably Wingard had been selected to succeed Fromme soon after Fromme submitted his resignation. No doubt, in the 1920's, a departing Department Head offered suggestions as to who might logically succeed himself. Fromme and Wingard had shared 11 years of productive association; Fromme had seen Wingard through a Ph.D. program under R. A. Harper at Columbia University and together they had laid the foundation for leadership in tobacco disease investigations. Growth of the Department under Wingard's leadership during the next 36 years was a tribute to the foresight of the administration of 1928 and to Fromme. The transition coincided with the appearance of C. E. Owen's textbook "Principles of Plant Pathology", which set the format for plant pathology textbooks for years to come.

When "Sam" Wingard assumed the headship, the Department functioned under two titles; it was the Department of Botany and Plant Pathology in the V.P.I. catalogue, and the Department of Plant Pathology and Bacteriology in the Agricultural Experiment Station. In addition to Wingard, the faculty included Professor Horatio S. Stahl who taught botany and plant physiology; Associate Professor A. B. Massey who taught botany, bacteriology, and plant pathology; Associate Plant Pathologist F. J. Schneiderhan, fruit pathologist at Winchester; Assistant Plant Pathologist R. H. Hurt, fruit pathologist at Crozet; James Godkin, Assistant Extension Plant Pathologist; and E. F. Davis, Assistant Plant Physiologist for the Experiment Station at Blacksburg. Godkin was on educational leave and H. R. Angel was filling in for him during 1928-9. (The exact dates are not available). On Sept. 5, 1928, S. B. Fenne completed the M.S. degree in plant pathology.

In the teaching program, courses established during Fromme's administration were continued well into Wingard's administration. In the catalogue for the academic year 1928-29, issued May 1928, the following courses were listed:

- 131 - Principles of Botany; III, 3H, 6L, 5C. (III = 3rd qtr., 3H = 3 lecture hours, 6L = 6 laboratory hours, 5C = 5 credit hours)
- 212-222 - General Botany; I, II, 3H, 6L, 5C/qtr.
- 223 - Sanitary Bacteriology; II, 3H, 6L, 5C.
- 321-331 - Plant Pathology; II, III 3H, 3C/qtr.
- 322-332 - Plant Pathology Laboratory; II, III, 6L, 2C/qtr.
- 333 - Household Bacteriology; II, 2H, 6L, 4C.
- 411 - Bacteriology; I, 3H, 3C.
- 412 - Bacteriology Laboratory; I, 12L, 4C.
- 413 - Pathogenic & Dairy Bacteriology; I, 12L, 4C.

- 424 - Advanced Botany; II, 4H, 12L, 8C.
- 431 - Plant Physiology; III, 3H, 6L, 5C.
- 435 - Taxonomy of Flowering Plants; III, 6L, 2C.
- 5?1 - TBA - hours and credits in areas of specialization for graduate students.

Since the catalogue was issued in May 1928, Fromme, Massey, and Stahl were the instructors. For 1929-30, only Stahl and Massey were the instructors, assisted by graduate student W. F. Skinner. Massey had received his M.S. degree in Plant Pathology only in June 1928, but he had gained much respect. After Fromme departed, he became acting advisor for Biology, Pre-medicine, and Pre-dentistry undergraduates. For 1929-30, he was advisor.

The teaching program underwent changes in the 1930-31 catalogue. Whether or not he taught, Wingard was added to the teaching faculty. The student assistant was S. D. Preston. Plant Physiology was revised, and other courses were added. 232 (from 431) - Plant Physiology; III, 2H, (reports 1H), 6L, 5C (or 4C if reports not opted).

- 323 - Diseases of Crop Plants; II, 6L, 2C.
- 424 - Advanced Work; (a - Bacteriology; b - Ecology; c - Plant Anatomy; d - Mycology; e - Plant Pathology; f - Plant Physiology; g - Economic Botany), II, 3 or 4H, 6 or 12L, 5 or 8C.
- 5?1 - Graduate Work in Bacteriology - T.B.A.
- 5?2 - Graduate Work in Botany - T.B.A.
- 5?3 - Graduate Work in Plant Pathology - T.B.A.

In the catalogue for the 1931-32 academic year, the years of appointments for the faculty were shown. Stahl was the senior faculty member, having been appointed in 1908. Doris Shannon was the Service Fellow for Botany and Plant Pathology. In the 1932-33 catalogue, I. D. Wilson was first shown as adviser for Biology, Pre-medical, and Pre-dental students and there were some changes in botany courses. New courses were listed:

- 112-122-132 - General Botany; I, II, III, 2H, 4L, 3 1/3C/qtr. was specified for Wilson's advisees.
- 212-222 - General Botany; I, II, 3H, 6L, 5C/qtr., was specified for agricultural majors.
- 411 - Agricultural Bacteriology (changed from Bacteriology); I, 3H, 3C.
- 412 - Agricultural Bacteriology Laboratory (from Bact. Lab.); I, 12L, 4C.
- 413-423 - Pathogenic Bacteriology (from 413, Path. & Dairy Bact.); I, 3H, 12L, 7C; II, 3H, 6L, 5C.

Thomas E. Smith was the Service Fellow in Botany & Plant Pathology. Again in the 1934-35 catalogue, the courses were revised:

- 112, 122, 132 became
- 211-221-231 - Botany and Plant Physiology; I, 3H, 6L, 5C; II, 2H, 3L, 3C; III, 1H, 3L, 2C.
- 212-222 - General Botany; I, II, 1H, 6L, 3C/qtr.
- 233 - Mycology; III, 1H, 6L, 3C.
- 313 - Plant Physiology; I, 2H, 2C.
- 332 - Plant Pathology Laboratory III, 6 to 12H, 2 to 4C.
- 411 - Bacteriology; I, 3H, 3C.

- 412 - Bacteriology Laboratory; I, 6L, 2C.
- 414-424 - Plant Ecology; I, II, 3H, 3C (Lab.-TBA).
- 422-423 - Bacteriology Laboratory; II, III, choice of (a) Soil Bact. (b) Veterinary Bact. (c) Dairy Bact., 6H, 2C/qtr.
- 435 - Plant Anatomy; III, 6H, 2C.

Other courses remained as in previous catalogues. There were no changes in the 1935-36 (May 35) but in the 1936-37 (May 1936) catalogue, Botany and Plant Pathology disappeared and its courses were incorporated under the Department of Biology. Thus began phase II of the Wingard era. What happened and how it came about will be described later.

The research programs under way when the Wingard era began were continued. The projects at Blacksburg addressed black root rot of apple, loose smut of wheat, bean rust, ringspot of tobacco and drought spot of tobacco. With Fromme's departure and Wingard's promotion, there was a vacancy. Robert G. Henderson was hired as Assistant Plant Pathologist on March 20, 1929. Other vacancies soon occurred; Schneiderhan resigned June 30 to take a similar position in West Virginia. The announcement of his resignation appeared in *Virginia Fruit* [17(5):7-8, May 1929] with the comment that, "While it is not officially announced, no doubt, an increase in salary is one of the inducements offered by West Virginia. It is indeed a shame that Virgnia, the third largest apple-growing state in the Union, does make such a meagre appropriation to the Horticultural Division of our State Agricultural College that the latter serves largely as a training ground for scientific workers who are picked up by other States as soon as they have proven their ability in their chosen field." Although this lament may have had foundation, Ancell B. Groves, who was appointed on September 1, 1929, to replace Schneiderhan, became a leader in fruit pathology and remained at Winchester until his death in 1966. Everett F. Davis, Assistant Plant Physiologist resigned on June 30, 1930, and was immediately replaced by G. Myron Shear on July 1. Both Henderson and Shear would remain in the Department until they retired. All three of these men contributed significantly to their fields and were a tribute to Wingard's sagacity.

The development of the Department under Wingard's leadership can be assessed in part by publication records and in part by growth of the faculty and facilities. Henderson apparently was assigned to investigate tobacco diseases. His initial efforts were to carry on the ringspot investigations. He published nothing on the topic until 1931. Everett Davis furthered the information on walnut toxicity in a paper entitled, "The toxic principle of *Juglans nigra* as identified with synthetic juglone, and its toxic effects on tomato and alfalfa plants" (Am. J. Bot. 15:620-?, 1928). "It is thought that resistance and susceptibility of plants to walnut toxicity may be related directly to differences in reducing intensity to the extent that the cells of certain plants (resistant species) may be able to reduce the toxic quinone to its hydro-form. The roots of susceptible species may be unable to make this reduction." (Ann. Rept. of Va. Agri. Expt. Sta., July 1, 1927-June 30, 1931:31.1931).

Even though there was a scarcity of publications in the first 6 months of Wingard's headship, there were a number of diseases reported throughout the State by federal and state workers in volume 12 of the *Plant Disease Reporter*:

- p. 45 - Wingard reported wheat stem rust very severe in Washington Co.
- p. 46 - H. R. Angell (substituting for James Godkin) reported copper carbonate

seed treatment had reduced bunt in wheat fields to negligible amounts.

- p. 47 - Angell reported wheat scab as up to 5% infection.
- p. 49 - Schneiderhan reported rapid development of apple scab and losses in southern Valley of Virginia counties would be greatest since 1924.
- p. 51 - Wingard reported *Bacterium pruni* to be very severe in Loudoun and Campbell Cos.
- p. 65 - McWhorter at the Truck Station reported 100% infection of cantaloupe by *Sclerotium rolfsii*, following carrots in the rotation.
- p. 82 - Vera K. Charles and G. H. Martin (U.S.D.A.) reported a *Kabatiella* sp. causing damage to plants of *Lilium auratum* received from Virginia (place not named).
- p. 92 - Schneiderhan reported brown rot of peaches to be more damaging than in any year since 1922.
- p. 98 - Angell reported tobacco wildfire, blackfire, ringspot, and mosaic to be widespread during August.
- p. 143 - L. C. Beamer, V.P.I. Extension Horticulturist reported heavy damage to sweet potato by *Ceratostomella fimbriata*, causing black rot and *Fusarium* spp., causing stem rot, on Eastern Shore.
- p. 149 - McWhorter reported an association of *Sporotrichum poae* and a mite *Pediculopsis graminum*, on diseased greenhouse carnations at Newport News.

The Extension Service published Bul. 102, Spray Information (for fruit growers) and the *Southern Planter* reprinted it. Motz, horticulturist, Schneiderhan and Hough (entomologist at Winchester) collaborated in its preparation. The importance of other plant diseases was highlighted by notes on controlling potato late blight with Bordeaux mixture [Sou. Pl. 89 (14):19, July 15] and treating oat seeds with formaldehyde dust (3 oz/bu, store 12 hr, and plant). Several testimonials indicated smut was eliminated but there was no comment on yield [Ibid. (16):19, Aug. 15]. In the "Work for the Month" column farmers were urged to treat seed wheat with copper carbonate dust to control stinking smut and to treat wheat and barley with hot water to eliminate loose smuts. This time the wet treatment of oats with formalin (1 pt. to 40 gal. water) for the control of smuts [Ibid. (17):32, Sept. 1] was recommended. To facilitate efficient dust treatments of seeds, a barrel treater was illustrated and described [Ibid. (18):22, Sept. 15]. T. W. Wood and Sons, Virginia's largest seed company had a full page advertisement illustrating smutted spikes and kernels, and advocating the purchase of their seed wheat treated for control of stinking smut (for an added cost of 10¢/bu.) [Ibid. (19):2, Oct. 1].

At the end of the year Godkin published Extension Division Bulletin 110, "Four Major Tobacco Diseases in Virginia and Their Control." The diseases were blackfire, wildfire, drought spot and mosaic.

Schneiderhan presented a paper to the 33rd Annual Session of the Virginia State Horticultural Soc. on "A new method of preparing Bordeaux mixture." [Va. Fruit 17(1):104-112 + 3 pp. of questions and answers]. In this presentation, Schneiderhan reviewed the discovery of Bordeaux mixture and presented a case for more extensive use of the fungicide late in the season to protect apples from cloud and bitter rot. He compared the old way of making Bordeaux mixture from stock solutions with the new method of preparing "Instant Bordeaux". He also emphasized the importance of spraying the tank to emptiness within 3 hours of the preparation time. The paper was well received and a lively discussion followed. Schneiderhan usually injected humor into his talks and discussions but this one was strictly a no-nonsense presentation. It was also his swan song as the Winchester pathologist at these meetings. At the next meeting he would be on the West Virginia staff. However, as a result of his presentation, the volume of subsequent inquiries was so great he found it necessary publish a supplement, "Powdered bluestone and hydrated lime for preparing Bordeaux mixture according to the new method" [Va. Fruit 17(5):6-8]. Here he described the chemical and physical traits of copper sulphate and lime necessary to implement the Instant Bordeaux method.

At the same December meeting, Judge S. F. Tavenner of Woodstock gave a comprehensive review of "Our cedar rust fight through the U.S. Supreme Court [Va. Fruit 17(1):72-77]. The Judge demonstrated an incisive knowledge of rust and apple production. This is a landmark presentation in which the entire history of cedar eradication is reviewed concisely. Following his presentation and in recognition of the role he had played in behalf of apple growers, the Horticultural Society voted to make him an honorary life member. It was the first such action by the Society [Va. Fruit 17(1):77].

At the Truck Station, F. P. McWhorter, pathologist, and M. M. Parker, horticulturist, published V.T.E.S. Bul. 64, "Fusarium Wilt of Tomato in Virginia", and proclaimed wilt to be "The most destructive disease with which growers have to contend." It was severe in the Northern Neck canning and Roanoke trucking districts. They obtained evidence for the existence of *Fusarium* strains when 'Marglobe' was susceptible at some locations and resistant at others. This was the first recognition of *Fusarium* strains in Virginia.

Among events to occur elsewhere in 1928, the first organic-mercury chemical for seed treatment (Ceresan) was introduced and Purdy and Dvorek demonstrated that plant viruses are antigenic in animals (G. K. Parris. 1979. A Chronology of Plant Pathology, 2nd. ed., Publ. by the author, Mississippi State, Miss. 251 pp.). In 1929, the first full year that Wingard was Department Head, there were several staff changes. As previously noted, Henderson was hired on March 20, Schneiderhan resigned on June 30, Groves replaced him on Sept. 1 and Godkin was promoted to Associate rank. At Norfolk, McWhorter resigned on Dec. 31. The American Phytopathological Society met in New York Dec. 28, 1928 to Jan. 1, 1929. Schneiderhan read a paper, "The influence of the form and proportion of lime and copper sulphate on the suspension of bordeaux mixture." (Phytopathology 19:88, 1929). He had studied the effects of three lime sources and three types of copper sulphate in all possible combinations and at various ratios. Best results were obtained with chemical hydrated lime and finely granulated copper sulphate in a 2-3.5-50 formula.

Godkin read a paper, "Physiological studies of *Bacterium translucens* and *Bacterium translucens* var. *undulosum*" (Ibid. 19:99), probably based upon work done while he was on leave at the University of Chicago. The bacteria he studied are more common in northern states and rarely occur in Virginia. Godkin was also a co-author of a paper with G. K. K. Link and A. E. Edgecombe, "Further agglutination tests with phytopathogenic bacteria" (Ibid. 19:99). They reported on serological relationships among 9 bacteria.

Hurt reported on his experiments with, "Calcium monosulphide, a substitute for lime-sulphur for summer spraying" (Phytopathology 19:106). He had found that the product was safer (causing less injury) and more efficient for control of scab than lime- sulphur. It also gave fruit a better finish.

Schneiderhan and Hurt contributed information to Extension Division Bulletin III, Jan. 1929, "Spray Information for Virginia Fruit Growers". This was virtually reproduced in the *Southern Planter* 90(3):4, 8, Feb. 1, 1929.

Godkin received a personal tribute when he was pictured in the Jan. 15 *Southern Planter* [90(2):27] and named to be the toastmaster at the Virginia State Corn and Grain Show, Leesburg, Jan. 24-25. "His success as a toastmaster has made the banquet a leading feature of the show .... Godkin is widely known throughout the State and has done much for its agricultural advancement."

The most significant departmental publication in 1929 was by Hurt and Schneiderhan, "Calcium Sulphide for the Control of Apple and Peach Diseases" (Va. Agri. Expt. Sta. Tech. Bul. 36. Feb. 1929). The experiments were conducted in private orchards near Crozet and Winchester and the owners' spray equipment was also used. The composition of CaS was described and data for 1926, -27, and -28 experiments were presented. They concluded, "That calcium sulphide is a comparatively non- caustic spray material that ... can be used throughout the season on varieties susceptible to spray injury." However, it "Should not replace Bordeaux mixture in late summer applications on varieties which are susceptible to bitter rot."

At the Truck Station, McWhorter and M. M. Parker, Horticulturist, concluded their studies on the tomato wilt problem with the publication of "A Comparison of Wilt Resistant Tomatoes in Virginia" (F. P. McWhorter and M. M. Parker. 1929. Va. Truck Expt. Sta. Bul. 69). This bulletin was also McWhorter's final contribution to Virginia plant pathology literature. The authors compared two Fusarium wilt resistant varieties 'Invincible' and 'Marglobe' with the susceptible varieity 'Stone'. Survival on wilt sick soil was about equal for Invincible and Marglobe; both were superior to Stone which was virtually wiped out. Surprisingly, no data were presented on yield. Invincible had been bred for greenhouse production but because of its high proportion of flesh, it proved to be prized by canners. Recall that earlier they had reported Fusarium strains which rendered 'Marglobe' susceptible.

"Spray Information for Virginia Fruit Growers" was issued in March (Va. Ext. Div. Bul. 111), but the *Southern Planter* published a copy of it in February [91(3):4, 8, Feb. 1]. That was the only plant pathology topic to appear in the 1929 Southern Planter.

Several significant reports of diseases on Virginia appeared in the 1929 *Plant Disease Reporter*, volume 13:

- p. 8 - McWhorter reported mosaic ranged from 2 to 50% in *Narcissus* on bulb farms in the Norfolk area.
- p. 9, 28 - Cobb and Steiner, (U.S.D.A.) reported the occurrence of *Tylenchus dipsaci* on 3 varieties of *Narcissus* and on bulbous Iris at North in Mathews Co.
- p. 14-18 - Schneiderhan reported on the incidence and severity of apple scab, the severe damage by fire blight and the predisposing weather during April, occurrence of rust near cedars, presence of frog-eye on poorly pruned trees, and a severe outbreak of powdery mildew in northern Virginia.
- p. 51 - Schneiderhan stated peach bacterial spot "Is general on foliage in northern Virginia. It is more prevalent than at any time in the history of peach

growing in this state."

- p. 47-48 - Schneiderhan reported that "instant Bordeaux", 2-4-50, has become popular in Virginia.
- p. 48 - Scab has become more severe than in any previous four years.
- p. 49 - In a brief article, "Benefit from cedar eradication evident in Virginia", Schneiderhan reported that eradication of red cedar as the result of a rigidly enforced state law saved the apple industry. "We feel sure that we have here an example of disease control that will register a real kick to a plant pathologist's pride of profession".
- - In a second article, "Apple russeting in Virginia", he reported russeting was very severe on 'Ben Davis' and 'Grimes' in 1929. He suspected weather conditions were the major factor causing it, and that some sprays exaggerated it.
- p. 75 - Schneiderhan reported that sycamore anthracnose was severe. (Note: This has been a recurring problem - C.W.R.).
- p. 76 - G. H. Martin, U.S.D.A., reported severe blighting of hydrangea at Richmond and moderate blighting at Norfolk and Alexandria.
- p. 92 - Martin reported the first U.S.A. occurrence for both *Ascochyta juelii* and *Phyllosticta latemerensis* on *Colchicum autummale* at Cradle Point, Va.
- p. 97 - Godkin reported severe downy mildew, reducing the crop by 25% in 50 fields of cucumbers.
- p. 99 - Godkin reported on a tobacco plant bed survey. Blackfire was found in 8 of 11 counties surveyed, wildfire was found in only one. In fields, Granville wilt was 15% prevalent in a Brunswick Co. field, and ringspot was 25% prevalent in a Prince Edward Co. field.
- p. 105 - Godkin found the wheat gall nematode in fields in Albemarle, Prince William, Rappahannock, Rockingham, and Shenandoah Cos.
- p. 112 - Hurt reported heavy apple foliage scab in the Lower (southern) Valley and damage to 'Pippins' by fireblight in the Piedmont.
- p. 113 - Hurt reaffirmed the earlier reports of apple russeting attributed to frost. Of bacterial spot of peach he wrote "A few 'Hale' orchards will be a complete loss (fruit) due to this disease."
- p. 140 - Godkin observed cotton anthracnose in Nansemond Co. (now Suffolk) ranging from trace to 15% severity.
- p. 170 - Godkin reported on the use of seed treatment dusts to control cereal smuts, "About 20,000 bu will be treated for fall seeding. Copper carbonate will be used on wheat, while Ceresan is recommended for oats and barley."

The foregoing reports give some account of the principle diseases on Virginia crops. Note that peanuts, corn, tomatoes and other truck crops are missing from the list. This may be related to the predominance of attention to the crops listed, but it may also be due to a lack of inquiries by growers. As the personnel changes at Winchester, Blacksburg, and Norfolk in 1929 and 1930 no doubt so will the crop emphasis.

Other events occurring in 1929 that would have future impacts on Virginia plant pathology include Fleming's discovery of penicillin, Helen Purdy Beale's report that a partially purified virus may be injected into rabbits and an antiserum could be obtained; from this, serological tests were developed for identifying viruses. F. O. Holmes developed the local lesion method on *Nicotiana glutinosa* for estimating the titer of tobacco mosaic virus in tissue. As a matter of curiosity, the German dirigible, Graf Zepplin, plying the Atlantic Ocean was found to have three kinds of plant pathogens among floral arrangements displayed in passenger areas (G. K. Parris. 1979. A Chronology of Plant Pathology. pp. 116-117).

The Experiment Station plant physiologist, E. F. Davis, resigned June 30, 1930, and his replacement, G. M. Shear, was on the job the next day. Shear would make several pathology related contributions. Harold T. Cook was appointed Plant Pathologist at the Truck Station March 10, to replace McWhorter. As the result of a $2,500 contribution from the Virginia fruit growers, a new fruit research laboratory was constructed on the University of Virginia campus. There, for the first time, Hurt would have adequate office and laboratory space. It would serve as the Piedmont Research Laboratory for 19 years. He would share space with an entomologist.

No major research publications were prepared by plant pathologists in 1930. However, Hurt addressed the 34th Horticultural Society meetings in late 1929 on "New developments in spray materials"; [Va. Fruit 18(1):158-169, Jan. 1930]. He discussed calcium sulphide (also called calcium mono-sulphide), a fungicide of which he was the leader in its development. He described its preparation, properties, results of four years of tests, and comparison with recommended fungicides. He showed that the material was superior to Bordeaux mixture and lime-sulphur in disease control and producing better fruit finish but apparently it has an awful odor, that of hydrogen sulphide. Hurt next described the use of waste calcium bisulfite from paper mills in fruit sprays. The product was marketed as Glutrin (a liquid) and Goulac (a powder) and was suggested as a substitute for calcium caseinate, the traditional sticker-spreader of the time. Hurt claimed these products were easier to handle, produced a more stable emulsion, were miscible in any proportion with concentrated lime-sulphur, and was cheaper than calcium caseinate.

Dr. J. F. Adams of the Delaware Agricultural Experiment Station had been invited to speak at the same meeting on "Foliage injury in relation to spray materials and plant diseases of the peach" [Va. Fruit 18(1):52-59, Jan. 1930]. He described injuries caused by copper sprays, sulphur, arsenic, lead arsenate and their interactions with environmental factors. He also pointed out that bacterial spot damage is often confused with spray injury. He emphasized that although these injuries are difficult to control, they may be minimized by keeping trees at maximum vigor, carefully mixing sprays according to recommendations, and by applying sulphurs and arsenicals during the coolest part of the day. Bacterial spot control has not yet been achieved. James Godkin and A. H. Teske, extension fruit specialist had developed an interesting format to discuss fruit problems on WDBJ-Roanoke radio. Teske took the role of a Professor with boundless knowlege and Godkin, "The part of a Southern European who is just learning American Language and methods of fruit growing." Godkin was Joe Apple. "Those who have listened in, have pronounced the dialogue very humorous as well as instructive. Reports from growers all over the State have been highly complimentary, and it is evident the Professors Teske and Godkin are making an enviable reputation for their ability as broadcasters. Their Amos and Andy method of delivering otherwise dry information to the fruit growers, is rapidly gaining interest among grower radio fans" [Va. Fruit 18(5):3, May 1930].

At the annual meetings of the American Phytopathological Society, (Dec. 28, 1929 - Jan. 1, 1930), Hurt read a paper, "The waste sulphite liquor of paper mills as an adjunct to spray materials" (Phytopathology 20:111), in which he gave a brief review of his December Horticultural Society address.

The reports about Virginia plant diseases in the *Plant Disease Reporter* volume 14, were contributed by all of our pathologists:

- A. B. Groves and R. H. Hurt appraised the development of fruit diseases (pp. 55, 60, 66, 126, 133, 156). Fruit tree diseases were unimportant due to a prolonged spring and summer drought. Powdery mildew was severe in 'Jonathan' orchards.
- S. A. Wingard, H. T. Cook, T. C. Johnson, and R. J. Haskell collaborated on reports of onion white rot in Prince George Co., only the fourth known occurrence in the U.S.A. Since it was a rare disease, it created quite a stir among vegetable pathologists. (Ibid. pp. 82-83, 104-105).
- James Godkin and R. G. Henderson monitored tobacco diseases.
- H. T. Cook monitored vegetable diseases mostly in eastern Virginia. Cucumber downy mildew, lima bean stem rot (p. 143), powdery mildew of bean, first Virginia record (p. 217), two kinds of leaf spot and rust of cowpeas, downy mildew of soybean (p. 225) and dodder on pepper (p. 216), attracted his attention.
- Wingard and Henderson reported severe blossom-end rot of tomato in southwest Virginia due to severe drought and severe losses to cabbage yellows due to a lack of seeds of resistant varieties (p. 162). Ringspot occurred on cantaloupes in a Prince Edward Co. field near tobacco which also had ringspot (p. 187).
- Henderson found tobacco ringspot on *Petunia violacea* in Pittsylvania and Washington Cos. He had already found that ringspot is seedborne in petunia.

No corn, peanut, or potato diseases were reported in 1930.

"Information for Virginia Fruit Growers" was reissued in January as Extension Division Bulletin 114. There were new sections on rodent control, grafting, and wound dressing. The *Southern Planter* reprinted it in February [91(3) Feb. 1:4, 6]. For two years, 1929 and 1930, the spray information was the only plant pathology appearing in the *Southern Planter*. The magazine seemed to be drying up as a resource.

At the Truck Station, the first contribution by H. T. Cook to Virginia plant pathology appeared in the bulletin "Onion Culture" (W. O. Strong, H. H. Zimmerley, and H. T. Cook. 1930. Va. Truck Expt. Sta. Bul. 72), for which he prepared a section on fungous and bacterial diseases. He described neck rot, white rot, soft rot, and smudge, and gave control measures for each; he also rated the diseases for importance to Virginia growers. Strong was an Entomologist and Zimmerley was a Horticulturist.

Cook also began his pioneer work for forecasting the timing of fungicidal applications with special emphasis on potato late blight and cucurbit downy mildew.

In 1931, results of research by the new members of the faculty appeared in several publications. Henderson described experiments on, "Transmission of tobacco ringspot by seed of petunia" (Phytopathology 21:225-229). After having observed naturally infected *Petunia* plants in Pittsylvania and Washington Cos., he grew plants from seed produced on plants inoculated with ringspot virus from tobacco. In two plantings, 19.8 and 20.2%, respectively, of the seedlings were infected. In another publication, "Further studies on tobacco ringspot in Virginia" (J. Agr. Res. 43:191-

207), Henderson and Wingard reported there was no transmission of ringspot virus through tobacco seeds. In tobacco, they reported that plants inoculated with ringspot virus showed symptoms soon after inoculation, but later, emerging leaves may be symptomless. Cuttings from symptomless portions of infected plants were virus-free. As a consequence, the term "acquired immunity" was coined, not by Wingard, and Henderson but by W. C. Price. Yet Wingard's name was associated with the term in the literature of the 1930's to 1950's. Wingard may have discovered the phenomenon of recovery from symptom expression but he never used "acquired immunity" in his publications. Henderson and Wingard made many inoculations with juice of sweet clover, yellow iron weed, petunias, and squash and found that virus from these sources was less virulent than virus occurring in tobacco. They referred to virus from those sources as attenuated strains.

Shear published "Studies on inanition in *Arachis* and *Phaseolus*" (Plant Physiol. 6:277-294, 1931); this was from his Ph.D. dissertation presented to the University of Illinois (Inanition = starvation). It had nothing to do with plant pathology but indicated Shear would be anxious to publish his findings. He would soon make contributions to the understanding of physiological diseases in plants.

Hurt authored, "The Waste Sulphite Material of Paper Mills as Adjuvant to Certain Spray Materials" (Va. Agri. Exp. Sta. Bul. 227). This was his M.S. degree thesis work; it has been reviewed previously (see 1930). Hurt was also a co-author of, "Removal of Spray Residue from Apples" (W. S. Hough, R. H. Hurt, W. B. Ellett, J. F. Eheart, and A. B. Groves. Va. Agri. Exp. Sta. Bul. 278, 1931). He presented a paper to the 35th Annual Meetings of the Horticultural Society December 1930, "New spray materials for apples and peaches [Va. Fruit 19(1):88-95, Jan. 1931]. He described lignin pitch, previously discussed as waste paper manufacturing sulphite (Goulac and Glutrin), and zinc-lime (see below) which he had found reduced spray injuries on peach. He carefully described how and when to use it. In a paper to plant pathologists, he described his discovery that the zinc-lime spray developed by J. W. Roberts for control of the peach bacterial shot-hole disease, if applied with lead arsenate, would prevent arsenical injury to twigs and foliage. There was no comment in his brief article as to the efficacy of the mixture toward peach insects (R. H. Hurt. The prevention of arsenical injury to peach twigs and foliage in Virginia. Phytopathology 21:1204, 1931).

Groves published his initial paper as a Virginia plant pathologist on, "Natural fireblight infections on *Spiraea vanhouttei*". At Winchester, two spiraea bushes growing under a pear tree developed fire-blight symptoms and Groves showed by inoculation experiments that both pear and spiraea were susceptible to the bacteria isolated from either host (Phytopathology 21:89-91, 1931).

At the 35th Annual Meetings of the Horticultural Society, December 1930, Wingard spoke on "Some important orchard diseases" [Va. Fruit 19(1):143-151, Jan. 1931]. The diseases covered were apple scab, powdery mildew, black root rot, winter injury, and fruit russet. He described and illustrated each item, and mentioned but did not dwell upon bitter rot, black rot, Missouri blotch, sooty blotch, fly-speck, and Phoma fruit spot.

Scattered throughout *Virginia Fruit* in 1931 were several other items on plant pathology. Wingard wrote, "Mr. Fruit Grower, don't forget apple scab this spring" [Va. Fruit 19(4):10-12, Apr. 1931], in which he reminded growers that even though scab was rare in 1930, there is ample inoculum to cause a flare-up in 1931. If cool, wet weather occurs in April, May, and June, scab infections may be expected. "The grower who sprays thoroughly with the proper materials and at the right time ... should have no difficulty in securing commercial control of scab."

James Godkin published notes on "Powdery mildew of roses" [Va. Fruit 19(6):15, June 1931], and "The home orchard" [Ibid. (7):14-16, July 1931]. For rose mildew, he recommended strict sanitation and use of potassium sulphide spray in the summer. For home orchards, he admonished owners to spray for disease and insect control or cut the trees down lest they menace commercial orchards. Godkin and Teske, it was announced, would be on a national radio hookup June 16, as Joe Apple and Professor Hort, in a discussion of "Apples consumers like to eat" [Va. Fruit 19(6):18, June 1931]. Groves wrote, "Fire blight becoming prevalent on apples" [Va. Fruit 19(7):14, July, 1931]. He emphasized occurrence of cankers on twigs which could lead to main- branch cankers. These could be treated with a hydrochloric acid-zinc chloride-alcohol concoction.

Vegetable Gardening Extension Specialist L. B. Dietrick wrote an article on, "Insect and disease control for truck crops" [Va. Fruit 19(6):16-18, June 1931], in which he enumerated 14 procedures for pest control; 11 of these were aimed partially or entirely at disease control. Items included were soil sterilization, crop rotation, field sanitation, resistant varieties, seed treatment, rogueing, spraying, and dusting. D. A. Tucker of the V.P.I. Horticulture Department contributed, "Growing grapes in Virginia" [Va. Fruit 19(8):12-13, Aug. 1931]. He hammered away on the necessity of controlling black rot with frequent sprays of Bordeaux mixture and by destruction of plant residue. (For many years black rot has been a limiting factor in Virginia grape production - C.W.R.).

S. B. Fenne published his M.S. thesis "Field studies on the ring-spot disease of burley tobacco in Washington County, Virginia" (Phytopathology 21:891-899, 1931). Although he was a county agricultural extension agent at the time, he would later succeed Godkin as the Extension Plant Pathologist at Blacksburg. Fenne found that steam sterilization of tobacco plant beds did not prevent ringspot infections in fields planted from such beds; that insects common on tobacco do not transmit ringspot; that *Verbesina alternifolia*, stickweed, was a carrier of ringspot virus. White sweet clover, as already shown by Wingard, was the only other weed carrying the virus. The loss due to ringspot in Washington Co., 1929, was $27,384.

The first original research published by H. T. Cook at the Truck Station was on the "Powdery Mildew Disease of Snap Beans" (Va. Truck Expt. Sta. Bul. 74, 1931). The 1930 fall crop was severely damaged by the pod-russeting phase of the disease. In 1930, commerical snap beans were usually hand picked several times. After the first picking, beans in subsequent pickings were severely russeted. Cook illustrated leaf and pod symptoms. The disease was favored by a dry, cool growing season. Sulphur dusts or sprays or lime-sulphur sprays were recommended for mildew control. Cook observed that 'Bountiful' green and 'Hodson Wax' varieties were susceptible while 'Refugee' was resistant and was recommended for fall crops. He presented a paper on the "Nature of powdery-mildew injury to snap beans in Virginia in 1930" at the December 30, 1930-January 1, 1931 meetings of the American Phytopathological Society (Phytopathology 21:116, 1931).

Cook's second major publication was "The Diseases of Sweet Potatoes in Virginia and

Methods for Their Control" (Va. Truck Expt. Sta. Bul. 76, 1931). This was a review of literature; no original experiments were described. Cook described about 12 major diseases common to sweet potatoes in Virginia. The bulletin was well illustrated. In addition, there were reviews of control methods applicable to production and storage of roots. There was a six-part calendar of control measures, which appeared to be an original innovation.

In the *Plant Disease Reporter*, volume 15, Cook reported on the occurrence of spinach downy mildew (p. 36), kale *Sclerotinia* rot (p. 36), and *Phomopsis vexans* induced damping-off of eggplant seedlings (p. 48). W. D. Moore, U.S.D.A., reported extensive pod blight on lima bean (*Diaporthe*) in the Norfolk area.

Reports on fruit diseases indicated there was little damage expected in 1931 (pp. 49, 99-100). Wingard reported powdery mildew to be playing havoc with wheat and barley in some sections of the State in May (p. 49). R. J. Haskell (U.S.D.A.) reported wheat stinking smut to be very damaging in Fairfax Co. Other wheat diseases found there were galls (nematode), loose smut, leaf rust, powdery mildew, scab, and glume blotch (p. 68). Leukel (U.S.D.A.) and Godkin, at the request of millers in Page Co., surveyed for and found galls in wheat from 12 farmers. All had purchased seed from a common source. He also learned that most farmers had implemented the recommended practices of cleaning seeds and crop rotation to rid their wheat of the galls (p. 129-130). In reports of tobacco angular leaf spot in Halifax (p. 58) and several other counties, Godkin found that growers who followed recommended practices of seed treatment and seed bed sanitation avoided the disease (p. 98). In late May and early June, downy mildew was generally prevalent in Mecklenburg and Patrick Cos. (p. 61). It was the first time this disease appeared in Virginia (Godkin). Cook (p. 50) reported rapid killing of alfalfa in Newport News in a field preceded by a planting of turnips which were also "affected by the same disease." (Note: the fungus was reported as *Sclerotinia trifoliorum* but this fungus does not colonize turnip; *S. sclerotiorum* colonizes both species - C.W.R.). The first report of the white pine blister rust fungus in Virginia came from Frederick and Rappahannock Cos. (p. 144). The fungus was found on *Ribes rotundifolium* according to Roy G. Pierce reporting in the Blister Rust News 15(9):213. In a survey of the Virginia peanut crop, W. D. Moore (U.S.D.A.) found peanut leaf spot (*Cercospora personata*) causing 15% defoliation and stem rot (*Sclerotium rolfsii*) causing a 5-10% loss, mostly on sandy soils (p. 166). Finally, a report of the sugar beet nematode, *Heterodera schachtii*, on a *Polygonum* sp. in Fairfax Co. came from G. Steiner (p. 145). The nematode was later found to be *H. polygoni*, not the sugar beet nematode.

The annual "Spray Information for Virginia Fruit Growers" was published early in 1931 (Va. Ext. Div. Bul. 123). It was republished in the *Southern Planter* [92(3):4-5, Feb. 1, 1931] and was the only plant pathology topic in the 1931 issues of the magazine.

For plant pathologists, the year ends with a meeting of the American Phytopathological Society, followed by publication in January of abstracts of their presentations. At the 1931 meeting, Cook, of the Truck Station, read a paper, "Control of powdery mildew of snap beans", in which he reports that of twelve sulphur and copper sprays and dusts, lime-sulphur spray and sulphur-based dusts gave the best control. Four applications at weekly intervals were necessary beginning when mildew first appeared (Phytopathology 22:7, 1932). Groves, of the Winchester station, reported on variation in cultures of fungi causing, "The sooty-blotch and fly speck of the apple" (Phytopathology 22:10, 1932).

Papers delivered before the December 1931 meetings of the Virginia State Horticultural Society were also published in January 1932. Hurt spoke on two topics, "Zinc lime spray and its importance as a peach spray", and, "Tar oil distillates as dormant spray materials for fruit trees" [Va. Fruit 20(1):94-104, Jan. 1932]. In the first paper, Hurt pointed out that arsenical injury of peach foliage coincided with efforts to control the oriental fruit moth and that he first observed injury in 1924. With the introduction of zinc-lime spray, zinc Bordeaux by J. W. Roberts (U.S.D.A.) for control of bacteriosis, Hurt experimented with it although no bacteriosis occurred in his spray plots. He discovered that arsenical injury was eliminated; this serendipitous find led Hurt to recommend zinc-lime be included in the spray simply as a foliage-maintaining product, not as a pathogen-controlling agent.

In the second paper, Hurt described the origin and diverse uses of coal tar oil distillates. Hurt experimented with them beginning in 1927 and found them to be very efficient for control of apple aphids, but petroleum oils were superior for San Jose scale.

M. B. Waite (U.S.D.A.) contributed a talk on, "Peach yellows and little peach in Virginia" [Va. Fruit 20(1):104-117]. He reported that peach yellows was common but not prevalent or destructive in Virginia through 1931. Little peach had been found only at Lovingston in Nelson Co., 1929. Waite considered this to be the southern-most outpost of little peach (Note: Little peach and yellows are now known to be different expressions of an MLO infection). No phony peach nor peach rosette was known in Virginia. For yellows control, infected (symptomatic) trees should be destroyed as soon as they are discovered. All trees in an area where yellowed trees are found should be surveyed frequently during the growing season. Control becomes a community necessity.

In 1931, F. E. Clements and C. L. Shear (father of G. M. Shear) published "The Genera of Fungi", a most useful taxonomic work.

The earliest research publication from the Blacksburg station in 1932, was "Some nutritional disorders in corn grown in sand cultures" (N. A. Pettinger, R. G. Henderson, and S. A. Wingard. Phytopathology 22:33-51, 1922). The authors recognized and described magnesium and manganese deficiency and sodium toxicity symptoms and, "Found that addition of manganese, zinc, copper, boron, and arsenic to the basal nutrient solution increased the frost resistance of young corn plants grown in sand culture."

Groves published an article, "A photographic light box for use in agricultural research" (J. Agric. Res. 44:467-475, 1932), in which he stated, "This light box ... has proved very satisfactory as a source of illumination for photographing diseased fruits and similar specimens." He illustrated the article with photographs of a mushroom, twig canker, apple spray injury, and an insect larva.

Thus, there was little research publication by the Experiment Station plant pathology staff in 1932. There was a considerable flow of popular articles, as cited below.

During 1932, several articles were published in *Virginia Fruit*. Hurt reviewed again how to, "Prevent arsenical injury to your peach trees" [Va. Fruit 20(3):10-12, Mar. 1932]. Wingard raised the question, "What is the present status of apple scab in Virginia?" [Ibid. 20(3):12-14, Mar. 1932]. The nation was gripped in the depths of a depression and growers were seeking ways to cut costs. Wingard warned them that they must apply pink, petal-fall, and 3-week sprays in order to produce a high percentage of No. 1 apples. Wingard also described and illustrated, "Blister canker of apple trees" [Ibid. 20(4):15-16, Apr. 1932], a disease apparently not well known to growers but wide-spread in Virginia orchards and caused by *Numularia discreta*. Varieties were classified into four response categories from very susceptible to very resistant. The disease was said to be one of old orchards where control by pruning proved unsuccessful. Wingard recommended destruction of old trees.

Two articles on peach leaf curl appeared in *Virginia Fruit*. Wingard described, "Peach leaf curl" [20(6):10-11, June 1932], and pointed out that a single oil emulsion spray of lime-sulphur or Bordeaux mixture should be applied during dormancy. Hurt reiterated the same points and emphasized that these oil emulsion sprays also controlled scale [Ibid. 20(12):6-8, Dec. 1932]. Hurt emphasized that even though orchardists were suffering in the depression, they could not survive if they did not maintain their trees in a healthy condition.

Wingard described, "Bitter pit of apple" [Ibid. 20(12):8-10, Dec. 1932]. He pointed out that this non-parasitic disease is affected by rainfall distribution and degree of maturity at harvest and storage temperature. Growers were urged to pick only fully ripe fruit. Hurt had two other publications in *Virginia Fruit*. He reviewed his, "Observations of tar oil sprays in 1932". The article dealt with insect control. There was concern for the environment even back in 1932. "Disposal of the acid wash solutions from fruit washers," was a topic aired by Hurt [Ibid. 20(8):6-8, Aug. 1932]. The lead and arsenic could be precipitated from the wash by the addition of calcium sulphide. The precipate was insoluble and could be dumped. (Could this be done in the 90's?)

Assistant Experiment Station Horticulturist, R. C. Moore, earned an M.S. in June 1932. He submitted a 140 page review of literature text on tree fruit diseases in Virginia for his minor. Each was beautifully illustrated with ink drawings of incitants and sections through infected tissues. There were also high quality photographs of each disease. *Reiterating, this tome was submitted for a minor in plant pathology*. Modern students do much less for a major. Having prepared this wonderful compendium, Moore submitted an extract from it to *Virginia Fruit*, "Fire blight of apple" [20(6):11-13, June 1932]. After a description of fire blight, Moore recommended strict pruning of cankers or treatment of cankers with a hydrochloric acid-zinc chloride-denatured alcohol mixture.

Godkin also published a note in *Virginia Fruit*. He described, "The wilt disease of sweet corn" [20(7):10, July 1932]. The sole source of inoculum was thought to be bacterial-infected seed. The role of flea beetles had not been established. Therefore, a seed treatment with bichloride of mercury was prescribed.

There was a warning to growers that cedar rust on apple leaves was increasing. Growers were urged to cut young cedars from previously cleared land. [Ibid. 20(9):11, Sept., 1932].

Virginia Fruit had become a clearing house for applied fruit pathology articles.

Certainly, information was reaching the targeted audience. On the other hand, the *Southern Planter* as a source of popular articles had dried up. Through 1934, only reproductions of the spray program were published. However, sometime during late 1933, there was a change in the editorship; T. K. Wolfe's name was no longer listed in the masthead. Beginning in March 1934, Paul D. Saunders was editor. Perhaps thereafter, plant pathology articles would be featured. But beginning in 1932, the depression also struck the *Southern Planter*. It cut from 24 to 12 issues a year.

The *Plant Disease Reporter* vol. 16 had a scattering of reports of disease incidences and surveys from Virginia in 1932:

- p. 5 - Godkin described surveys made May 11 through July 1, 1931. He found wheat loose smut averaged 1%, stinking smut reached 40% but average 2%, nematode gall disease averaged 3% in seven counties, black stem rust was serious only in Grayson and Smyth Cos.; one field was scored 90% severity and was a total loss. Leaf rust averaged 5%. He found oat and barley smuts to be common and on rye only leaf rust was common. There was no mention of powdery mildew, glume blotch, crown rust or scald.
- p. 6 - In a field survey of tobacco diseases in 1931, he found blackfire, mosaic, black root rot and frenching. One field in Pittsylvania Co. had almost 100% prevalence of mosaic.
- p. 19 - Paul R. Miller and R. J. Haskell of the U.S.D.A. made a survey of sweet potato storage diseases during February 1932. They were accompanied by H. T. Cook of the Va. Truck Station. Black rot, soft rot, surface rot, and charcoal rot were most frequently observed.
- p. 92 - Groves at Winchester reported pear and apple fire blight to be more prevalent and damaging in 1932 than in previous year.
- p. 94 - Groves reported scab and powdery mildew to be very common in May 1932.
- p. 95 - Godkin reported tobacco downy mildew (= blue mold) to be present throughout the bright (flue-cured) belt, in 10 counties, by June 8. Where 4-4-50 Bordeaux sprays were applied, the spread of the disease appeared to be checked.
- p. 96 - G. F. Gravatt and R. B. Clapper (U.S.D.A.) reported maple Verticillium wilt to be present in Roanoke and Pulaski and from Staunton northward in the Valley of Virginia. They also found an *Ailanthus* tree with the disease in Roanoke.
- p. 111 - *Physarum* sp., a slime mold was troublesome in sweet potato seed beds in 1932.
- p. 115 - Wheat rosette-mosaic is mentioned by H. H. McKinney (U.S.D.A.) as occurring in Virginia.
- p. 153 - Cook reported damage from *Septoria* in Northern Neck tomato fields and bacterial blight of lima bean severe in King and Queen Co. and on Eastern Shore. In a test of Marglobe from different seed companies, variation in resistance was observed. From 4 to 58% wilted plants occurred in a heavily infested field.
- p. 158 - Paul R. Miller found apples not infected with cedar-apple rust were infected with quince rust. Quince rust occurred from Augusta and Albemarle Cos. northward.
- p. 164 - Miller also surveyed peanut fields from Virginia southward. In Virginia, he found *Cercospora* leaf spot, Botrytis leaf spot and *Sclerotium rolfsii* induced

wilt.

- p. 182 - Miller followed up the earlier storage survey of sweet potato diseases with a field survey. "... There is a close correlation between severity of disease in storage and the cultural and handling practices, especially the rough handling during harvest."

Godkin wrote about "Controlling tobacco diseases in Scott County, Virginia" (The Extension Pathologist 3:25-26, Nov. 1932). He described the treatment of 130 lots of tobacco seed with bichloride of mercury and how plants from treated seed were free of black fire while plants from untreated seed had the disease. The profit from treating were estimated at $10,000-15,000.

At the Truck Station, Cook and H. G. Walker released a bulletin, "Rose Diseases and Insects and Their Control" (Va. Truck Expt. Sta. Bul. 79, 1932). Powdery mildew and leaf spot were among the 10 diseases listed. The use of sulphur dusts and sprays and Bordeaux mixture was recommended.

M. M. Parker, Horticulturist prepared a bulletin entitled "Celery Culture in Eastern Virginia" (Va. Truck Expt. Sta. Bul. 78, 1932) in which he described briefly damping-off (caused by several fungi), pink rot (*Sclerotinia* spp.), early blight (*Cercospora apii*), and black heart (physiological). Crop rotations were required and weekly spraying with Bordeaux mixture was recommended as soon as early blight was detected. Parker did not acknowledge any help from Cook.

Cook published an article, "The control of powdery mildew of snap bean" (Trans. Peninsula Hort. Soc. 22:25-28), in which he reviewed the content of Truck Experiment Station Bul. 74.

In American Phytopathological Society affairs for 1932, of Virginia pathologists, only Cook served on a committee, the Elections Committee, an annual *ad hoc* function.

As in previous years, meetings were held in December, papers were read and the contents were published in January 1933. At the December 1932 meetings of the Virginia State Horticultural Society, Hurt spoke on "Zinc and copper spray materials for peaches and apples" [Va. Fruit 21(1):55-64]. Since having learned to control arsenical injury to peach foliage by adding zinc sulphate, Hurt said spray pressure may be increased from 200-225 lbs. to 300-350 lbs. He presented a revised peach spray schedule. He discussed Bordeaux mixture injuries and how to ameliorate them by adding calcium sulphide. There was a lively question and answer session following Hurt's paper.

The after dinner speaker for the 1932 meetings was S. W. Fletcher, former director of the Virginia Agricultural Experiment Station, who addressed the Society on "A history of fruit growing in Virginia" [Va. Fruit 21(1):109-146, Jan. 1933]. This must have lasted more than an hour; I hope his voice and manners kept his audience awake. In the talk he mention that as of 1722, stone fruits bore lavishly even under neglect. "There were no serious insect or fungous pests." Early in the 17th century, the London and Virginia Companies and the Colonial Assembly offered rewards and requirements that growers plant European grapes. These plantings were doomed to failure by downy mildew, black rot and the phylloxera root louse, to which native American grapes were resistant. The Old Dominion Fruit Growing Co. had planted 18,000 peach trees in Surry Co. by 1867. They were not profitable because the fruit rotted. They tried in 1873 with 20,000 pear trees, mostly Bartlett. They were profitable through 1881 but then fire blight began to decimate the orchards and by 1887, little remained of Tidewater pear culture. In other Tidewater areas, peach culture was destroyed by yellows, borers, and brown rot. Grape culture was attempted again after the Civil War but by 1870 black rot and downy mildew forced growers out of business. Two years later, Bordeaux mixture was discovered but by the time the growers could master spraying, the vines were gone. Fletcher reported that Oscar Reierson of Albemarle Co. was spraying with Bordeaux mixture in 1887. It remained for William Alwood of V.P.I. to experiment with and teach spraying methods. (And also import suitable spray equipment). Fletcher recalled that Alwood had in 1889 published the first papers in Virginia on spraying and on apple rusts. He also reminded growers that the first crop pest law in Virginia aimed at controlling peach yellows had been prepared by Alwood. No doubt Alwood was in the audience to hear the praise for his role in saving the Virginia fruit industry.

At the December American Phytopathological Society meetings, Henderson reported that carbolic acid would preserve tobacco ringspot virus in extracts for 7 days (Phytopathology 23:14-15, 1933). Hurt described the substitution of zinc hydroxide for calcium hydroxide in arsenical sprays to reduce arsenic injury (Ibid. 23:17, 1933). Wingard described the, "Nature of rust resistance in beans," in which he described reaction types and distinguished three reponse groups (Ibid. 23:38, 1933). This work is illustrated in Va. Agri. Expt. Tech. Bul. 51, 1933). Cook of the Truck Station spoke on, "Infection of seed clusters of spinach by *Peronospora effusa*" (Ibid. 23:6, 1933). Infection of pericarp, funiculus, and intiguments of ovule but not of the embryo or perisperm was demonstrated.

In 1932, the genetics of fungi was stimulated by Hansen and Smith who reported heterokaryosis was a mechanism which enabled fungus variation, and by Lindegren whose studies with *Neurospora* laid the groundwork for vast experimentation in Ascomycete genetics. (Parris, 1979. A Chronology of Plant Pathology, 2nd ed., p. 123).

During 1932, Hurt completed the requirements for an M.S. degree in plant pathology. His thesis was entitled, "A study of calcium monosulphide and waste sulphite material of paper mills as fungicides and adjuncts to fungicides and insecticides." A copy is on file at the V.P.I. & S.U. Library but oddly it is not dated and there are no literature citations.

Shear published his first technical bulletin based on research at V.P.I. in June 1933 (G. M. Shear. Field and Laboratory Studies on Frenching of Tobacco. Va. Agri. Expt. Sta. Tech. Bul. 49). Frenching had caused some problems in the southwestern Virginia burley area. It was first noted by John Clayton of Virginia in a letter to the Royal Society of London, dated May 12, 1688. It is characterized by a ceasation of terminal growth, whitening of veins and chlorosis, a proliferation of axillary buds resulting in an excessive number of strap shaped leaves. Shear attempted to determine its causes. He was able to induce the disease in the field at Blacksburg and in soil and sand in the greenhouse. Frenched plants showed signs of recovery when a superfluous amount of nitrogen was applied to field soils. In greenhouse experiments, Shear noted that excessive watering and soil compaction favored frenching. He could produce the symptoms in glazed, paraffine-coated, or shellacked pots but not in uncoated clay pots. Aeration of glazed or coated pots reduced symptoms as did addition of ammonium nitrate. Cotton added to the soil (to create competition for nitrogen between microorganisms and tobacco) favored frenching; symptoms developed at pH 5.2 to 7.9, the range of the experiment; optimum was pH 7.0-7.5. He collected leachings from soils that produced frenching and watered plants in sand culture with it and produced symptoms, provided the sand surface was sealed with paraffine and the pots were impervious. He observed that partial sterilization of frenching-prone soil prevented frenching. He also observed that application of nitrogen to symptomatic foliage and to roots of frenched plants protruding from pots did not ameliorate symptoms. Shear concluded that the cause of frenching is inherent in the soil on which it occurs. Leaching experiments "... Indicate that frenching is the result of some material in the soil that is toxic to tobacco plants." Thus, frenching, he concluded, is a toxicity disease rather than a deficiency disease, as were the prevailing view of the time.

Groves published his Ph.D. dissertation which he had presented to the Univeristy of West Virginia as the text for a technical bulletin from Virginia (A. B. Groves. A Study of the Sooty Blotch Disease of Apples and the Causal Fungus *Gloeodes pomigena*. Va. Agri. Expt. Sta. Tech. Bul. 50. Sept. 1933). He received his degree in June 1933. Groves studied cultural variation in the fungus and tried to relate colony type in culture to that on apple fruits. He had to develop efficient methods of isolation and suitable culture media. He had photomicrographs that demonstrated penetration of cuticle and epidermis of fruits. He concluded the fungus is an active but weak parasite.

A third technical bulletin from the Department was published by Wingard (S. A. Wingard. The Development of Rust-Resistant Beans by Hybridization. Va. Agri. Expt. Sta. Tech. Bul. 51. Oct. 1933). In this report, Wingard's objectives were to determine the inheritance of the rust-resistance factor in beans and to develop rust-resistant strains of Kentucky Wonder (green, pole) and Boston Navy beans. In all crosses between resistant and susceptible varieties, the F_1 plants were resistant and F_2 segregated 3:1 resistant:susceptible. Thus, resistance was conditioned by a single dominant factor. The resistance was described as "hypersensitiveness of the host to the parasite." Wingard could establish no linkages between resistance and morphologic characters. He complained that it did "require an unusually large number of generations to obtain hybrid plants combining the plant characters of the susceptible parent with the rust resistance of the resistant parent". Apparently Wingard made no use of the backcross procedure which might have simplified his project. For this work, Wingard was awarded the J. Shelton Horsley Research Prize of the Virginia Academy of Sciences, May 1933.

Hurt published the final bulletin of the year from the Department. (R. H. Hurt. Tar Oil Distillates as Dormant Spray Materials for Fruit Trees. Va. Agri. Expt. Sta. Bul. 293, Dec. 1933). In the bulletin he described the nature of tar oil distillates as probably being creosotes, his seven years of experiments with them in apple orchards, instructions for preparing them, and time to apply them. For peaches, the distillates were recommended where aphids were a problem. Hurt had discussed this topic before the Horticultural Society in December 1931 [Va. Fruit 20(1):94-104, Jan. 1932]. Mary C. McBryde received an M.S. in Plant Pathology in June 1933. Her thesis was entitled "Preliminary studies of boxwood blight."

The 1933 *Plant Disease Reporter* contained subjects that forecast trouble to two prominent Virginia plants, tobacco and American elm. Tobacco downy mildew became widespread in Virginia in 1933. Godkin reported an outbreak of the disease in Halifax Co., April 24. Widespread occurrence was reported in Halifax and Pittsylvania on May 2 (Pl. Dis. Reptr. 17:31, 1933). E. E. Clayton reported from a survey that all tobacco beds examined in Dinwiddie, Lunenburg, Mecklenburg, and Nottoway Cos. on May 15, had downy mildew present for at least two weeks. Neil Stevens (U.S.D.A.) found it in Washington Co. on May 11. (Ibid. 17:45, 60). A summarizing comment by Clayton indicated losses may be reduced because growers doubled seed bed sizes. "It is reported that more tobacco cloth was sold in southern Virginia than for many years (p. 45).

G. F. Gravatt and M. E. Fowler (both of U.S.D.A.) published an interesting article titled "Log interceptions at Norfolk in relation to the entry of tree diseases" (Pl. Dis. Reptr. 17:129-133, 1933). They reported that three shipments of elm logs were intercepted by quarantine inspectors at Norfolk, Virginia on July 25, August 15 and 22. In each shipment, *Graphium ulmi* (now *Ceratocystis ulmi*) was isolated from logs in each shipment. *Scolytus* beetles, known vectors of *G. ulmi* in Europe, were found in the August shipments and 14 of 52 larvae were found infested with *G. ulmi*. Thus, the risk of an outbreak of Dutch elm disease lay on piers at the Norfolk waterside. No diseased trees were found in Virginia in 1933.

There was a disturbing article published in the June *Plant Disease Reporter* (Ibid. 17:46-53, 1933). Eel grass (*Zostera marina*) was dying out in the coastal waters from North Carolina to Labrador. Eelgrass served as a water fowl food and was used in packing, insulation, bedding, etc. The plant abounded in Back Bay, Virginia Beach and in various parts of Chesapeake Bay. Loss of this plant caused starvation among the migratory ducks and geese that wintered in Back Bay. No cause of eelgrass death was demonstrated; its disappearance was documented on the European Atlantic coast at the same time it was dying out in the North American coast (Ibid. 17:119-120, 142- 144).

Wingard, Groves, M. B. Waite (U.S.D.A.), J. S. Cooley (U.S.D.A.), and C. L. Shear (U.S.D.A.) issued reports on various fruit diseases (Ibid. 17:33, 41, 54, 55, 56, 57, 58, 111, 176). Groves wrote a summary of, "The fruit disease situation in northern Virginia for 1933" (Ibid. 17:134-137). He covered the gamut of fruit diseases. Noteworthy diseases were apple scab which was deemed the most damaging since 1924 and cedar rust which had ceased to be damaging as a result of cedar eradication.

Cook reported a destructive outbreak of Sclerotinia drop of kale in January and a 30% loss of autumn cabbage caused by black rot in the Norfolk trucking area. Cook attributed the outbreak to wind-driven rains from tropical storms that swept the area on August 23 and September 16 (Ibid. 17:18, 156).

Aside from tobacco diseases, only alfalfa and clover root rot (*Sclerotinia trifoliorum*) were reported by Wingard as very destructive in late winter (Ibid. 17:34).

In <u>The Extension Pathologist</u>, Godkin reported on plans of Virginia cabbage growers to produce their own seed of Fusarium wilt resistant varieties. Seed of Marion Market, Jersey Queen, and Wisconsin All-Seasons had been in short supply in some previous years. Such a procedure would pump $30 to 60 thousand into the cabbage production area (Serial No. 8:36-37, Aug. 1933).

The annual, "Information for Virginia Fruit Growers" is numbered Extension Bulletin 131. It would remain 131 and be revised for many years.

In *Virginia Fruit* [21(4):6-10, Apr. 1933], Groves wrote about, "Lime-sulphur substitute spray materials." The products he described were sulphur manufactured by a variety of procedures. As a consequence, the particle sizes vary; this is related to their fungicidal properties. Groves gave a description of several products, giving their physical characteristics and relative effectiveness.

Hurt wrote about, "Fungicide compositions for late summer applications on apples" [Ibid. 21(6):18-19, June 1933]. He explained how the growers should adjust the strength of various components when making mixtures, i.e., Bordeaux mixture and wettable sulphurs, zinc-lime and wettable sulphurs.

Wingard contributed two articles, the first, "The black root rot disease of apple" [Ibid. 21(7):13-14, July 1933], was an admonition to growers not to attribute all apple tree death to black root rot. Severe drought had contributed to death of trees in shallow soils and those weakened by winter injury, mouse injury or other causes. If trees died from the aforementioned causes, growers could safely replant in the vacant site, but if black root rot caused death, replanting in such a site would only lead to death of the replant. Thus, the grower needed to establish in each case whether black root rot was the cause. Therefore, Wingard described and illustrated the symptoms and signs and stated that roots must be examined for blackening. Northern Spy had been previously recommended as a resistant root stock but recent observation indicated it was as susceptible as others. Thus, to avoid the disease, growers were advised to keep trees in a vigorous state.

Wingard's second article was a warning to growers that, "Peach leaf curl is ready to play havoc with the 1934 peach crop if ---" [Ibid. 21(10):8-10, Oct. 1933]. A build-up of peach leaf curl had been noted during 1931, 1932, and 1933. This was attributed to the depression during which growers were seeking ways to cut expenses and off-set falling fruit prices. As a result, they had reduced their efforts during dormancy and bud expansion. Wingard advised them to spray for control of curl and scale insects with an oil-lime sulphur or an oil-Bordeaux dormant spray. Leaf curl cannot be controlled after the buds open.

Even Godkin had an article in *Virginia Fruit*; his was a warning to readers to look for Dutch elm disease [Watch your elm trees. Va. Fruit 21(10):11, Oct. 1933]. This disease was spreading and a new outbreak had occurred in New Jersey. Recently, four logs from France had been found at Norfolk bearing the causal fungus. (See review of *Plant Disease Reporter* items below, esp. vol. 17:129-133). Dutch elm disease had not yet been found in Virginia but readers who found suspicious trees were encouraged to contact the Dutch Elm Disease Laboratory at Wooster, Ohio. The year ended with five talks on plant diseases given to the State Horticultural Society and two papers being read to the American Phytopathologic Society.

At the Horticultural Society, C. R. Willey, Associate State Entomologist, Richmond, spoke on, "Cedar rust and Japanese beetle" [Va. Fruit 22(1):58-63, Jan. 1934]; actually it was more of a conversation with the audience. Willey described why cedar eradication failed to protect orchards in 1933 as it had also failed in 1924. Eradication to the north, west, and south of orchards but not to the east had been very thorough. A few isolated trees to the east had showered orchards with spores when for the first time in years at a critical time, an east wind had prevailed during a wet spell. Willey then described the Cedar Rust Law enacted March 4, 1914, which must be adopted by the county Board of Supervisors before it can be implemented. Afterward a petition must be provided to the State Entomologist who investigates and certifies that a condition meriting eradication exists on non-orchardist property. The Entomologist notifies the petitionees; then eradication may begin. The growers must finance the eradication. He gave precautions to growers as to how public funds must be accounted for by county Commissioners and Treasurers.

Next, Hurt spoke on, "Phoney peach and other peach diseases" [Ibid. 22(1):64- 69, Jan. 1934). Note the spelling of "phony." He described the disease symptoms, incubation period, transmission by root grafts, control, and distribution. It had been found in Missouri, Illinois, Tennessee, North Carolina, and southward, but not yet in Virginia. Hurt did not call it a viral disease but later it was thought to be. (Note: It was established in the early 1970's that rickettsia-like bacteria cause the disease. It had been established earlier that certain leafhoppers were the vectors). Hurt also talked about brown rot and bacterial shot-hole. Afterward, President Nininger complimented Hurt on his good work through the years.

Groves spoke on, "The lime-sulphur substitutes and their role in the Virginia spray program" [Ibid. 22(1):116-126, Jan. 1934]. This was a grower-oriented discussion of various sulphur fungicides, their efficacy, etc. Their usage was recommended to reduce injury caused by Bordeaux mixture and lime-sulphur. Groves was becoming an expert on sulphur fungicides.

Next, F. D. Fromme, now Dean of Agriculture at West Virginia University, spoke as a substitute for S. A. Wingard who could not attend the meeting. His topic was, "Apple scab control" [Ibid. 22(1):142-149, Jan. 1934]. Fromme gave detailed discussion of the disease cycle, epidemiology, and effects of environment, especially rainfall in May, on the severity of scab. Failure in wet years was due to extremely vast numbers of ascospore being discharged over a long period, and inability of the grower to get into the orchard for timely spraying. He dwelt briefly upon fungicides, but because he had already been in administration for five years, deferred that discussion to Virginia's fruit pathologists.

Hurt presented a second talk on "Tar oil distillates (tar creosotes) as dormant spray materials for the control of aphids and other insect pests" [Ibid. 22(1):149-160, Jan. 1934]. This was an oral repetition of his 1933 bulletin no. 293, previously reviewed.

Resolution no. 5 requested that the Society Secretary contact and ask the Civil Conservation Corps to join in destroying cedars near orchards; and further resolved that the CCC be reminded of the importance of destroying cedar, barberry and other plants harmful to agriculture; and the U.S.D.A. be urged to destroy systematically all plants that harbored harmful diseases and insects [Ibid. 22(1):163, Jan. 1934]. Mention of the CCC reminds us that the New Deal programs had been activated under the auspices of the National Industrial Recovery Act (later NRA), enacted by the Congress June 16, 1933. The act provided for establishment of the AAA, PWA, CCC, and WPA, all of which contributed to the betterment of agriculture during their existence, and in several cases were involved with plant pathology projects.

At the 25th annual meeting of the American Phytopathological Society in Atlantic

City, December 28-30, 1933, only Henderson presented papers. He described the, "Effect of air temperature on tobacco ring-spot infection" (Phytopathology 24:10-11, 1934), in which he reported that moving symptomatic plants from the lower temperature (80-85°F) to a higher temperature (above 93°F) curtailed further development of symptoms. Plants at 93° having no symptoms developed symptoms when moved to 80- 85°. In the paper, "Experiments on the control of downy mildew of tobacco" (Ibid. 24:11), he reported the product Cal-Mo-Sul (calcium monosulphide) gave results approaching commerical control, while Bordeaux mixture gave only slight control. In the annual report of the meeting, it was announced by H. H. Whetzel that Phytopathological Classic No. 3, "The Discovery of Bordeaux Mixture," three papers by Millardet, had been prepared by F. J. Schneiderhan and published by the Society in 1933 (Ibid. 24:569). Schneiderhan had translated Millardet's publications during his review of literature for his Ph.D. project; he earned the Ph.D. degree at West Virginia University.

That resistance to tobacco mosaic virus is conditioned by a single dominant gene in *Nicotiana glutinosa*, was announced by F. O. Holmes in 1933. This discovery provided tobacco pathologists, including R. G. Henderson, and breeders the tool to virtually eradicate tobacco mosaic from grower's fields.

Only one publication by Virginia pathologists appeared in a scientific journal in 1934. Henderson reported on the, "Occurrence of tobacco ring-spot-like viruses in sweet clover" (Phytopathology 24:248-256, 1934). When the viruses were transferred to tobacco, symptoms atypical of tobacco ringspot were produced. However, he could not transfer the virus back to sweet clover. The sweet clover virus obviously is not the same as tobacco ringspot.

Groves spoke to the Peninsula Horticultural Society on, "Fungicides in relation to spray russet and disease control" [Bul. State Board Agri., Camden, Del. 24(5):20-24, 1934]. He stressed that most fungicides offered fruit growers are tested at Winchester and the acceptable ones are recommended. Copper fungicides are most apt to cause russet, but there is some variation in apples with respect to russet sensitivity.

Virginia Extension Bulletin 131, "Information for Virginia Fruit Growers" continues to be reproduced in the *Southern Planter*. Apple and peach spray program tables appear annually in the monthly bulletins of The Department of Agriculture and Immigration (for example, Bul. 313:5-6, 1934). In these bulletins one expects to find notices of federal and state law changes related to plant diseases and pests. The Crop Pest Law provides that the Commissioner of Agriculture, with Board of Agriculture, may revise the list of plant diseases which appear in Rules and Regulations. Effective February 7, 1934, black stem rust, cedar rust, and Dutch elm disease were added to Regulation One. Black stem rust was added because of a movement afoot sponsored by Federal and State agencies to eradicate barberry bushes from certain areas of Virginia. Dutch elm disease was added because Virginia had been exposed to the disease by infested logs imported through Norfolk in 1933. Cedar rust was already covered by the Cedar Rust Law but had not been named as a serious pest before. (Va. Agri. & Imm. Dept. Bul. 313:14-15, 1934). It was noted that in the winter of 1933-4, cedar cutting had been limited to Augusta and Frederick Cos. and little had been done to protect other orchard areas (Ibid. 314:7, 1934).

State Plant Quarantine No. 3, effective May 25, 1934, permitted state agents to eradicate all species of wild currant and gooseberries growing in 10 counties of the Piedmont, and cultivated species growing within 1500 feet of white pine stands (Ibid. 319:11, 1934). The discovery of Dutch elm disease in a single elm tree in Norfolk, October 1934, was announced in the December issue (Ibid. 322:11, 1934). Scouting for diseased trees in 1935 would be hampered by a lack of funds in the depression.

Several short papers appeared in *Virginia Fruit*. Wingard described, "Winter injury to fruit trees" [22(3):8-12, Mar. 1934]. It was a review of literature including symptoms and procedures for minimizing damage. A severe temperature drop from well above freezing on Nov. 30, 1929 to O°F on Dec. 3., followed by a severe drought in 1930 and a repeat of a similar cycle in the next 3 years brought about various kinds of winter injury and killing. During the depression, growers could not afford the labor to tend their orchards properly, thus, avoiding winter injury by normal orchard culture. Groves followed with an article on, "Early spraying and scab control" [Ibid. 22:(3)12-14]. It was an urging of growers to be vigilant and follow the prescribed schedule.

Wingard followed with a brief note on, "Control of peach leaf curl in orchards where fruit buds have been killed" [Ibid. 22(3):14, Mar. 1934]. He tried to assure growers that even though there may be little fruit, the trees should be protected from curl which would weaken them and decrease future crops.

Shear contributed an article on, "Winter injury of ornamentals" [Ibid. 22(4):20- 233, Apr. 1934]. Wingard had already addressed winter injury of apple and peach, therefore, an article on ornamental shrubs and trees affirmed the seriousness of the situation. Shear coupled fall drouth with winter injury, sudden temperature drops especially after a warm fall, and unseasonably warm periods in February followed by severe cold.

Godkin contributed a brief note urging farmers to treat seed corn with one of three dusts, Barbak, Merko, or Semesan, Jr. [Treating seed corn for the control of root, stalk, and ear rot disease. Ibid. 22(5):13, May 1934].

W. J. Schoene (Entomologist) and Wingard contributed a lengthy article on, "The more important insects and diseases of grapes" [Ibid. 22(5):13-18, May 1934]. They included a spray calendar, disease cycles and control measures for black rot and downy mildew. In addition to spraying with Bordeaux mixture, pruning and destruction of crop residues (sanitation) was advised.

Hurt added an item, "Protect your peaches against brown rot at harvest," [Ibid. 22(7):14-16, July 1934] in which he advised growers to spray or dust peaches just prior to harvest, or during the packing process.

Groves discussed, "The fruit disease situation and mid-summer spraying" [Ibid. 22(7):16-17, July 1934]. Thus far, 1934 seemed to be a recovery year from severe drouth, insect, and disease damage. He advised growers how to protect from fruit diseases while controlling the codling moth. Primarily, the task was to avoid pesticide incompatibility and phytotoxicity.

In the final issue for 1934, Groves pointed out that growers could, "Control peach leaf curl with fall spraying" [Ibid. 22(12):14-15, Dec. 1934] instead of waiting until February or March. The probability of having better and more spraying time is greater in fall than in spring. Emphasis on leaf curl was apparent in a number of articles in 1934 because growers were financially pressed and were cutting corners in the spray programs. As a result, leaf curl had increased from 1932 to 1934.

In the *Plant Disease Reporter* for 1934, there were reports by Cook of overwintering of the spinach downy mildew fungus (*Peronospora effusa*) in systemically infected spinach plants (Pl. Dis. Reptr. 18:48-49, 1934), and of seed-borne pepper mosaic (Ibid. p. 49); Godkin reported the presence of tobacco downy mildew in all the bright belt tobacco counties by May 28 (Ibid. p. 49). Henderson summarized, "Diseases of burley tobacco on Southwest Virginia" (Ibid. p. 135-36). He mentioned root knot, frog-eye leaf spot, angular leaf spot, black root-rot, mosaic and frenching. In an article, "Tobacco diseases for 1934 in Georgia, South Carolina, North Carolina, Virginia, Maryland, and Pennsylvania," seven tobacco scientists including Henderson, reported on the distribution of 10 parasitic diseases (Ibid. pp. 154-155). Only Granville wilt, black root rot, downy mildew, angular leaf spot, and mosaic were reported from Virginia, yet Henderson had already reported frog-eye leaf spot and root knot from burley areas.

The tobacco workers were feeling the need to have a more formal organization. They met in a "Conference on diseases of flue cured tobacco" at Oxford, N.C., Aug. 8- 10, 1934. Wingard, Henderson, Godkin, and Shear of the Experiment Station at Blacksburg, and Cook of the Truck Station and V.P.I. graduate student, W. A. Fuller, represented Virginia (The Extension Pathologist, Ser. No. 14:38-53, Oct. 1934). Henderson spoke on spraying for downy mildew (blue mold) control in 1934, and on black root rot of tobacco. In the latter case, the problem was very severe in burley areas and was appearing in some bright areas. 'Turkish' was being used as a source of resistance. It was for Henderson the beginning of a long career of breeding disease resistant tobacco. Godkin described the progress made in Scott Co. from 1931 to 1934 in controlling blackfire. There was a steady decline of disease incidence and a steady increase in yield and leaf quality. Shear described his work with frenching and a committee (including Henderson) gave 11 suggestions for controlling downy mildew and two for controlling root knot. Clayton and Stevenson (U.S.D.A.) said the downy mildew fungus should be *Peronospora tabacina* rather than *P. hyoscyami* as was the current name. The Tobacco Research Committee would meet again in 1935.

In other areas, Wingard and Paul Miller (U.S.D.A.) reported on cereal, fruit, tomato, and shrubbery diseases in Southwest Virginia based on a joint tour through Carroll, Grayson, and Wythe Cos. in July (Pl. Dis. Reptr. 18:115, 117, 118). They reported that wheat scab, stem rust, loose smut, and glume blotch were very severe and damaging; that bacterial (Stewart's) wilt of sweet corn was very damaging; and that barley stripe was more prevalent than average. Apple scab and rust were of average severity but cherry brown rot was extremely severe. They reported tomato early blight would probably reduce the crop by half. Neil Stevens (U.S.D.A.) reported heavy damage by the sweet corn wilt bacterium in the Arlington area and in test plots (Ibid. p. 122).

At the December 1934 meeting of the Virginia State Horticultural Society, A. W. Drinkard, Jr., Director of the Virginia Agricultural Experiment Station, spoke on, "Progress in horticultural research" [Va. Fruit 23(1):116-118, Jan. 1935]. He praised the progress that had been in fruit pathology and entomology. Especially significant to him was the Virginia Spray Service (referring to the card mailings of alerts, and the bulletin "Information for Virginia Fruit Growers"). Revisions, he said, were made annually based on research findings at the field stations. He was very appreciative of Hurt's accomplishments at the Piedmont Field Laboratory in Charlottesville. He enumerated as among Hurt's significant contributions the development of a zinc sulphate and hydrated lime solution to prevent arsenical injury to peaches, a machine for dusting sulphur on peaches at packing time to control brown rot in transit, the find that lignin pitch was a good emulsifying agent, and that tar oil distillates control aphids. C. R. Willey, Associate State Entomologist told, "How the fruit grower can use the Crop Pest Law" [Ibid. 23(1):74-78, Jan. 1935]. He reviewed the history of the Crop Pest Law and pointed out that Virginia had few state quarantines because state quarantines cannot conflict with federal quarantines. In 1934, Virginia was cooperating with the Federal Government in the Japanses beetle, white pine blister rust, and Narcissus bulb quarantines. Willey told growers how to petition against an orchard harboring a pest. State quarantine no. 3 described earlier apparently is the intra-state quarantine paralleling and required in a Federal quarantine.

The reliable R. H. Hurt reviewed, "Our peach spray program" [Ibid. 23(1):90-96, Jan. 1935]. It was more of a pep talk but the new dust chamber for applying sulphur to protect peaches from brown rot in transit was mentioned and promoted.

Groves discussed, "Fungicides in relation to scab control and spray russet" [Ibid. 23(1):100-105, Jan. 1935]. He pointed out that many products are foisted upon the orchardists. They must be tested for efficacy of disease control, non-injurious effects and compatibility with other pesticides. For this reason the growers should follow Experiment Station recommendations and not yield to the claims of advertisements. The Society heard two talks about black root rot. Wingard spoke first on the, "Black plague of apple and its path of destruction" [Ibid. 23(1):142-146, Jan. 1935]. He described the interactions of drouth and winter injury with black root rot. Essentially, black root rot-affected trees were more prone to killing by drouth or winter injury and drouth or injured trees were more susceptible to black root rot fungus infection. He described the weather for 1930 to 1934 during which many trees died and he told of the contribution of each factor, drouth, winter, and fungus.

Schneiderhan of the West Virginia Station at Kearneysville, spoke next on, "The black root rot disease --- a serious threat to our apple orchards" [Ibid. 23(1):147-153, Jan. 1935]. Through a series of questions he posed, he guided the audience lucidly through the life cycle of *Xylaria mali* and the disease cycle, symptoms, the search for resistant rootstock, and advice to examine roots of dead trees and not replant apple trees where black root rot was found. Because orchard space is lost where black root has occurred, he considered the disease the apple orchardist's No. 1 enemy.

The other year-end event was the Pittsburgh meeting of the American Phytopathological Society, December 27-29, 1934. Four papers were contributed by Virginians. Cook of the Truck Station spoke on the, "Occurrence of oospores of *Peronospora effusa* with commerical spinach seed" (Phytopathology 25:11, 1935). He said that the 1932 seed crop was badly infested and the 1933 crop grown from those seed was severely damaged by mildew. Cook and J. A. Callenbach (a Va. Smelting Co. Res. Fellow in Pl. Path. and Entom. at the Truck Sta.) contributed a paper, "Spinach seed treatments in Virginia" (Ibid. 25:12, 1935). They found that copper sulphate solution, red copper oxide, zinc oxide, zinc hydroxide, and Vasco 4 (a zinc material) gave approximately equal results. Increases up to 594% of untreated stands and 42% in yield were obtained. Semesan was the least beneficial. Zinc fungicides were being used on 90% of the seed sown for the early fall crop.

Henderson reported on, "Control downy mildew of tobacco" (Ibid. 25:19, 1935). He described testing numerous materials in greenhouse experiments and found that benzoic acid, cuprous oxide, and a copper-molasses mixture were most effective. Field tests of the best materials were needed.

Wingard reported on, "Host-parasite relationship in bean rust" (Ibid. 25:39, 1935). He described the histology of resistant and susceptible reactions. Resistant plants were hypersensitive but susceptible plants nourished sori at the expense of surrounding host cells. No one from Virginia participated on committees of the Society for the 1934 meeting.

In 1934, Tisdale and Williams patented dithiocarbamate fungicides. At last, the possibility of controlling plant diseases with products other than inorganic sulphur and copper compounds loomed possible (Parris, G. K. 1979. A Chronology of Plant Pathology. 2nd ed. Publ. by author, State College, Miss. 251 pp.).

In the V.P.I. Catalogue for 1932-33, I. D. Wilson was named course adviser for Pre-dental, Pre-medical and Pre-veterinarian students. Massey of the Department of Plant Pathology and Botany had been handling this assignment. This change was an ill omen for in the academic year 1935-36, Plant Pathology and Botany was obliterated; the faculty were included in the Biology Department with Wilson as Head. Wingard was thereafter called Head of the Section of Plant Pathology and Botany. In essence, he functioned only as administrator of Experiment Station projects and personnel conducting research in plant pathology and physiology at Blacksburg, Charlottesville, and Winchester. Massey no longer taught plant pathology and may have been transferred to the Wildlife Unit of the Biology Department. J. George Harrar was appointed as Assistant Professor of Biology with responsibilities in teaching botany, plant pathology, and plant physiology courses. There was bad blood between the faculty of the former Plant Pathology and Botany group and the Biology people Harrar and Wilson, which endured throughout the Harrar and Wilson tenure. Thus, the fiscal year beginning 1935-36 (= July 1, 1935) marks the end of part one of the three part Wingard era.

One member of the Department did not survive to know of its demise. H. S. Stahl died on January 14, 1935. He had taught plant physiology and other botanical courses since 1908, thereby having served under Reed, Fromme, and Wingard.

The last degree awarded by the Department of Plant Pathology and Botany was an M.S. degree in plant pathology on June 11, 1935 to W. A. Fuller. His thesis was entitled "A study of the nature of rust-resistance, rust-susceptibility, and rust infection in beans (*Phaseolus vulgaris* L.)." For the next 14 years, all degrees in plant pathology would be awarded in the Biology Department.

It was a lean publication year for the Department; only Shear managed a technical article, "The growth of *Agaricus campestris* on plots treated with sodium chlorate" (Phytopathology 25:440-442, 1935). On land infested with quackgrass, 30 plots 11.5 ft. square totaling 1984 square ft. were treated with sodium chlorate on June 1. An additional, alternate 30 plots were left untreated. On Aug. 3, there were 293 mushrooms on treated plots (2 to 47 per plot) and 47 (0-13 per plot) on untreated plots. On Aug. 16, there were 70 (0-15 per plot) on treated and 17 (0-4) on untreated plots. Shear pointed out that sodium chlorate sufficiently concentrated to kill weeds was not toxic to *A. campestris*, and the mushrooms proliferated where there was no competition, but an increase of available food. Also, decomposition of sodium chlorate may have stimulated mushroom growth.

Cook and Callenbach published their bulletin on, "Spinach Treatment" (Va. Truck Expt. Sta. Bul. 87, 1935). They found that Vasco 4, a zinc oxide + graphite material, gave the best stands when compared to zinc oxide, red copper oxide and Semesan Jr. Vasco 4 worked best on early fall plantings because when spinach was sown then, the temperature was most favorable for spinach damping-off caused by *Pythium* spp. The graphite reduced the tendency of zinc oxide to plug up planters; it also reduced wear on planter plates. Since early fall was the time when the most spinach was planted, the introduction of zinc oxide plus graphite essentially saved the spinach industry in eastern Virginia as it netted growers over $100 per acre. After treatment was adopted by growers, seedsmen began treating seed for growers at cost.

Several popular articles by the Experiment Station plant pathologists were printed in *Virginia Fruit* in 1935. Groves led off with a discussion of, "Early spraying and scab prevention" [Va. Fruit 23(3):24, Mar. 1935]. This was a pep talk to remind growers that timely spraying with appropriate materials was very necessary on susceptible varieties such as Delicious and McIntosh. Shear followed with an article on, "Arsenic in the soils" [Ibid. 23(3):28-28, Mar. 1935] in which he described the pros and cons of continued use of arsenical insecticides. He allayed fears that arsenic caused damage to plants and said that soil microorganisms could decompose arsenicals and cause arsenic to pass from the soil in a gas. Thus, it did not accumulate. In an article, "The control of plant diseases through the use of resistant varieties" Wingard made a few general statements about substituting genetic resistance for chemical control and cited troublesome cabbage yellows in southwestern Virginia, told how L. R. Jones at Wisconsin developed Wis. Hollander No. 8, Wis. Brunswick, and Wis. All-Seasons. These varieties were used in the Virginia cabbage industry [Ibid. 23(3):29-30, Mar. 1935]. A series of articles was planned for *Virginia Fruit* which when completed would be assembled in bulletin form. The first article by Groves was, "Apple or cedar rust" [Ibid. 23(4):26-30, Apr. 1935]. Groves described the indigenous origin of the cedar-apple rust fungus and its being presented with an additional succulent, highly susceptible host as colonists introduced the apple. Details of the symptoms, disease cycle, fungus life cycle, effects of weather, relative resistance of apple varieties, comparisons of cedar-apple rust with quince and hawthorn rusts, and controls were provided. Photographs referred to in the text were eliminated by the editor but were to be included in the prepared bulletin.

Hurt reviewed his work with an knowledge of, "Honeysuckle as an orchard pest and its eradication," with cresylic acid and tar emulsions [Ibid. 23(5):18, May 1935]. Growers were provided with concise procedures as to how to kill or just control honeysuckle for the enhancement of apple production.

In the July 1935 issue of *Virginia Fruit*, three items on plant pathology were published; G. T. French, State Entomologist at Richmond wrote that the, "State is being thoroughly scouted for the phony peach disease" [Ibid. 23(7):6, July 1935], and in the area between highway U.S. 1 and the Chesapeake Bay, none had been found. Groves continued the proposed bulletin series with an item on "Apple blotch" in which he described the symptoms on fruit, leaves, and limbs, all caused by *Phyllosticta solitaria* [Ibid. 23(7):10-13, July 1935]. The outline followed the pattern set for cedar-apple rust, and this time illustrations were included. Immediately following, Wingard issued a warning that, "Brown rot stands ready to attack the Virginia peach crop" [Ibid. 23(7):13- 14, July 1935]. He pointed out that the weather in the spring of 1935 was conducive to the blossom and twig blight phases and that even green, immature fruits were rotting in some orchards. He urged growers to intensify their use of sulphur sprays and late season dusts so that fruit would be adequately protected at harvest time. A pink sulphur dust had been developed by Hurt that blended with the color of ripened fruit. Wingard urged growers to use this product just prior to picking and to dust fruit during packing to protect them during transit.

French published a follow-up note, "Phony peach disease found in Virginia this year," a title which should have read ... "disease not found ..." [Ibid. 23(9):16, Sept. 1935], as the final paragraph begins, "We are encouraged to believe as a result of this summer's scouting that the Phony Peach Disease has not become established in Virginia."

The new status of the now defunct (as of July 1, 1935) Plant Pathology and Botany Department was announced to the Horticultural Society through a brief article by J. G. Harrar, newly appointed Assistant Professor of Biology who would instruct all classes in plant pathology, plant physiology, forest pathology and botany [Ibid. 23(10):13-14, Oct. 1935]. In the article, "Horticultural students at V.P.I. to receive thorough grounding in biology," Harrar indicated the former Departments of Botany and Zoology had been consolidated into the Department of Biology. "This department is prepared not only to continue the services heretofore rendered but to render additional service to Virginia orchardists by improving its teaching program....It is hoped that each year a number of students will be graduated in Horticulture and Biology who will give their services to the field of Horticulture...A new service laboratory has been established in the department, enabling the grower to send specimens to the college for diagnosis." Although Wingard, Godkin, Groves, and Hurt already provided this service, Harrar was presenting it as a new innovation. He needed specimens for his classes and experience in diagnostics for his soon-to-enroll graduate students. Most probably it was a preliminary step in establishing himself as the kingpin in V.P.I. plant pathology. He might have succeeded had he not have hooked an even larger fish in 1941, the Headship of Plant Pathology at Washington State University.

Harrar followed the article above with one on, "Boxwood diseases in Virginia" [Ibid. 23(10:14-15, Oct. 1935]. He named *Macrophoma candollei*, *Volutella buxi*, and *Nectria rousselliana* as most probable causes of boxwood problem, and prescribed four general measures for preventing boxwood diseases. He indicated that research on boxwood diseases would be initiated. Why Harrar became interested so quickly in boxwood problems is unknown but perhaps there were several wealthy estate owners in Virginia who felt their horticultural status symbols were imperiled and perhaps they would support boxwood investigations. On the other hand, Blacksburg and V.P.I. abounded in boxwood plantings which furnished a convenient source of material that attracted Harrar's eyes. Who knows why Harrar chose boxwood among the myriad of choices available?

In the same issue, Groves contributed a third chapter to the fruit disease bulletin, "Apple scald" [Ibid. 23(10):17-19, Oct. 1935]. He described and illustrated the disease. Quick cooling and the distribution of oiled paper at the rate 1 1/2 lbs/barrel was recommended.

In the *Plant Disease Reporter*, R. K. Beattie and A. E. Verrall, U.S.D.A., reported that the elm burl logs that entered the United States in 1933 had been traced from ports of entry to their destinations (Pl. Dis. Reptr. 19:11-14, 1935). One shipment from Norfolk travelled through Virginia to Princeton, W.Va. (and ultimately to Indianapolis, Ind.), thus exposing over 320 miles along the Norfolk and Western Rwy. in Virginia to Dutch elm disease. There were also seven shipments by truck from Norfolk piers to Portsmouth, Va. (Probably to Dixie Veneering Co. near highway U.S. 13 and Norfolk Navy Yard at Portsmouth Va.).

Clarence Cottom reported an improvement of eelgrass stands in the Chesapeake Bay of Maryland and Virginia but not along the Atlantic coastline. There was no explanation as to the demise of the plant [The present situation regarding eelgrass (*Zostera marina*). Ibid. 19:33-36, 1935].

Wingard in, "Plant diseases and weather in Virginia," stated that reported appearances of tobacco downy mildew proved false; injuries were caused by low temperatures and too much rain. Blossom and twig blight of peach caused by *Sclerotinia fructicola* was playing havoc following a three-week rainy period in late April (Ibid. 19:99-100, 1935). This precipitated the warning Wingard published in *Virginia Fruit* [23(7):13-14, July 1935].

Groves reported on, "The fruit disease situation in northern Virginia" (Pl. Dis. Reptr. 19:137-138, 1935). Apple scab was more prevalent because rains had favored ascospore discharges on May 2-3, and had interferred with petal fall sprays. He was concerned about the large number of trees being destroyed because of black root rot. Wingard reiterated that scab was causing problems (Ibid. 19:199, 1935). He also reported on bacterial canker, *Alternaria* collar rot, *Fusarium* wilt, and southern bacterial wilt of tomato, black knot of plum and cherry, cane blight and anthracnose of raspberry, frog-eye leaf spot and cedar-apple rust, peach leaf curl, black rot of grape, and potato black leg (Ibid. 19:198-204, 1935). A number of common cereal disease were listed (Ibid. 19:209).

Two trees were confirmed in 1935 as having Dutch elm disease in Norfolk; the report said nothing about the proximity of the trees to the pier where infested logs had been imported in 1933 (Ibid. 19:217, 1935). A quarantine in effect since October 1933, had prevented further imports. In late summer, an infected tree was found in Portsmouth (Ibid. 19:259).

Cook reported on, "Vegetable diseases in Virginia" (Ibid. 19:243-244, 1935). Bacterial canker caused extensive damage to tomatoes in Northern Neck, Essex, King and Queen and Middlesex Cos. Seed from several companies were involved but the highest percentage of damage was in plants grown from one seed source. *Fusarium* wilt had become so widespread in the same area that only resistant tomato varieties could be grown. Successful spinach growers were producing crops from seed treated with Vasco 4. Those who were not successful were trying to produce stands from untreated seed and a *Pythium* sp. was rotting seeds and seedlings. Later, Cook reported that a severe outbreak of powdery mildew on snap beans in the Norfolk area caused at least a 50% loss of the fall crop. Growers were warned twice through newspaper articles to spray or dust with sulphurs. Those who did produced a full crop and received a high price (Ibid. 19:311-312, 1935). Cook also reported isolated outbreaks of lettuce leaf spot (*Septoria lactucae*), drop (*Sclerotinia sclerotiorum*), and yellows (virus) and a severe, costly outbreak of spinach downy mildew. Godkin reported tomato bacterial canker from Bedford Co. (Ibid. 19:244, 1935); apparently the seed-borne disease was widespread in Virginia in 1935.

Tobacco pathologists from Connecticut, Wisconsin, Pennyslvania, Virginia, Georgia, and the U.S.D.A. banded together to report on "Tobacco plant bed diseases in 1935" (Ibid. 19:192-194); R. G. Henderson represented Virginia and reported a late appearance of downy mildew and only slight damage caused by it. Blackfire was universally present but wildfire was seen only once. South Carolina, North Carolina, and Tennessee pathologists joined the above to report on "Tobacco diseases in the field, 1935" (Ibid. 19:295-299). Diseases causing significant damage in Virginia were bacterial wilt, wildfire, blackfire, and mosaic. Members of this informal group became the nucleus of the Tobacco Disease Council.

The Tobacco Disease Council was organized at a conference in Greensboro, N.C., Nov. 6-7, 1935, for the purpose of coordinating research work on tobacco diseases (Phytopathology 26:495-496, 1936). Sixteen members of the American Phytopathological Society were present. The Executive Committee consisted of S. A. Wingard, Chairman; E. E. Clayton, U.S.D.A.; R. F. Poole, N.C.; W. D. Valleau, Ky.; and G. M. Armstrong, S.C.; R. G. Henderson was elected Secretary. Wingard and Henderson, having been elected Chairman and Secretary, respectively, of the Council, would serve in this capacity for many years. The group discussed 6 diseases, tobacco disease survey, and breeding disease-resistant varieties. A list of items for possible coordinated study was compiled for each item. Then there was a round-table discussion of the various diseases, with emphasis on distribution, relative importance, epidemiology and progress in control with emphasis on chemicals and finding sources of resistance.

It was ironic that in 1935, Wingard was deposed as a department head and became leader of one of the most important agricultural work groups in the eastern United States. Although his own research work on tobacco diseases had ended, his leadership, the work of Henderson, and several pathologists to be hired later for tobacco disease research at Chatham, VA., would establish Virginia as a premier center for applied tobacco pathology.

The final year of phase I of Wingard's 3-phase headship of plant pathology ended on the 50th anniversary of Millardet's publication on Bordeaux mixture; 1935 was the year W. M. Stanley reported the isolation of a crystalline protein having the properties of tobacco mosaic virus. This would lead to a Nobel prize, the first awarded for work with a plant pathogen; and F. A. Wolf of Duke University published, "Tobacco Diseases and Decays," the first comprehensive text on diseases of the "sovereign weed." During the next 14 years, the Experiment Station plant pathology faculty would increase from 4 to 8 and the world would endure the most destructive war ever.

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A History of Plant Pathology in Virginia: The Wingard Era - II (1935-1949)

Author's note: Describing the events and characterizing the people involved in plant pathology from 1935 to the present ought to be easier than for the pre-1935 periods because I entered the scene in 1939, and was part of it from 1941 to 1944, and from 1947 to the present. On the other hand, I know all of the people who were involved from 1939 onward; thus, there is a tendency to include anecdotes and events that may make the history more readable and possibly, more enjoyable but more voluminous. Since I am writing this history as a hobby and self-indulgence, I do not have to respond to editors and publishers; therefore, I choose to embellish these writings as I see fit. I hope you will find it progressively more interesting. Eventually, the cut-off date may be 1999 when our current department celebrates its first 50 years.

C. W. Roane. September 1996.

In 1935, I. D. Wilson convinced President Julian Burruss that combining several biology related disciplines into one big Biology Department would be an academic stride and economic gain for V.P.I., not to mention that he, Wilson, would be Head of the conglomerate. All instruction in botany, plant pathology, entomology, bacteriology, plant physiology and mycology as well as zoological courses, would be administered through the Biology Department, I. D. Wilson, Head. Although I have not seen or heard a statement to the effect that botanist H. S. Stahl's death in January 1935 contributed to formation of this super department, the search for his replacement may have been a factor. In any case, Wingard of the Department of Botany and Plant Pathology as named in the V.P.I. catalogue (but Department of Plant Pathology and Bacteriology in the Agricultural Experiment Station) and W. J. Schoene, Head of the Department of Entomology, became deposed department heads. However, both men continued to administer the affairs of the Experiment Station in their respective fields under the titles, Section of Plant Pathology and Botany and Section of Entomology.

To replace the teachers in botany and plant pathology, J. G. Harrar, a plant pathologist having earned the Ph.D. degree at the University of Minnesota, was hired as Assistant Professor for fall quarter teaching. Harrar was an excellent lecturer, organizer, graduate student recruiter and politician. He was of questionable character in the eyes of Wingard, Shear, and Henderson, all of whom abhorred the use of alcohol while Harrar consumed considerable amounts of it. Thus, to be a graduate of Minnesota plant pathology, one was automatically referred to in a derogatory manner by Henderson and Shear as being one of "that Minnesota crowd".

When Harrar arrived, he was expected to teach the following courses as listed in the

1935-36 (May '35) catalogue:

- 211-221-231 - Botany and Plant Physiology; I. - 3H, 6L, 5C; II. - 2H, 3L, 3C; III. - IH, 3L, 2C (I, II, III being the quarters F, W, S; H= hours of lecture; L= Hours of laboratory; C= credit hours).
- 212 - 222 - General Botany; I, II, 1H, 6L, 3C/qtr.
- 233 - Mycology; III, 1H, 6L, 3C.
- 313 - Plant Physiology; I, 2H, 2C.
- 321 - 331 - Plant Pathology; II, III, 3C/qtr.
- 332 - Plant Pathology Laboratory III, 6 to 12L, 2 to 4C.
- 424 - Advanced Botany; II, 4H, 12L, (could be arranged for up to 8C).
- 435 - Plant Anatomy; III, 6H, 2C.
- Graduate work in Botany - hours and credits arr.
- Graduate work in Plant Pathology - hours and credits arr.

Botany and Plant Physiology was renamed "Botany" and General Botany became "Phytology; the former was intended for students from the College of Agriculture, while the latter was intended for majors in Biology. Initially the hours and credits for Botany and Phytology were different but later they were the same and there was no real reason for offering botany under two different titles. We (the students) always thought it was simply a ploy by Wilson to maintain an upper and lower crust of students; i.e., to keep Biology students separate from Aggies. After all Biology students were destined to become doctors, dentists, veterinarians, and through advanced training in various disciplines, college professors; in general, they would not have to deal with soil, crops, manure, tractors, etc. Such may or may not have been the truth but it was perceived as so.

Into this atmosphere of segregation and dissention came Harrar who with Wilson had visions of grandeur for botany and plant pathology. Harrar did not promote his cause very tactfully when he announced to the Virginia State Horticultural Society that "A new service laboratory has been established in the department (of Biology), enabling the grower to send specimens to the college for diagnosis". Although this service was already available through Godkin, Extension Plant Pathologist, and Wingard and Henderson at Blacksburg and Hurt and Groves at field stations, Harrar was presenting it as a new innovation. He thereby further alienated himself from the faculty of the Section of Plant Pathology and Botany.

No matter how Harrar was regarded by other V.P.I. plant pathologists, his mission was to teach botanical courses but being a plant pathologist himself, he chose to train graduate students in plant pathology and, therefore, he revised the plant pathology course listings at the first opportunity. The 1939 - 40 catalogue (Apr. 1940) showed the following changes:

- 213-223-233 - Botany; 2H, 3L, 3C each qtr., a reduction from 10 to 9C and uniform hrs. and credits throughout the year.
- 312 - Plant Physiology; 2H, 3L, 3C, I (laboratory added).
- 337 - Forest Pathology; 2H, 3L, 3C, II (new 1936-37 catalogue).
- 5213 - Advanced Plant Pathology; 2H, 3L, 3C, II (new).
- 616-636 - Advanced Mycology; Credits and hours arranged.
- 617 - Cereal and Fruit Pathology; 2H, 3L, 3C, I (new).
- 638 - Diseases of Special Crops; 2H, 3L, 3C, III (new).
- 639 - Bacterial Diseases of Plants; 2H, 3L, 3C, III (new)

- 6210 - Principles of Plant Disease Control; 3H, 3C, II (new).
- 712 - Ornamental Pathology; Credits and hours arranged (new).
- 723 - Genetics of Plant Pathogens; 3H, 3C, II (new).

I do not know which textbooks Harrar recommended for use prior to 1940 but for the 1940-41 session, "Elements of Plant Pathology". by I. E. Melhus and G. C. Kent, 1939, was the text for Plant Pathology and, "Forest Pathology", by J. S. Boyce was recommended for the course by that name. The last 8 courses were for graduate students. No doubt these courses initiated were added in anticipation that a Ph.D. program would be initiated in the Department of Biology and indeed it was in the fall 1940. The list of courses was almost identical with the list in the University of Minnesota Graduate Catalogue; however, at Minnesota eight people participated in teaching versus one person at V.P.I. It seemed like a very ambitious undertaking for one person. Wilson had great faith in him because in 1937, Harrar was promoted to Associate Professor and in 1941 to Professor, a rather spectacular rate of advancement at V.P.I.

During Harrar's tenure, seven students earned M. S. degrees. It will be seen from the following list that three of them presented mycology-related thesis:

- B. L. Shelhorse completed his degree in 1936, but S. A. Wingard was his advisor. He wrote about purifying bean lines for rust resistance. He turned to medicine for his career.
- R. S. Mullin finished in 1937. He was Harrar's first student. His thesis was titled "Cercospora leaf spot of *Calendula* species". Mullin later briefly held the same position as Harrar had held in the Biology Department. He also worked several years at the Virginia Truck Experiment Station.
- L. I. Miller received his degree in 1938. His thesis was on "A Phoma leaf spot and stem canker of *Antirrhinum* species". Miller worked at Holland on peanuts and later was on the faculty at Blacksburg.
- G. E. Matheny graduated in 1939. His thesis was titled "A study of the relation of *Berberis canadensis* Mill. to stem rust in Virginia". He was barberry eradication leader in Virginia for several years.
- J. G. Martland wrote "A study of a species of *Beauveria* from *Dendroctonus frontalis*", and graduated in 1941. He became an employee of Minnesota Valley Canning Co. at LeSueur, Minn., canners of Green Giant products.
- J. J. McKelvey graduated in 1941, and wrote "A new entomogenous fungus parasitizing members of the Eriococcinae". McKelvey later was one of Harrar's assistants in the Rockefeller Foundation. J. W. Showalter graduated in 1941. His thesis was "Physiologic studies on some entomogenous fungi".
- R. P. Porter started under Harrar but graduated in 1942 under E. K. Vaughan. His thesis was titled "A study of Phomopsis blight on eggplant emphasizing seed treatment as a possible means of practical economic control". He became owner of a business for distributing chloropicrin.

Note that while Harrar was at V.P.I. most of his graduate students studied either diseases of ornamental plants or fungi infecting insects. It was claimed that he had the power virtually to eradicate mealy bugs from infested greenhouses by spraying them with macerated and diluted cultures of a fungus in the genus *Beauveria*. Porter, who wrote about Phomposis blight of eggplant, chose his thesis subject after Harrar had departed.

There is a personal sidelight concerning the work with entomogenous fungi. A medium for growing these fungi was based on egg yolks. I had been hired in fall of 1940 as a student employee on the National Youth Administration program (NYA, one of the New Deal projects), for the phenomenal sum of 25 cents/hr. I was assigned to Harrar. My first task was to wash the petri dishes that had been accumulated by Harrar's graduate students (Martland, McKelvey, and Showalter). I quickly found that agar easily washed from dishes but egg yolk required over-night soaking then a scraping with a scalpel before they could be washed. Dr. Orcutt complained to Harrar that I was painfully slow at the simple task of washing dishes. I asked Harrar to have Orcutt show me how to speed up the cleaning of egg yolk; he did and I heard no more from Orcutt.

It can be seen from the list of graduate students that the program was gaining momentum; three students earned M. S. degrees in 1941. Then the situation changed drastically; Harrar accepted the headship of the Department of Plant Pathology at Washington State Collage. This was a prestigious appointment as his predecessor was F. D. Heald, author of the very useful "Manual of Plant Diseases", and the textbook, "Introduction to Plant Pathology". The Washington State Department had become a world center for research on smut fungi.

At V.P.I., Harrar published 3 papers in *The Plant Disease Reporter* in 1936 and 7 abstracts in *Phytopathology* from 1938 to 1942, mostly about his student's thesis projects. He inserted himself as the senior author in contrast to present tradition. He published with his students a number of abstracts in the Proceedings of the Virginia Academy of Science and for the most part was senior author.

Apparently, J. M. Grayson, later to become head of the Department of Entomology, came under Harrar's influence and with Harrar in 1936, gave a paper on "Boxwood blight in Virginia". Among the fungi isolated only *Verticillium* sp. caused disease. In 1936, Harrar published a note in *The Plant Disease Reporter* describing the occurrence of, "Cercospora leaf spot of *Calendula* in Virginia" (20: 277-278); he reported it could be controlled with Bordeaux mixture, copper oxide, or sulfur dust. At the 1936 Virginia Academy of Sciences, Harrar and R. S. Mullin read a paper, "Cercospora leaf spot of *Calendula* species", in which they described isolates of *Cercospora* which failed to sporulate in culture, therefore, inoculations of *Calendula* had to be made with spores from lesions. Mullin, in the late 40's would be appointed to the position held by Harrar. In 1937, Harrar and L. I. Miller read a paper on, "A *Phoma* leaf spot and stem canker of *Antirrhinum* spp". Apparently this was the first report of this disease. At the year-end meetings of the American Phytopathological Society (A.P.S.) they read the same or similar paper (Phytopathology 28:8.1938). Miller then studied an entomogenous fungus; Harrar and Miller read a paper in 1938, "Studies on the morphology and physiology of a species of *Entomophthora* on *Typhlocyba pomaria*, the white apple leaf hopper" (Proc. Va. Acad. Sci. 1937-8). With Wingard they apparently read the same paper at the 1938 A.P.S. meetings under the title, "Cultural studies on a species of *Entomophthora* from the apple leaf hopper (*Typhlocyba pomaria*)" (Phytopathology 29:9. 1939).

The duplication of papers read at two meetings was also practiced with Martland, McKelvey, and Showalter. Harrar and Martland read papers, "The etiology of the *Beauveria* disease of *Dendroctonus frontalis*" (Proc. Va. Acad. Sci. 1940) and, "A fungus parasite of the pine bark beetle" (Phytopathology 30:8. 1940). Harrar and

McKelvey read, "Biological control of the mealy bug" (Proc. Va. Acad. Sci. 1941) and "Biological control of the mealy bug (*Pseudococcus* spp.)" (Phytopathology 32:7). Harrar and Showalter read, "Physiologic studies of some entomogenous fungi" (Proc. Va. Acad. Sci. 1941) and Harrar, McKelvey, and Showalter read, "Parasitism of economic insects by fungi" (Phytopathology 31:10. 1941).

Harrar was the sole author of several publications and papers read at meetings. He listed the, "Powdery mildews collected in Virginia" (Pl. Dis. Reptr. 20:278-279), described "blue rot of boxwood" (Phytopathology 28:8. 1938), "Hyphal structures of *Fomes lignosus* Klotzsch." (Proc. Va. Acad. Sci. 1935-6), "Infection of *Buxus sempervirens* by *Verticillium* sp." (Ibid. 1936-7); *Verticillium* caused blue rot. He described, "Cladosporium leaf and stem disease of snapdragon" (Ibid. 1936-7). One of his students, G. W. Matheny, who was Barberry Eradication State Leader, U.S.D.A., presented papers based on his field work, "Stem rust control on small grains in Virginia by barberry eradication" (Ibid. 1936-7), and "Effects of four years of barberry eradication on stem rust of cereals in Virginia" (Ibid. 1937- 8). Matheny stated that since 1934, 83 million barberry bushels had been destroyed on 2300 properties and 800 sq. mi. The incidence of rust had gradually declined and infection had generally been delayed. Eradication near grain had virtually eliminated damage.

When Harrar departed in 1941, Edward K. Vaughan, another Minnesota graduate was appointed Associate Professor to replace him. He assumed the same teaching load but before he had been at V.P.I. for six months, the Japanese attacked Pearl Harbor and war was declared. The number of students gradually declined. Vaughan continued teaching until June 1943 when he transferred to the Virginia Agricultural Extension Service. His activity as Extension Plant Pathologist will be described later. Vaughan was well-liked by Wingard, Henderson, and Shear. His hobbies were geography and telling raunchy stories. He shared them with all the staff but especially with Shear. Together, they shared many a thigh-slapping moment. He also shared them with me. During his tenure, the phrase, "that Minnesota crowd", faded away.

During the 1941- 42 session, Vaughan had an extremely busy year. He completed his dissertation entitled, "Bacterial wilt of tomato caused by *Phytomonas solanacearum* (E.F.S.) Bergey et al.", and was awarded the Ph.D. degree from the University of Minnesota in August 1942. He also had to advise J. J. McKelvey and R. P. Porter through the final stages of their graduate programs. Both were carry-overs from Harrar's tenure. He was having to adjust to teaching, outlining courses and preparing lectures. He changed the Plant Pathology textbook to "Introduction to Plant Pathology" by F. D. Heald, 1937. His criticism of the Melhus and Kent book was that it lacked literature citations (not uncommon in those days); Heald's book lacked attention to bacterial wilts, fusarial wilts and tobacco mosaic, while Melhus and Kent covered these subjects well. However, there was no ideal general textbook available. Vaughan continued to use Boyce's "Forest Pathology" because there was no other choice.

The 1942-43 session was a little easier. There were no graduate students so Ruth McDonald was hired to assist with laboratories. She was a good teacher and an artist. In addition to her instructional duties, she prepared the illustration comparing Granville wilt, black shank, and sore skin of tobacco that appears on page 14 of "Important Tobacco Diseases in Virginia and Their Control" (Va. Agri. Ext. Div. Bul.

152, 1942, prepared by S. B. Fenne, Ext. Pl. Pathologist). During this session, the impact of World War II became severe. Full classes in the fall were depleted by the wartime draft such that by spring the remaining students were largely conscientious objectors, female, too young, or those deferred by physical impairments. For students and faculty it was a frustrating time; for those facing military duty, the future was uncertain.

An accelerated program had been initiated in the summer of 1942 so that classes were conducted four quarters a year. I graduated in June 1943 and immediately became a graduate research assistant and an advisee of Vaughan with aspirations of earning an M.S. degree in plant pathology. However on June 1, Vaughan had transferred to the Extension Service to replace S. B. Fenne who was on a war time assignment in Brazil. Nevertheless, he remained as my advisor until he resigned from V.P.I. in September 1944. He saw me through to completion of the M.S. degree in September, and acceptance in graduate work at the University of Minnesota. A. B. Massey was once again assigned to teach botany and plant pathology courses. I assisted him in the preparation and presentation of botany, plant physiology and pathology laboratories although I was a research assistant. Vaughan tutored me through mycology, cereal and fruit pathology, history of plant pathology and he took me on some of his Extension Service trips where I was the recipient of some interesting instruction in field plant pathology and extension procedures. My M.S. thesis was entitled "Studies in the physiology, genetics, and pathology of *Colletotrichum phomoides* (Sacc.) Chester, the cause of tomato anthracnose." The degree was granted at the end of the summer session, 1944. It was the last M.S. Degree granted in Plant Pathology in the Department of Biology. It was the only degree for which Vaughan was the sole advisor. Later, Vaughan referred to me as his first graduate student; I hope I made him proud. Through 1996, I was the only V.P.I. graduate to be named "Fellow" in the American Phytopathological Society; that gave him great satisfaction.

From fall of 1943 through summer of 1946, A. B. Massey taught whatever plant pathology was offered. When the catalogue for the 1946-47 session appeared (May 1946), Cereal and Fruit Pathology, Diseases of Special Crops, and Bacterial Diseases of Plants, were stricken from the list of courses. This was a step toward realism. It was also evident that the Ph.D. program in plant pathology was being shelved. Meanwhile, R. S. Mullin who had succeeded G. F. Matheny as Barberry Eradication Leader, made a deal with Wilson to the extent if he would earn a Ph.D. degree in plant pathology, he would be appointed Associate Professor of Biology in charge of botany and plant pathology. Mullin spent a year at Minnesota during which time he met the residency requirements and was admitted to candidacy. (For other students, this took from 2 to 4 Years). When he was ready to return to V.P.I., Wilson had to renege on his offer. There were not enough students to justify his appointment but Wilson arranged to have him appointed Plant Pathologist at the Virginia Truck Experiment Station until the student enrollment would justify his appointment at V.P.I. From fall of 1945 to fall of 1946, Mullin worked on vegetable problems. In fall of 1946, Wilson fulfilled his promise and Mullin became Associate Professor of Biology. He remained at V.P.I. through the summer of 1948 when he decided he liked the Truck Station better than teaching. H. T. Cook had resign from the Station in September 1948 and Mullin was again appointed Plant Pathologist there. With Mullin gone in 1948, Massey probably taught Plant Pathology again in the 1948-49 year. Whatever the situation, Wilson was seeking a replacement for Mullin and again he sought help from E. C. Stakman of Minnesota and Axel Anderson was interviewed. Axel declined Wilson"s offer but Huey I. Borders then at the Homestead, Florida Station and also Minnesota-trained accepted an appointment. Two weeks before the opening of the 1949-50 session, Borders came to Blacksburg in search of housing. When he could find nothing suitable, he resigned the appointment and went back to Florida. Thus, Wilson's attempt to hire yet another Stakman-trained plant pathologist seemed hopeless. With the beginning of fall quarter bearing down on him and in urgent need of someone to teach plant physiology, Wilson conferred with President W. S. Newman declaring that the faculty in the Section of Plant Pathology and Botany ought to be responsible for plant physiology and pathology courses. Newman concurred and approached S. A. Wingard. Wingard's response was not to Wilson's liking. Newman would have to separate the Section into a department of its own; Newman agreed to do so and about September 10, 1949, the Department of Plant Pathology and Physiology was established with Wingard as Head. It was the beginning of the end of Wilson's empire. Wingard had persevered for 14 years; his return to a headship was his reward for perseverance.

Nothing has been written about the projects and accomplishments in research and extension for the period 1935 through 1949. The accomplishments at Blacksburg, the Winchester, Charlottesville, Chatham and Holland field stations and the Truck Station can now be reviewed.

The publications prepared and issued in the second half of 1935 were reviewed at the end of the Wingard Era-I, 1928-1935. Perhaps the most significant event in 1936 was the establishment of a position for a plant pathologist at the Tobacco Research Station at Chatham. Joseph A. Pinckard became Assistant Plant Pathologist on March 1, 1936. He was appointed to the first new research pathology position established in the Department since 1923. Pinckard devoted much of his time to the control of blue mold.

Research reports appeared early in 1936 as a result of papers read at meetings. Hurt spoke on, "Control of fungous diseases of the peach," and, "The relative efficiency of fungicides" at the December 1935 meeting of the Virginia State Horticultural Society [Va. Fruit 24 (1):123-127, 127-132. 1936]. In the first he covered peach leaf curl, scab, and brown rot. For leaf curl the emphasis was on dormant spraying with lime sulphur or Bordeaux mixture. Sulphur sprays were stressed for scab and early pink or bud and late pre-harvest sprays for brown rot. However, removal of mummies from trees and the ground is necessary for economical control. Finally, the peaches should be dusted with sulphur as they pass over the grading equipment.

In the second paper, Hurt noted that only sulphur and copper fungicides were available and both were damaging to the foliage and fruit. On the other hand, if no damage was sustained, the diseases probably would not be controlled.

At the same meeting, G. T. French, State Entomologist, spoke on, "Preventing introduction and spread of crop pests by quarantine and regulatory measures" [Va. Fruit 24 (1):60-66]. He summarized work on four diseases. White pine blister rust found in Virginia in 1931, is known on *Ribes* in nine counties, on pine in six counties; Dutch elm disease, found in Virginia in 1934, is known in Norfolk and Portsmouth; phony peach disease cause by a virus, is not verified to be in Virginia; it "spreads from roots only and the peach borer is thought to be the spreading agency." (Now known to be caused by a fastidious bacterium, *Xylella fastidiosa*, transmitted by the sharp shooter leaf hopper). French reported on red cedar eradication in eleven counties in 1935, and litigation by several objectors to cedar eradication. He reminded growers to operate under the Cedar Rust Law.

At the year-end meeting of the American Phytopathological Society, Dec. 31, 1935 to January 3, 1936, five papers were presented by Virginia Plant Pathologists. Cook described, "Cross inoculation and morphological studies on the *Peronospora* species occurring on *Chenopodium album* and *Spinacea oleracea*" (Phytopathology 26:89-90, 1936). He found differences in spore morphology and that the fungi did not cross-inoculate. He concluded they were distinct species. Cook and J. A. Callenback made a, "Comparison of the effectiveness of seed-treatment materials for prevention of seed and seedling decays in Eastern Virginia" (Ibid 26:90). Vasco 4, ZnO, CuO, and Semesan were effective in declining order listed in both field and greenhouse tests. Vasco 4 was ZnO with graphite added to eliminate clogging of planters.

Henderson described the, "Effect on nutrients on susceptibility of tobacco plants to downy mildew" (Ibid. 26:94). In low nitrogen, high potassium solutions, plants were susceptible; in high N, low K solutions; plants were resistant. He also described "Promising fungicides for tobacco downy mildew control" (Ibid. 26:94). Cuprous oxide and benzoic acid used with cottonseed oil emulsion were very effective.

Wingard described, "Parasitism of the apple leaf hopper, *Typhlocyba pomaria*, by *Entomophthora*" (Ibid. 26:113). After a wet period in late August 1935, leaf hopper infestation declined. It was found that many dead hoppers adhering to the leaves had been parasitized by a fungus identified as *E. sphaerosperma*.

Except for abstracts, there were no research publications by any Virginia plant pathologists in 1936, but there were numerous popular and semi-technical articles. R. J. Haskell of the Federal Extension Service published a review article, "Big yields by seed treatment" in the January *Southern Planter* [97 (1):7,26]. He emphasize the control of oat smuts and cotton seedling blight with organic Hg compounds, mostly formulations of ethyl mercury phosphate. He also recalled the successes that had occurred with ZnO + graphite in the control of spinach damping-off. The apple spray program for 1936 was published without new compounds or procedures being listed [Sou. Planter 97 (2):13]. It was as usual an extract from Va. Ext. Ser. Bul. 131, Rev. A. H. Teske was cited by E. R. Price, Extension Service Editor as recommending with emphasis dormant peach sprays to control peach leaf curl [Ibid. 97(2):23].

H. T. Cook of the Truck Station wrote about "Prevention of tomato diseases" [Ibid. 97 (2):12,17]. He emphasized good seed from healthy fruits, disinfestation with 1:2000 $HgCl_2$, followed by dusting of the dried seed with zinc oxide, red copper oxide or Vasco 4. Tomatoes should be grown in clean soil; i.e., that which had not produced tomatoes for 3 years. Seedlings should be dusted with copper-lime-arsenate or sprayed with a 3-4-50 formulation of Bordeaux mixture. Cook did not recommend fungicides for transplants.

There was a list of corn varieties recommend for the state by the Virginia Extension Service [Ibid. 97(5):8]. All were open-pollinated varieties. The green revolution from the introduction of the first wave of hybrids was still in the offing for Virginia.

In the *Plant Disease Reporter* (P.D.R.), 1936, Cook reported 6.4% of spinach plants were systemically infected with the downy mildew fungus but they survived the winter as well as non-infected ones (P.D.R. 20:118, 1936). He reported tomato losses due to bacterial canker in Accomac and Norfolk Cos. from Georgia-certified plants was as high as 50%. In one field, canker correlated with plants from one crate (P.D.R. 20:226). *Sclerotium rolfsii* killed 32% of the eggplants in one field (P.D.R. 20:227). Later, Cook reported that so-called Georgia - certified tomato plants furnished to growers by canners were not actually certified in Georgia but the seed had been treated with $HgCl_2$. Some short cuts had been taken to avoid premium prices for certified plants. This would eventually bring the State Entomologist into the picture to provide sanity in the certified plant business.

Late in the year, bean rust became prevalent on fall beans. Sulfur dusting and spraying used for powdery mildew control did not work (P.D.R. 20:327). In another report, Cook found potato late blight in an area of Princess Anne (Virginia Beach) where it had never occurred before (Ibid. 327). Finally, he reported downy mildew of spinach had caused up to 50% damage in Tidewater, although it appeared one month later than usual (P.D.R. 20: 337).

Groves published a number of articles in *Virginia Fruit* wherein he continued the comprehensive description of individual apple diseases. It was proposed that these articles would eventually be assembled in an apple disease handbook (something that apparently never occurred). Topics covered in 1936 were, "Apple measles" [Va. Fruit 24 (2):28-30], "Apple scab" [Ibid. 24 (3):10-18], "Bitter rot of apple" [Ibid. 24 (5):12-16], "Fire blight of the apple" [Ibid. 24 (6):27-30], and "Spray injury on the apple fruit" [Ibid. 24 (9):16-22]. Groves reported early in 1936 that scab developed on apples in storage on fruit York and Grimes, even through no scab showed when the fruit were packed (P.D.R. 20:76). He commented on this phenomenon in the apple scab article above.

A brief note was to the effect that the Cedar Rust Law was amended in 1936 so that cedars could be removed to a distance of 3 miles from commercial apple orchards. Formerly, the distance was 2 miles [Va. Fruit 24 (4):12].

At the first Tobacco Disease Council held in Greensboro, N.C., November 6-7, 1935, S. A. Wingard was elected chairman and R. G. Henderson was elected secretary. The purpose of that meeting was to establish objectives, review tobacco disease problems, appoint committees, and select topics for future regional research. At the second meeting June 24-26, 1936, Tifton, Georgia, Wingard and Henderson continued to serve as elected in 1935. Committees on specific projects were established and chairmen were named:

1. Committee on stem and root diseases, R. F. Poole, Chair.
2. Committee on virus diseases, W. D. Valleau, Chair.
3. Committee on leaf diseases, E. E. Clayton, Chair.
4. Committee on disease survey, Luther Shaw, Chair.
5. Committee on tobacco insects, W. D. Reed, Chair.

These chairmen, the council chairman and secretary comprised the Executive Committee. The various diseases of tobacco were reviewed in informal presentations with most attendees participating. None of the Virginia delegates contributed to the discussions. Presumably, Wingard and Henderson were busy with their elected duties and Pinckard was too new to the group.

In 1937, Henderson was promoted to Associate Plant Pathologist, J. M. Bell Assistant Plant Pathologist of the Truck Station resigned January 15, and T. J. Nugent was appointed to replace him on September 1. Luben Bozovaisky (=L. Spasoff) began working at Chatham on a wage basis. In a letter me, Pinckard related how Spasoff, a soil scientist rather than a plant pathologist, became a member of the group at Chatham. Pinckard wrote: "I had just finished building the laboratory at Chatham when Luben knocked on our door. He had taken a bus from Ames, Iowa, to Chatham and walked the three or four miles to the laboratory hoping for a job. It was depression times and a strange place for a Bulgarian to look for a job---in the South of all places. I could not turn a man like Luben away, however, so I offered him hourly work, temporarily and found him a place to live. Later, Sam Wingard and Dr. Drinkard (our director) made his job permanent at a better salary".

The 28th annual meeting of the American Phytopathological Society was held December 28-31, 1936. Abstracts of papers presented were publish in 1937. Henderson presented, "Histological studies of infection and sporulation of *Peronospora tabacina* in tobacco seedlings" (Phytopathology 27:131, 1937). He described direct penetration of epidermal cells by appressoria, infection hyphae, subepidermal vesicles, and haustoria. This was in contrast to the penetration of stomata by germ tubes as shown by Wolf (Tobacco Diseases and Decays. Duke University Press. Durham. N.C. 454 pp. 1935) As previously noted, Harrar described "*Cercospora* leaf spot of *Calendula*" (Ibid. 27:130). Cook described, "Germination of conidia of *Peronospora effusa* from spinach" (Ibid. 27:124), and *Sclerotinia sclerotiorum* on *Pyrethrum*" (Ibid. 27:124-125) in experimental plantings at the Truck Station. The fungus killed many plants in the spring 1936 (although reported as in 1930). Henderson published a , "Report of the Tobacco Disease Council in the summary of the business meeting of the annual meeting (Ibid. 27:658-659). Otherwise, Virginia's plant pathologists published nothing further in Phytopathology 27.

Only Hurt spoke at the December 8-10, 1936 meeting of the Virginia State Horticultural Society. His talk was published the following January. [R. H. Hurt. Home made wettable sulphur as a peach fungicide. Va. Fruit 25 (1):201-204. 1937] Two methods, tank mix and bucket mix, were described. Hurt emphasized that home made wettable sulphur was much cheaper than commercial products.

Several Experiment Station bulletins were published by plant pathologists in 1937. Hurt issued a two-part bulletin "1. The Control of Peach Curl, Scab, and Brown Rot. 2. Spray Materials for Peaches" (Va. Agri Expt. Sta. Bul. 312). Most peach sprays were various sulphur, lime sulphur or Bordeaux mixture formulations and their use has been noted previously.

Wingard and Henderson prepared the blue mold portion of, "Control of Tobacco Blue Mold (Downy Mildew) and Tobacco Flea Beetle" (Ibid 313. 1937). They reported that blue mold was first found in Virginia 1931, was damaging in 1932, -33,-37. Symptoms and etiology were described, and control measures were enumerated.

Three methods were emphasized:

1. Cultural methods which included site selection, rotation, and sanitation.
2. Fumigation with benzol.
3. Spraying with a yellow copper oxide-cotton seed oil .

No experiments were described.

Henderson summarized his studies on tobacco blue mold and for his efforts won the 1937 J. Shelton Horsley Award for research offered by the Virginia Academy of Science (R. G. Henderson. Studies on Tobacco Downy Mildew in Virginia. Va. Agri. Expt. Sta. Tech. Bul. 1937). Henderson gave detailed accounts of the histology of spore germination, penetration of leaves mostly through upper epidermis, and subsequent development of substomatal vesicles and haustoria. He described experiments upon effects of nutrition wherein plants supplied high amounts of nitrogen and low amounts of potassium were more resistant to downy mildew than those supplied low N and high K. Sprays of cuprous oxide proved to be superior to sprays of Bordeaux mixture, calcium monosulfide, benzoic acid, and other lesser known fungicides.

Cook published "Spinach and Cabbage Seed Treatment" (Va. Truck Expt. Sta. Bul 96. 1937) which was a summary of experiments during the past 5 years. Zinc oxide and red copper oxide were best for spinach and zinc oxide was best for cabbage. Both compounds require added graphite to reduce friction and clogging of seeders. Cook also published, "Watermelon Wilt and Resistant Varieties for its Control" (Ibid. 97:1937). The disease was found in Virginia in 1918, and did severe damage near Smithfield in 1933. Cook described and illustrated the disease and stated that is seed-borne. Treatment with $HgCl_2$, 1:1000, disinfects the seed. A wilt resistant variety, 'Hawkesbury', from Australia was superior to moderately resistant 'Leesburg' and 'Klondike'. In a paper presented to the Association of Official Seed Analysts, Aug. 1937, "Vegetable-seed treatment experiments and practices in Virginia", Cook paraphrased Bulletin 96 and described treatments tried on tomato, kale, and cucurbits. He attempted to find the highest concentration of material that would control seed- borne pathogens without causing seedling injury.

Groves published a paper, "Common non-parasitic diseases of the apples" [Va. Fruit 25 (4):22-26. 1937], which addressed bitter pit, cork, water core and fruit cracking. Internal cork and bitter pit were believed to be caused by boron deficiency. At present corking is known to be caused by B deficiency but bitter pit is now attributed to high N and K levels and low Ca levels interacting with irregular water supply. Groves attributed water core to high fruit temperatures. Presently, water core is associated with low Ca and high N and over-ripe fruit at harvest. Fruit cracking was attributed to several environmental factors and genetic proneness. This is also the case at present.

In *The Southern Planter*, vol. 98, 1937, a few items but no major articles appeared. The annual spray calendar did not list any new fungicides or procedures [98 (2):4]; the editor reviewed previous articles by Cook and Haskell in, "Seed treatment controls seed-borne diseases" [98 (2):24]. E. T. Batten in an article on, "Peanut production" denied control of leaf spot was necessary but acknowledged its presence and increasing intensity [98 (3) 6,24]. In the Truck, Garden, and Orchard section under "Start right with tomato plants, it was mistakenly stated that late blight is seed-born in tomato. Early blight is but late blight is not. Bichloride of mercury and dust treatments were recommended to control bacterial diseases, early blight, and damping-off [98 (3):40]. Cook provided a vegetable seed treatment chart for 13 crops or crop groups. Inorganic Cu, Zn, and Hg compounds predominated, but organic Hg (Semesan) was recommended for cabbage, peas, and watermelon [98

(4):40]. Godkin promoted cotton seed treatment with 2% Ceresan for control of damping-off and seed rot [98 (4):25].

Federal and state pathologists contributed several items to *The Plant Disease Reporter*, (P.D.R) vol. 21, 1937. M. E. Fowler (U.S.D.A.) reported the first occurrence in Virginia of wilt (*Verticillium albo-atrum*) of smoke tree (*Cotinus coggygnia*) at Mt. Vernon in 1936 (P.D.R. 21:10). Cook (Truck Station) reported the first occurrence of powdery mildew (*Erysiphe polygoni*) on kale in Virginia (P.D.R. 21:141). There were several disease status reports on tobacco (Pinckard, Godkin, Henderson, P.D.R. 21:27-29; P. R. Miller, (U.S.D.A.) 21:185, 260; and Tobacco Disease Survey Committee, including Godkin 21:44- 50). Downy mildew caused little damage in 1936 but was very destructive in 1937. Groves reported on the progress of quince rust, apple powdery mildew and peach leaf curl and Wingard reported on stem rot of clover and alfalfa and on general prevalence of cereal powdery mildew (P.D.R. 21:174).

P.R. Miller and Godkin reported that 2% Ceresan seed treatments greatly improved cotton stands. Growers were convinced they should treat future seed lots (P.D.R. 21:211-212). Matheny in reports on cereal rusts stated leaf rust was heavy on wheat, barley and rye, and stem rust was very heavy near barberry bushes; it was scored as high as 47% on rye, 70% on wheat, and trace on barley while none occurred on oats (P.D.R. 21:199, 224). Harrar listed some unusual diseases of ornamental plants; namely, *Cladosporuim* leaf and stem blight and *Phoma* leaf spot and stem canker of snapdragon, and *Verticillium* stem rot of boxwood (P.D.R. 21:218). Harrar and Wingard listed the occurrence of sycamore anthracnose, maple leaf blight, oak leaf spot, and *Gloeosporium* leaf spot of elm and ash (P.D.R. 21:218). Cook stated that in the fall of 1937, potato late blight occurred again in Princess Anne Co. (=Virginia Beach), and bean powdery mildew was severe after the second week in October. In one test, U.S. Mosaic Resistant Refugee No.5 was also mildew resistant. Bean rust was locally severe, spinach downy mildew was mild, and spinach *Fusarium* wilt caused some fields to be replanted (P.D.R. 21:426-427).

The federal quarantine on rust-susceptible barberry bushes was extended in 1937 to include Virginia. Black shank of tobacco occurred in Virginia for the first time in summer of 1937 but this event was not reported until 1939 (Wingard, P.D.R. 23:369-370).

The Third Annual Conference of the Tobacco Disease Council met July 7-8, 1937 at Florence, S.C. S. A. Wingard was elected permanent Secretary. Pinckard contributed a "Preliminary report on the occurrence of tobacco mosaic in random samples of flue-cured tobacco collected from the market". He reported a low level of virus in leaves collected at the market, but that leaves of infected 'Yellow Mammoth' collected in summer of 1936, when tested for virus, caused symptoms in inoculated plants through to spring of 1937. Chewing tobacco is much less infectious than cigarette tobacco because the former is cured at "° F. Experiments on the relationship between curing temperature and virus inactivation are needed.

Pinckard contributed a comprehensive review of tobacco black root rot and its causative fungus and listed 10 suggestions for further study. He also reviewed his results with benzol vapors for control of downy mildew. Henderson described his results with copper oxide- cottonseed oil sprays for control of downy mildew.

In 1938, there were several staff changes in plant pathology; in May, L. I. Miller was appointed Freeport Sulphur Fellow and was stationed at Holland; in June he received the M. S. degree from V.P.I. after having been an advisee of J. G. Harrar for two years. On June 30, James Godkin resigned his position as Extension Plant Pathologist. Sometime in 1938, probably July 1, Luben Spasoff Bozovaisky was appointed Senior Scientific Aide at the Tobacco Station in Chatham. He would work under the direction of Pinckard. Wingard began a term as American Phytopathological Society representative to the AAAS council.

Early in 1938, the abstracts of the December 27-30, 1937 meetings of the American Phytopathological Society appeared in *Phytopathology*. Cook and Nugent reported on the increasing prevalence of "Fusarium wilt and stunt of spinach in Virginia" (28:5). Harrar reported that *Verticillium* spp. caused, "Blue rot of boxwood" (28:8) and Harrar and L. I. Miller described, "*Phoma* (*Phyllosticta*) *antirrhini* in Virginia "as a seed-and soil-borne pathogen of widespread occurrence in the state (28:8). Pinckard described, "The effect of flue-curing on the survival of ordinary tobacco virus 1" (28:18). This was the same report he gave at the 1937 Tobacco Disease Council meeting.

Groves and Hurt were as usual invited to speak at the December 1937 meeting of the Virginia State Horticultural Society and their papers were published in *Virginia Fruit* 26 (1). 1938. Groves spoke on, "Copper fungicides in Virginia " [26 (1):70-74]. He commented that Bordeaux mixture, the standard copper fungicide for apples, frequently causes injury to fruit and foliage. Eight copper compounds and several modifications of Bordeaux mixture had been tested. Although some were less phytotoxic than Bordeaux, they were also less fungicidal. He concluded it was not yet time to abandon Bordeaux mixture.

Hurt spoke on, "The Virginia spray program" [26 (1):91-94]. He emphasized the application of dormant sprays to control peach leaf curl. One should use either lime-sulphur or Bordeaux mixture, the latter being preferred if an oil emulsion is also applied for scale control. Subsequent sprays with lime-sulphur and sulphur were recommended for pink, mid- season and preharvest sprays. The preparation of various sulphur sprays was discussed.

Later, Groves published on, "Spray injuries to apple foliage and bark" [26 (3):16-30]. He discussed factors influencing injury (temperature and humidity extremes, rainfall and drought, weathering and age of materials, residual effects and build-up of spray materials, spray combinations and correctives, manner of application, condition of equipment, condition of the tree, spray water, age of leaves and wood, orchard locations) and common types of spray injuries (sulphur, arsenical, copper, oils, tar distillate and cresylic injury, fluorine bearing materials, and lime). Most of the injuries caused by fungicides and oil sprays were illustrated. In 1946, Groves would publish bulletins on this subject.

A bulletin written by a committee of tobacco workers from Duke University, the Extension Service and Experiment Stations of North Carolina, South Carolina, and Virginia entitled "Blue Mold (Downy Mildew) of Tobacco and its Control" was published as Va. Agri. Expt.. Sta. Bul. 318. Wingard, Henderson and Pinckard were the committeemen from Virginia. Although Henderson had shown in Technical Bulletin 62 (1939) that the fungus penetrates directly through epidermal cells, the bulletin has an illustration from Wolf's book on tobacco diseases showing that the fungus penetrates via germ tubes entering stomata. This indirect penetration is not erroneous but it is much less frequent than direct penetration.

Groves, in a paper, "The relation of concentration of fungicides and bud development to control of peach leaf curl" (Phytopathology 28:170-179. 1938), stated that peach leaf curl could be controlled with much weaker concentrations of lime-sulphur (1:50) and Bordeaux mixture (2-4-100) than had been recommended. Good control was obtained with sprays applied when leaves were protruding as much as one inch. This information provided the grower more latitude for spraying and considerable savings in fungicide costs.

No other major publications were issued in 1938; however, a number of disease reports and popular articles were issued. Cook at the Truck Station reported that late blight was destroying potatoes in storage on Eastern Shore (Plant Dis. Repts. 22:24); that *Sclerotinia* stem rot destroyed 25% of the plants in Princess Anne Co. (=Virginia Beach) in February (Ibid. 22: 91); that an occurrence of potato late blight in spring of 1938 was the first ever in Accomac and Princess Anne Cos., although fall occurrences were common (Ibid. 22:196). He also reported abundant occurrences of potato early blight and black leg, celery late blight and snap bean halo blight (Ibid. 22:197); that potato late blight which was first noticed on June 6, spread rapidly in June when moisture and temperature favored the disease (Ibid 22: 239); a summary of the situation was given in November. The most destructive incidence of late blight ever known on the early crop occurred in 1938 (Ibid. 22:419-420). Wingard added a note that potato late blight and soft rot were very prevalent in the Blacksburg area (Ibid. 22: 420). Late blight was so destructive nationally in 1938 that the editor was moved to cite Liam O'Flaherty's novel "Famine" which was based on the appalling effects of late blight in Ireland, and H. G. Wells' "Shape of Things to Come" in which it was predicted that, "All disease, human, animal and plant, is eradicated from the earth". The editor doubted this Utopian situation would ever be achieved and, "That there will always be a need for the work of plant pathologists---". (Ibid. 22:423-424).

In other reports, T. W. Turner of the Hampton Institute observed *Botrytis* stem rot destroying tomatoes in greenhouses (Ibid. 22:91) and southern blight (*Sclerotium rolfsii*) being very destructive to peanuts on the Institute Farm (Ibid. 22:452); R.G. Henderson reported two severe occurrences of corn leaf blight (*Helminthosporium turcicum*); and J. W. Taylor (U.S.D.A., Arlington Farm) stated that wheat leaf rust, stem rust, powdery mildew, and Septoria were very common (Ibid. 22:301). T. J. Nugent of the Truck Station reported an outbreak of watermelon downy mildew at Smithfield and the Station. In the latter case, all plants were killed a few days after the disease was first observed. Cook described a late but destructive outbreak of spinach downy mildew on Eastern Shore and around Norfolk (Ibid. 22:462). Finally, Pinckard at the Chatham Tobacco Research Station reported that downy mildew caused some damage to field tobacco plants in the Danville area (Ibid. 22:203). Conditions were highly favorable for the development of downy mildew diseases in Virginia in 1938.

Wingard contributed three major articles on tobacco diseases to *The Southern Planter* in 1938. In each article, he described and illustrated a disease, explained how it was spread, how it overwintered, and how to control it. The diseases were blue mold [Sou. Pl. 99 (1):6, 19], tobacco mosaic [Ibid. 99 (6):4, 10-11], and Granville wilt [Ibid. 99 (7):10] An article by E. E. Clayton and J. K. McClarren (U.S.D.A.) on blue mold was similar to Wingard's [Ibid. 99 (2):15, 41].

Hurt contributed an article, "Peach sprays" in which he described leaf curl, scab, and brown rot and described sprays for their control [Ibid. 99 (3):5]. There was an anonymous article on small grain seed treatment in which formalin was recommended for oats, copper carbonate for wheat and New Improved Ceresan (=ethyl mercury phosphate) was recommended for all small grains [Ibid. 99 (4):10].

White pine blister rust was found in Bath and Nelson Cos., the southern-most known occurrence of the disease and in response to recent damaging outbreaks of wheat stem rust, Virginia State Quarantine No. 4 was enacted, enabling barberry eradication in 13 counties and barring movement and planting of rust-susceptible *Berberis* and *Mahonia* spp. This was in support of the federal barberry eradication program.

The appointment of S. B. (Chuck) Fenne as Extension Plant Pathologist was effective January 1, 1939. Fenne's appointment included Extension work in both plant pathology and entomology. There were no other staff changes in 1939.

Early publications in 1939 resulted from papers read at meetings held in December 1938. The American Phytopathological Society met in Richmond, Virginia December 27-30, 1938. Wingard was an APS representative to the AAAS. Several papers were read by Virginia plant pathologists.

Cook and Nugent of the Truck Station described, "The Hawkesbury watermelon, a promising wilt-resistant variety" (Phytopathology 28:7). They described tests in *Fusarium*-infested soil, and the characteristics of the melon which growers found acceptable. Nugent and Cook described tests with "Chloropicrin as a seed disinfectant for control of black rot of kale" (Ibid. 28:21). They found that fumigations at various rates were as effective as treatment with bichloride of mercury. Nothing was said about the irritating effects of the product which is tear gas. Groves gave two papers on his work with sulphur particle size. In, "Observations on the supposed colloidal state of sulphur in fused bentonite sulphur" (Ibid. 28:10), he reported that the sulphur occurred as large particles and in lime-sulphur preparations no colloidal state existed. In "Particle size of elementary sulphur fungicides" (Ibid. 28:10), he described the advantages of photomicrography for determining particle size. Groves would continue this work for several years and would publish two bulletins on the subject. Harrar, Miller, and Wingard described, "Cultural studies on a species of *Entomophthora* from the apple leaf hopper (*Typhlocyba pomaria*)" (Ibid. 28:11). They reported that it was difficult to distinguish species of the fungus by morphology but that physiologic criteria appeared useful. Hurt described the pros and cons of, "Bordeaux mixture as a summer fungicide for peaches" (Ibid. 28: 13). The fungicide was acceptable except as a pre-harvest spray when its use caused fruit spotting and it had to be removed by brushing. In, "Removal of spray residue with sodium hydroxide, sodium carbonate, and acetic acid" (Ibid. 28: 14), three steps involving a $NaOH/Na_2\ CO_3$ bath, an acetic acid bath, and an H_2O rinse were effective in removing lead and arsenic residues and destroying mold spores without injury to four apple varieties. Miller, E. T. Batten, the Holland station superintendent, and Wingard described experiments on, "Control of *Cercospora* leaf spot of peanut with copper and sulphur fungicides" (Ibid. 28: 20). Either Bordeaux mixture or dusting sulphur controlled leaf spot but without causing injury. Lime-sulphur controlled leaf spot but was phytotoxic and wettable sulphur failed to control leaf spot.

At the December 1938 meeting of the Virginia State Horticultural Society, Hurt and Groves were invited speakers. As indicated by President Frank H. Wissler's introduction, Hurt was highly regarded by the Society as, "A man whose ability we greatly appreciate and from whose instruction we profit very greatly". Hurt's first talk was on "Bitter rot in Virginia and its control" [Va. Fruit 27 (1):58-60. 1939]. There was no new information. In a discussion of "Peach fungicides" [Ibid. 27 (1):137-139], Hurt emphasized the injuries caused by Bordeaux mixture and sulphur products. To reduce such effects, he advised careful adherence to recommendations in spray calendars. Groves emphasized apples in, "Fungicides and injuries to fruit and foliage" [Ibid. 27 (1):122-123]. He prescribed the use of sulphur in early cover sprays to avoid injury from Bordeaux mixture, but the use of Bordeaux thereafter. Early use of Bordeaux gave the highest fruit weight. Groves attributed this to the "corrective action on lead arsenate and not to disease control".

Two brief articles, one by G. T. French, State Entomologist at Richmond, and one issued anonymously warned peach growers about the "X" disease present in northeastern states. According to French, the disease, similar to yellows and little peach, is transmitted by budding and probably by some insect from choke-cherries (*Prunus virginiana*). Growers should remove infected trees, destroy choke-cherry trees, obtain stock from uninfested areas, and insist on a valid certification of inspection [Ibid. 27 (3):10; 27(12):6,8]. (Note: Peach X disease is now known to be caused by a mycoplasma-like organism, MLO, transmitted by the leaf hoppers *Colladomus* sp. and *Scophytopius* sp.)

Only Pinckard and L. Spasoff Bozovaisky of the Chatham Tobacco Station published research papers in 1939. Pinckard and Luther Shaw of the North Carolina Experiment Station and Extension Service gave a detailed account of the development of "Downy mildew infection of flue-cured tobacco in the field" (Phytopathology 29:79-83. 1939). The disease was well- illustrated and described. A prolonged rainy period and cool temperature favored spread of the downy mildew fungus from seed beds into fields during May 1938. Subsequently, growers were urged to destroy seed-bed plants as soon as transplanting was completed.

In cooperation with research workers at Duke University, F. R. Darkis, P. M. Gross, Ruth McClean and F. A. Wolf, Pinckard published a series of papers on benzol and paradichlorobenzol fumigation to control tobacco downy mildew. Eight publications spanning two years with Pinckard as an author appeared in *Phytopathology* on the subject (29:16-17, 103-120, 177-187, 216-219; 30:16-17,19, 213-227, 485-495, 495-506). The research led to seed beds designed with nearly air tight sides over which were spread two layers of cloth, the lower of netting over which crystals of paradichlorobenzol were spread uniformly, the upper of tightly woven cloth stretched thereover and which was soaked with water. The crystals were applied in the evening and the upper cloth was removed after 12 hours; the procedure was carried out on several successive nights during which the fungus in plant tissues was killed. This is one of a few cases where the fungus is eradicated from host tissues without causing host damage. Although modern fungicides adequately control blue mold, some growers still find the method practical for eradicating the fungus after it has appeared in a seed bed. The work was timely as it provided a procedure that did not require use of strategic materials during World War II.

Pinckard and Spasoff (Bozovaisky) evaluated, "Carbon dioxide evolution from certain soils in relation to black root rot of flue-cured tobacco" (Ibid. 29:751). They could establish no relationship between presence or absence of *Thielaviopsis basicola* and CO_2 evolution. Perhaps the most significant report on plant diseases in Virginia was that authored by Wingard on the "Discovery of tobacco black shank in Virginia" (Plant Dis. Rept.. 23:369-370. 1939). Black shank was diagnosed for the first time from plants collected at Nathalie, Halifax Co. July 14, 1939, and Buffalo Junction, Mecklenburg Co., July 15. Upon investigation, it was found that black shank inoculum had been brought into the Mecklenburg farm on tobacco seedlings originating at Winterville, N.C. in 1937. The source of inoculum for the Halifax site was never determined although it was present there in 1938. Though not reported, some damage was sustained in 1938.

In other items, Miller elaborated on his 1938 experiments to control peanut leaf spot (Ibid. 23:5-6). Cook reported a recurrence of white rot of onion (*Sclerotium cepivorum*) in Warwick Co., Dec. 14, 1938, across the road from where McWhorter had found it in 1924 and 1925. No onions had been grown for 15 years on the affected site but 75% of the crop was lost. This says something about the ability of fungi to survive. Cook also found potato late blight in Northampton Co. on Eastern Shore on May 9. Favorable conditions occurred in the region for blight to attack early potatoes for the second successive year. Wingard found wheat leaf rust on March 3 in Wythe Co., wheat powdery mildew in Montgomery Co., March 17, and barley leaf rust in Powhatan, March 21; these were the earliest records for these diseases although we know now over-wintering does occur (Ibid. 23:97). White pine blister rust was found in Greene, Highland, Rockbridge, Shenandoah, and Warren Cos. for the first time in 1938 (Ibid. 23:58-63). Fenne found *Sclerotinia trifoliorum* killing clover in Southside Virginia, and reported that root knot was forcing farmers to discontinue production of certified sweet potatoes in Caroline Co. (Ibid. 23:98). Blue mold was found throughout the flue-cured tobacco area and would cause a plant shortage. In demonstrations, benzol, paradichlorobenzine, and red copper oxide-cotton seed oil sprays gave good control (Ibid. 23:153).

In *The Southern Planter*, an anonymous article emphasized blue mold control should be implemented by using materials cited above by Fenne [Sou. Planter 100 (1):21, 1939]. The apple and peach spray calendars were published in February [Ibid. 21 (2):20,23]; no organic products were mentioned. Fenne authored an article on "Tobacco root knot control", in which the disease was described and illustrated. A three-year rotation was prescribed [Ibid. 21 (5):12].

The 5th annual conference of Tobacco Disease Council was held in Greeneville, Tenn., Aug. 8-10, 1939. Henderson described experiments in breeding tobacco for mosaic resistance. "Ambalema' and the "Holmes hybrid' were sources of resistance. F_1 plants (Holmes x flue- cured) inoculated with virus developed stem necrosis and died. Eliminating Ambalema leaf type and retaining resistance was difficult. G. M. Shear discussed frenching of tobacco and described experiments which discarded thallium as a cause of frenching. Henderson reported that most commercial varieties of tobacco were susceptible to black root rot. An exception was the flue-cured variety was "Yellow Special". Resistant Turkish varieties crossed with susceptible domestic varieties have produced promising progenies. The use of paradichlorobenzine for blue mold control was discussed thoroughly. Although Pinckard had participated with the Duke University people in developing this material, he did not attend the conference.

In the annual report of the Extension Plant Pathologist, Fenne cited demonstrations with cotton to control damping-off by seed treatment with 2% Ceresan, and stated that control of the wheat gall nematode in Pulaski Co. could recoup enough funds to pay for Extension Service in that county for several years.

A summary of events in plant pathology for the decade 1930 through 1939 seems in order because the involvement of the U.S.A. in World War II would change the complexion on almost everything academic, investigational, social, and extensional in the 1940's. The Agricultural Experiment Station staff in Plant Pathology grew by the addition of Pinckard and Miller. Fenne replaced Godkin in Extension, Harrar was appointed to take over instruction, Cook replaced McWhorter and Nugent was added at Norfolk. Plant pathologists employed by Virginia on Dec. 31, 1939 totaled ten. New diseases were reported: 1930 - spinach Fusarium wilt, snap bean powdery mildew, and onion white rot; 1931 - white pine blister rust; 1932 - mosaic of wheat; 1934 - Dutch elm disease; 1937 - kale powdery mildew, tobacco black shank; 1938 - potato late blight in the early crop.

Other events were the industry-saving development of spinach seed treatments by Cook and Callenback, and vegetable seed treatments by Cook and Nugent, enactment of Federal quarantines against Dutch elm disease and barberry in Virginia, extensive investigation of blue mold of tobacco by Henderson, development of control measures using benzol and paradichlorobenze by Pinckard and Duke University investigators, the incorporation of the Department of Plant Pathology and Botany into the Biology Department, and enrollment of the author in the Biology curriculum at V.P.I.

In the 1940's, the U.S.A. would become entangled in World War II. This conflict would dictate many changes in the academic arena as students and faculty would be drafted into military service, and the tenor of research would shift toward military necessity and food for victory. The need to accelerate agricultural productivity became a national necessity. Rubber, fuel, meat, and sugar became luxuries as for the average American; these products went to war. However, for many, the ominousness of the situation did not strike home until December 7, 1941. Nothing could have more dramatically marshaled the nation into a feeling of urgency. The 1940's demonstrate how a science dedicated to protecting food and fiber responded to national needs but through 1940 and 1941 there was no evidence in plant pathology of impending calamity.

During 1940, Lawrence Miller, after having served for two years as a Freeport Sulphur Fellow, was appointed Assistant Plant Pathologist at the Tidewater Research Station, Holland, Nansemond Co. (now Suffolk). He would for the moment continue his work to control peanut leaf spot, but other problems would command his attention. Pinckard was promoted to Associate Plant Pathologist. There were no other staff changes.

The American Phytopathological Society met in Columbus, Ohio, December 27-30, 1939 and published abstracts of papers in January 1940. In the minutes of the meeting, Wingard ended a 2-year appointment as representative to A.A.P.S., Pinckard was appointed to the Committee on Advisory on Society Activities and Programs and the Committee on Publicity and Public Relations. Cook was to serve on the Committee on Coordination in Cereal and Vegetable Seed Treatment Research.

These activities were the first services to the Society by Virginians since 1928.

Five papers by Virginia workers were read at Columbus. Cook and Nugent described, "Sweet-potato-storage house fumigation", with chloropicrin and formaldehyde (Phytopathology 30:4, 1940). Harrar and Martland described, "A fungous parasite of the pine bark beetle which was classified as a *Beauveria* sp. (Ibid. 30:8). Henderson and Wingard discussed "Spraying tomatoes for disease control" (Ibid. 30:9). Yellow copper oxide was superior to red copper oxide in two formulations. All treatments increased yields by lengthening the production period and reducing damage from *Septoria*, *Alternaria* and late blight. Ruth McClean (of Duke Univ.) and Pinckard reported on "Field studies on paradichlorobenzene in the control of tobacco downy mildew" (Ibid. 30:16).

The significance is that the chemical has an eradicant effect on the parasite without injuring the host. The studies were conducted to refine recommendations for use of the chemical. Pinckard and McClean described, "A laboratory method for determining the fungicidal value of vapors and its application to paradichlorobenze in control of tobacco downy mildew" (Ibid. 30:19). The Virginia State Horticultural Society also met on December 1939 and published the proceedings in January 1940. G. T. French, the State Entomologist, warned growers about, "The peach X-disease or the yellow-red virosis disease [Va. Fruit 28 (1):44-45, 1940]. This paper was a review of literature. Hurt spoke on, "Spraying grapes" [Ibid. 28 (1):160-163]. The most important "diseases affecting grapes in Virginia are powdery and downy mildew, and black rot. Anthracnose, bitter rot and dead arm disease sometimes cause injury". Three sprays were recommended; pre-bloom, post bloom, and just before berries touch, with 6-8- 100 Bordeaux mixture usually suffice. In addition he recommended that growers remove mummies and all crop residue. Since new growth is hard to wet, add soybean flour or fish oil soap to Bordeaux mixture. Remove residues in dips of dilute hydrochloric or acetic acid. These comments were prompted by the fact that because of black rot, 1939 was one of the worst years for grape growers. R. C. Moore, Assistant Horticulturist at V.P.I. who had minored in plant pathology, spoke on the, "Apple breeding program - cedar rust inheritance" [Ibid. 28 (1):163-166]. His results with cedar-apple rust resistance are summarized in the following crosses:

- Jonathan x Rome Beauty - progeny all susceptible
- Arkansas Black x Mother - progeny all resistant
- Arkansas Black x Delicious - progeny all resistant
- Winesap x Jonathan - 1/2 resistant
- Winesap x Rome Beauty - 1/2 resistant
- Winesap x Delicious - 3/4 resistant
- Arkansas Black was thought to be homozygous resistant.

Bulletins were published by three agencies in 1940. Agricultural Experiment Station Bulletin 324 entitled, "Blue Mold (Downy Mildew) of Tobacco and its Control", was published anonymously by cooperating states Virginia, North Carolina, and South Carolina. It included for the first time comprehensive descriptions of fumigation with benzol and paradichlorobenzene; otherwise, it was a reprint of Bulletin 318. No doubt Pinckard and Henderson were the contributors from Virginia. Cook and Nugent at the Truck Station published, "The Control of Truck Crop Diseases in Tidewater Virginia" (Va. Truck Expt. Sta. Bul. 104). They reviewed diseases on 28 vegetable crops plus southern blight, root knot, and damping-off of crops in general. They divided the information into three sections:

1. Importance, nature, and methods of control.
2. Disease control programs for specific diseases.
3. Preparation and use of fungicides; soil sterilization.

Wingard later described this as a manual "Written in a new style in which the control measures were given for the disease of the crop as a whole rather than for individual diseases. This arrangement made the manual much more practical for use by county agents, agricultural teachers, and farmers" (S. A. Wingard, The role of plant pathology in Virginia agriculture, Pl. Dis. Reptr. Suppl. 200:36-41, 1951). The first bulletin prepared by S. B. Fenne was, "Information Insecticides and Fungicides" (Va. Coop. Ext. Div. Bul. 150, 1940). The bulletin covered principles of insect and disease control and available products. Except for organic mercury compounds, no organic fungicides were mentioned.

Several journal articles about tobacco downy mildew control research were issued by Pinckard and his cooperators at Duke University, namely, Ruth McClean, F. R. Darkis, F. A. Wolf, and P. M. Gross. The titles clearly express their contents:

- Volatile fungicides, benzol and related compounds, and the principles involved in their use. Phytopathology 30:213-227. 1940.
- Toxicity of paradichlorobenzene in relation to control of tobacco downy mildew. Ibid 30:485-495.
- The use of paradichlorobenzene in seedbeds to control tobacco downy mildew. Ibid. 30:495-506.

The third paper above is devoted to refining the techniques of on-farm use of paradichlorobenzene; 1.5 to 3 lbs. of PDB per 100 sq. yds. at a temperature of 7° C or above applied on 2 or 3 successive nights controlled downy mildew. The fungus in host tissue was killed. In attempts to induce farmers to use PDB, Fenne in his annual report for 1940 stated farmers were reluctant to invest in cloth covers and many were reluctant to spray or fumigate until severe damage had occurred.

A record of prevalent and damaging diseases may be gleaned from *The Plant Disease* Reporter for 1940:

- Cook found potato bacterial ring rot in Virginia for the first time on March 7, in Nansemond Co. and June 19 in Princess Anne Co. Some uncertified seed potatoes were the source (P.D.R. 24:252, 1940).
- Nugent eliminated kale black rot from seed by hot water treatment, but inoculum apparently survived elsewhere (Ibid. 24:84-85).
- Miller reported that 4 or 5 applications of sulfur beginning July 15, 1939 gave excellent control of peanut leaf spot (Ibid. 24:63-64).
- A. G. Johnson and C. L. Lefebvre (U.S.D.A.) found alfalfa downy mildew and bacterial wilt on April 18 in a field near Culpeper that had been seeded in fall of 1939 (Ibid. 24:185).
- Fenne found wheat and barley leaf rusts and powdery mildew to be generally prevalent. Barley smut was severe in Botetourt and wheat gall nematode caused losses in Grayson and Montgomery Cos. (Ibid. 24:207).

In other notes Fenne in P.D.R. 24 reported tomato late blight (p.329) and early blight to be very severe in Southwest Virginia (p.333). Cucumber bacterial wilt was very prevalent and there were numerous cucumber beetles (p.333). He reported corn leaf blight (*H. turcicum*) to be severe for the second consecutive year. Anthracnose and rust damaged some corn in mountain counties (p.379).

Groves gave an account of fruit diseased in Northern Virginia in 1939; rust appeared late, black rot was found to increase as the age of trees increased, and addition of boron controlled internal cork (p.44-48).

In *Virginia Fruit* vol. 28. 1940, Horticulturist D. A. Tucker described a grape spray program [28 (4):10-14], A. H. Teske, also Horticulturist, described the use of sulphur sprays and dusts protecting the peach crop from brown rot [28 (7):20]. Wingard explained why peach trees were dying [28 (10):10-14]. Since many trees died in the summer of 1940, he described the weather for 1938 to 1940 and indicated conditions in 1938 probably caused the dying. Heavy rainfall occurred in May, June, July; dry conditions followed in August, September, and October, then excess rainfall in early November was followed by a cold spell November 24-30, with temperature falling to 12-29° F during that period. Late rains delayed dormancy and sudden cold was destructive to non-dormant trees. Wingard gave an 8-point preventative program and a 7-point rehabilitation program. Site selection, good drainage, prudent use of fertilizer, and a fall cover crop were emphasized in prevention.

Miller contributed his first popular article entitled "Dusting peanuts to control pests" [Sou. Planter 101 (5): 20-21. 1940]. The article was based on 1938 and 1939 experiments and comments in Va. Agri. Expt. Sta. Bul. 316 by Batten and Poos. One should begin dusting July 5- 15 and dust 3 to 4 times at 2-week intervals. Precautions on use of sulphur and equipment were included. Treated peanuts should be dug 5-10 days later than undusted. Dusted plants should be dried longer than undusted plants before shocking.

G. M. Shear had been working on frenching of tobacco for several years. With help from H. D. Ussery, V.P.I. Physics Department, spectrographic methods were utilized for detection of thallium in tobacco plants. It had been suggested that thallium caused frenching but Shear and Ussery could detect no thallium in either healthy or frenched plants (Shear and Ussery. Frenching of tobacco distinguished from thallium toxicity by spectrographic analysis. J. Agri. Res. 60: 129-140. 1940). For this research, Shear and Ussery were awarded the Jefferson Gold Medal of the Virginia Academy of Science in 1939.

The Sixth Annual Conference of the Tobacco Disease Council met in Blacksburg August 7-9, 1940 with S. A. Wingard and R. G. Henderson continuing as Chairman and Secretary, respectively. S. B. Fenne described the demonstrations of downy mildew control and stated that sprays with yellow copper oxide and fumigations with paradichlorobenzene were about equally effective. Henderson described the breeding work for control of black root rot and mosaic. F. O. Holmes had provided breeding stock carrying the *Nicotiana glutinosa* local lesion gene. Henderson found that a systemic necrosis developed in F_1 hybrid plants if they were inoculated with virus, thus generating F_2 or backcross progenies was difficult. The Ambalema resistance was associated with undesirable plant types and inoculated plants developed deformities.

At the meeting of the Southern Division of the American Phytopathological Society held in Birmingham, Alabama, February 7-9, 1940, Fenne reported, "Some observations on the development of root-knot nematodes diseases in Virginia" (Phytopathology 30:708). Root knot was a problem on 'Nancy Hall' sweet potatoes following supposedly resistant 'Laredo' soybeans. Actually, Laredo was very susceptible and was increasing the nematode population. In Northern Neck tomato fields, root knot apparently was being imported on seedlings from a southeastern state. At the same meetings, The Plant Nematode Council met for the third time; attendees recommended it become a permanent organization. Wingard represented Virginia (Ibid. 30:711).

State quarantine no. 6 was enacted effective April 1, 1940 to prevent the importation and intrastate movement of root knot nematodes. Apparently, nematodes had been brought into Virginia on some southern-grown plants. Hereafter, only plants officially certified as nematode-free may be imported or moved within the counties of Essex, Lancaster, Middlesex, Northumberland, Richmond, and Westmoreland. The quarantine was enacted to protect tomatoes and clover (Va. Dept. Agri. & Imm. Bul. 379:10. Mar. 1940).

In a summary of white pine blister rust work for 1940, it was reported that the rust had been found in 15 mostly northern counties (Ibid. 393: 8-9. June 1941).

In 1940, I began my association with plant pathology as a student employee assigned to work for J. G. Harrar and his graduate students. I learned to prepare culture media, pour agar plates, transfer cultures, inoculate plants, propagate plants to be used in plant physiology and pathology student laboratory experiments, and to wash dishes *ad infinitum*!

Several faculty changes occurred in 1941. J. A. Pinckard resigned February 15, to become Head of the Department of Plant Pathology at Mississippi State University. Wilbert A. Jenkins was hired soon after as Associate Plant Pathologist to resume the work at Chatham. Harrar resigned at the end of the spring quarter to become Head of the Plant Pathology Department at Washington State University. Edward K. Vaughan was hired in September as Associate Professor of Biology to replace him.

Early publications were the abstracts of papers presented at the American Phytopathological Society meeting in Philadelphia, December 27-31, 1940. Harrar and his graduate student J. J. McKelvey, Jr. cooperated with V. K. Charles and J. N. Couch to study, "A fungous parasite of the mealy bug" (Phytopathology 31:5. 1941). No name was assigned to the fungus but infection studies were described. Harrar with McKelvey and another graduate student, J. W. Showalter, reviewed work at V.P.I on "The parasitism of economic insects by fungi" (Ibid. 31:10). Fungi assigned to genera *Entomophthora*, *Beauveria*, *Conidiobolus*, and *Hirsutella* had been isolated from various insects. Emphasis was placed on determining the effectiveness of the fungi in biologic control of insects. Henderson and Wingard described, "Copper fungicide tests on tomatoes" (Ibid. 31: 10-11). Results with five copper compounds were inconclusive, partly because an early frost killed two of the three varieties before much of their fruit ripened. Miller described his 1939 and 1940 experiments on the, "Control of *Cercospora* leaf spot of peanut with proprietary sulphur dust" (Ibid. 31:16). Leaf spot caused a 30 percent reduction in yield of nuts and a 40 percent reduction in yield of hay. Wingard summarized 20 years of observations on, "Varietal resistance of wheat to loose smut" (Ibid. 31:24-25). Several commercial varieties and 8 V.P.I. selections were consistently low in infection percentage. This work would be fully described in Technical Bulletin 70.

In the Report of the Thirty-second Annual Meeting at Philadelphia (Ibid. 31:362-372), Pinckard was shown to be a member of the standing committees, Advisory on Society Activities and Programs and Committee on Public Relations. H. T. Cook was a member of the temporary committee on coordination in Cereal and Vegetable Seed Treatment Research. At the December 1940 meeting of the Virginia State Horticultural Society, R. H. Hurt spoke on, "Spreading and sticking agents for spray materials" [Va. Fruit 29 (1):90-93. 1941]. Materials which act as both spreading and sticking agents would be ideal but most materials are lacking in one respect or are toxic when applied with certain fungicides or insecticides. Hurt described the properties and listed sources for soybean flour, sulphite by-products, and kerosene oil.

Two bulletins on plant disease were published by Experiment Station personnel in 1941. R. H. Hurt published, "Control of Grape Diseases and Insects" (Va. Agri. Expt. Sta. Bul. 332. 1941) in which he described black rot as the most destructive disease in Virginia. In addition powdery mildew, downy mildew and anthracnose were also described. A spray calendar for grapes lists lime-sulphur as a dormant spray and Bordeaux mixture as the products to be used. Wingard and F. D. Fromme elaborated on their work in, "Susceptibility of Wheat Varieties and Selections to Loose Smut" (Va. Agri. Expt. Sta. Tech. Bul. 70. 1941). The work was started about 1920 and was continued through 1940. The varieties Fulcaster, Fultz and Poole produced many lines which reacted to smut with very low percentages of infection. Wingard produced his most renowned publication in 1941, "The nature of disease resistance in plants. I. (Botanical Rev. 7:59-109. 1941). From the title and a foot-note, it was expected that a second article would be written by Wingard but that article never appeared. It is apparent that the outbreak of World War II and subsequent events changed his priorities forever. Wingard's review contained several subtitles:

- Types of resistance - including physiological and structural differences and disease endurance and avoidance.
- Misconceptions of disease resistance.
- Relation of environment to disease development - including temperature, moisture, soil fertility and pH, light, and weather sequences.
- Genetic behavior of disease resistance - including Mendelian inheritance, physiologic races.

I never found out what Wingard intended to discuss in part II but I do remember him commenting how difficult it was to bring together the information in part I. The review was frequently cited in publications dealing with inheritance of disease reactions and in textbooks. A review in the U. S. Department of Agriculture Yearbook, "Plant Diseases, 1953 by Wingard may have included some of the material originally intended for part II in the *Botanical Review*. It is apparent that part I ends rather abruptly.

The only other research publication in 1941 was by A. B. Groves who was one of four authors in a publication by H. W. Thurston, Jr. (Pa.), C. F. Taylor (W. Va.), A. B. Groves (Va.), and H. J. Miller (Pa.), "Interstate cooperation experiments on field spraying of sour cherries" (Phytopathology 31: 1047-1050). The advantage of pooling data from three states was that recommendations could be made after fewer years of testing different compounds and dosages. This paper resulted from cooperation among members of the Cumberland- Shenandoah Fruit Workers Conference. Such cooperation resulted in significant economic gains for the Experiment Stations and for growers in the region.

There were several contributions in 1941 to *The Planter Disease Reporter* by Virginia's plant pathologists. Hurt described increases of molds in apple orchards where mealy bugs proliferated. Apples from mealy-bug infested orchards rotted in storage more than those from mealy-bug free orchards (P.D.R 25: 32. 1941). Clarence Cottam, U. S. Dept. of Interior, Fish and Wildlife Service, reported eelgrass was recovering somewhat from its disappearance in 1931. No pathogen had been associated with the eelgrass disease through 1940 (Ibid. 25: 46-52). The spread of white pine blister rust in the Virginia counties of Clark, Page, Rockingham, Highland, and Augusta was reported in an anonymous article from the Bureau of Entomology and Plant Quarantine (Ibid. 25: 52-55). Fenne reported the occurrence of *Pythium* foot rot in small grains from Bland, Wythe and Montgomery Cos. in early winter 1940-41. Fields sown with fungicide treated seed had no damage (Ibid. 25: 99). Cook reported that strawberry red stele had spread from northern Accomac Co. It was also reported from Princess Anne Co. for the first time (Ibid. 25: 296). Cook also reported an unusual situation for celery late blight (*Septoria apii*) in the Norfolk area. Growers who used 4-year old seed (because new seed were not available) had no late blight. No late blight occurred on farms where hot water-treated seed were used, even where late blight occurred the year before (Ibid. 25: 311-31). Groves reported peach yellows was spreading in Northern Virginia (Ibid. 25:408-409) and T. J. Nugent identified mimosa tree *Fusarium* wilt near Norfolk at Fox Hall; this was the first diagnosis of the disease in Virginia (Ibid. 25: 409). Cook and Nugent reported that tomato bacterial canker occurred in two fields and bacterial spot was widespread by July 17 in Northampton Co. Southern blight and *Fusarium* wilt also occurred in Northampton. *Septoria* leaf spot was the most important disease in the Norfolk area. Because of the low profit margin in tomato production, spraying was not recommended in the Tidewater area (Ibid. 25: 446-447).

G. Myron Shear, Plant Physiologist and L. I. Miller reported from experiments they conducted that "Pouts" was caused by thrips feeding on young unopened leaves. When injured leaves unfolded, they had pouts. The authors recommended calling it "thrips injury" (Ibid. 25: 470-474). F. W. Poos, U.S.D.A. entomologist who worked at the Holland Station, got wind of the experiments by Shear and Miller and according to Miller tried to scoop them. Poos described the injury in a *Southern Planter* article [S.P. 102 (12):12. 1941].

S. B. Fenne reviewed the history of tobacco black shank in Virginia and reported new infestations occurred during 1941 in Pittsylvania and Halifax Cos. He gave a 6-point control scheme for infested farms and an 8-point scheme for uninfested farms (Pl. Dis. Reptr. 25: 534-535). Fenne also reported on the occurrence of cereal diseases. No uncommon diseases were found (Ibid. 25:553-554).

C. L. Lefebvre and H. W. Johnson of the U.S.D.A. and who worked with grasses listed a large number of pathogens on grasses which they had identified. Most of the fungi had been collected at Arlington, Virginia, probably at the research center there. Only 5 specimens were identified from collections elsewhere in Virginia (Ibid. 25:556-579).

In the *Southern Planter*, there were no major articles by plant pathologists. The editors published the apple spray calendar for 1941 [S.P. 102 (2):26-27. 1941]; the peach spray calendar [Ibid. 102 (3):44]; a spray program for grapes; and recommendations to treat seed corn with Semesan, Jr.; to spray or fumigate tobacco for downy mildew control; and to treat cotton seed with 2% Ceresan [Ibid. 102 (4):42-43].

At the 1941 meeting of the Virginia Academy of Science, Nugent and Cook described the breeding of *Fusarium* wilt resistant Virginia Savoy type spinach (Proceedings p.182. 1941) and the breeding of *Fusarium* wilt resistant watermelons. They had released Klondike, R7, Leesburg, and Hawksburg in 1938; and Blue Ribbon in 1941 (Proceedings p. 182. 1941). They reported progress on improving quality and wilt and anthracnose resistance.

Groves prepared two articles for *Virginia Fruit* in 1941. In "Cherry spraying" [Va. Fruit 29 (5):17-18], he presented some results obtained in the Cumberland-Shenandoah cooperative experiments and which were also published in *Phytopathology*. In the article "Watch for peach yellows" [Ibid. 29 (9):15-19], he pointed out that because no major outbreak of yellows had occurred in the past 20 years, Virginia orchardists tended to forget that it was an impending threat. He described its symptoms, and its transmission by the peach and plum leafhopper. He suggested, without experimental evidence, that applications of nicotine sulfate or pyrethrum would control the insect and, consequently, yellows. Hurt wrote about "Black rot of the grape and its control" [Ibid. 29 (10):14-15]. This was an abstract of Agricultural Experiment Station Bulletin 332.

On a personal note, I started my first course in plant pathology under Harrar, but as a survivor of a flue epidemic in mid-January I had lost so much ground that I resigned from school on January 26. After a month of rehabilitation including being fitted with eye glasses, I visited the Virginia Truck Experiment Station and was hired on March 1, at labor"s wages by Director Zimmerley, to work with M. M. Parker, Horticulturist. Under him, I learned to cross-pollinate muskmelons, tomatoes and brussels sprouts, to lay out randomized replicated field plots, to record and analyze data and to propagate plants for field experiments. In September I was transferred to work with plant pathologists Harold Cook and Tom Nugent. With them, I learned to infest soils with *Fusarium* spp. to collect spinach downy mildew spores and to inoculate spinach with them, to fumigate soils (and gain a healthy respect for tear gas) with chloropicrin to control nematodes, to steam soils, to run seed treatment tests and analyze the data therefrom, and to hot-water treat celery seeds. The experience was most valuable and it served me well in life. I was fully convinced I would like to become a plant pathologist. In January 1942, I returned to V.P.I.

In 1942, the plant pathologists at the Truck Station departed for military duty and replacements were hired. Nugent was the first to leave; he became a 1st lieutenant in the army on February 1. Cook departed on September 1 to become a navy lieutenant. He would use his expertise as a plant pathologist to enhance the transportation of perishable foods. On the day Nugent departed (February 1), Richard P. Porter, who had worked at the Truck Station during the summer of 1941 and who had just received the M.S. degree in plant pathology at V.P.I., was hired as Acting Assistant Plant Pathologist. Two months after Cook departed, G. K. Parris was hired on November 1 as Acting Plant Pathologist. It was clear that Director

Zimmerley expected Cook and Nugent to return to their respective posts (and indeed they did).

In October 1942, Luben Spasoff entered military service where his knowledge of Slavic languages led to an appointment as an instructor in the Army. In late December S. B. Fenne was granted a leave of absence for non-military war service in Brazil. L. I. Miller volunteered for service in the Marine Corps in mid-1942. Only Fenne"s position was temporarily filled, but not until June 1, 1943.

At the December 29, 1941 - January 1, 1942 meeting of the American Phytopathological Society, only Nugent among Virginians contributed an abstract (R. W. Samson, T. J. Nugent, & L. C. Schenberger. The importance of seed transmission of early blight and *Fusarium* wilt of tomato. Phytopathology 32:16. 1942.) The authors found that the transmission of *Alternaria solani* and *Fusarium lycopersici* in seed from processed tomatoes was an extremely remote possibility.

To serve on committees of A.P.S. for 1942, were S. B. Fenne on Extension Work and Relations, and Cook on Coordination in Cereal and Vegetable Seed Treatment Research. (Ibid. 32: 339). Cook had chaired the subcommittee on Vegetable Seed Treatments in 1941.

At the December 9-11, 1941 meeting of the Virginia State Horticultural Society, C. R. Willey, Associate State Entomologist, discussed the Peach Yellows Law and the Code of Virginia sections 895-904 [Va. Fruit 30 (1):38-42. 1942]. According to Willey, before agents of the State Entomologist could enforce peach eradication to prevent spread of peach yellow, the Supervisors of the target county must adopt the law and be willing to support the project financially. Only two counties had adopted the law, Roanoke and Loudoun, but when agents had submitted bills for eradication work, both counties had rescinded their action and eradication was discontinued as an official project. Thus, the Peach Yellows Law although "on the books" had lain dormant for about 52 years. It could be adopted on a county basis if the procedures stipulated by the code of Virginia were followed. Otherwise the State Entomologist was powerless to condemn and destroy yellows infected trees on private property.

As the same meeting, Hurt discussed "Crystalline versus monohydrated zinc sulphate as preventive against arsenical injury on peaches "[Ibid. 30 (1): 48 - 51]. Hurt concluded that the two materials were equally efficacious.

Before their departures for military service, Cook and Nugent diligently prepared summaries of their recent projects. In "Potato Scab in Relation to Calcium, Soil Reaction, and the Use of Acid-forming and Non-acid-forming Fertilizers" (Va. Truck Expt. Sta. Bul. 108. 1942), they reported that one may use either type of fertilizer provided the soil reaction was pH 5.0-5.2. Cook and G.V.C Houghland, Associate Soil Technologist, Division of Fruit and Vegetable Crops, U.S.D.A., in a paper entitled, "The severity of potato scab reaction in relation to the use of neutralized one third neutralized fertizers" (Amer. Potato Jour. 19:201- 208, 1942), reported essentially the same information but provided a more technical study and analysis of the problem. However, it was concluded potatoes should be grown at pH 4.8 or lower.

Cook and L. L. Harter (U.S.D.A.) published "Chemicals Effective for Sweet Potato "Seed" Treatment" (Va. Truck Expt. Sta. Bul. 109). Mercuric chloride (=$HgCl_2$) was better than boric acid, borax or lime-sulphur but these three materials could be substituted for $HgCl_2$ for control of black leg caused by *Ceratostomella fimbriata*. "Seed" should be dipped for 10 minutes in appropriate solutions of the above products and be bedded immediately.

At the annual meeting of the Southern Division of the American Phytopathological Society held in Memphis February 4-6, R.G. Henderson presented two papers; these were documented by very long abstracts. In, "Breeding tobacco for black-root-rot resistance" (Phytopathology 32:647), Henderson reported the program had been initiated in 1934. Turkish (Xanthia) x flue-cured or dark fire types yielded resistant lines approaching commercial type after selection in the F_2 and F_3 generations but backcrossing after selection to commercial types was required to reduce expression of Turkish traits. One hybrid selection of flue-cured types, No. 38, produced nearly $100/acre more return than the control susceptible variety Yellow Mammoth.

In, "Studies on soil sterilization with urea and calcium cyanamid" (Ibid 32:647-648), Henderson studied some of the physical changes that occurred in soil following treatment. Interest in these compounds is sustained by their potential for controlling weeds in tobacco seed beds.

A. B. Massey, now teaching taxonomy and field botany to students in the Forestry and Wildlife curriculum, co-authored a note on a smut of Indian grass (Massey and G.L. Zundel. *Sphacelotheca*, host of an unidentified smut. Phytopathology 32:544-546. 1942). The smut, identified as *Sphacelotheca sorghastri* actually had been identified previously as *S. Andropogonis - hirtifolii*, was found on *Sorghastrum elliottii*, long awned Indian grass in Pittsylvania Co. near Chatham. This collection extended the range of *S. elliottii* into the Piedmont; it was known previously from only a few counties of the Coastal Plain.

Pinckard, who had left the Chatham station, published a paper based on some work done while he was at Chatham entitled, "The mechanism of spore dispersal in *Peronospora tabacina* and certain other downy mildew fungi" Phytopathology 32:505-511). He found that after spores are matured in a saturated atmosphere, drying causes the sporophores to twist, bend, and to become entangled thereby dislodging spores. There was no evidence of forcible ejection of the spores.

Pinckard and L. Spasoff Bozovaisky described, "A method for the culture of seedlings and small plants in sunlight under controlled temperature conditions" (Phytopathology 32:467- 476). They described "home-made" growth chambers in which they studied the effects of temperature on the growth of tobacco colonized by *Thielaviopsis basicola*. Temperature was maintained within 2-3° F of the desired temperature when the greenhouse temperature was between 25 and 105° F. In a second paper, they described and illustrated, "Cold injury of flue-cured tobacco seedlings" (Ibid. 32:512-517). "White bud" was the chief symptom observed.

Bulletins published in 1942 addressed fruit, peanut, and tobacco. Groves published, "The Elemental Sulfur Fungicides" (Va. Agri. Expt. Sta. Tech. Bul. 82) in which he explained the preparation, composition and properties of sulfurs for sprays and dusts. Size of particle, the smaller the better, was the most significant property. He prepared a unique grid- photo study for analyzing size. Miller published a summary of the 1941 and 1942 results on, "Peanut Leafspot and Leafhopper Control" (Va. Agri. Expt. Sta. Bul. 338). The yield of nuts was increased from 238 to 834 lbs./ac. on 30 farms and the yield of hay increased from 593 to 3419 lbs./ac., compared to undusted plots when three applications of dust were made. A detailed account would be published in 1946. Henderson, and E. M. Mathews, Agronomist at Chatham, published, "Yellow Special Tobacco, a New Flue-cured Variety Resistant to Black Root Rot" (Va. Agri. Expt. Sta. Bul. 346). This variety was the first to be released from Virginia"s project to breed disease resistant tobacco. It was widely used from 1942 to 1946; it was considered tolerant of but not resistant to the black root rot fungus. Fenne published, "Important Tobacco Diseases in Virginia and Their Control" (Va. Agri. Ext. Ser. Bul. 152) in which he discussed downy mildew, mosaic, ring spot, brown spot, frenching, black root rot, Granville wilt, black shank, root knot, and sore shin. He emphasized seed bed problems and that production of disease free seedlings is essential to a healthy tobacco crop. A section on collecting and mailing diseased plants concluded the bulletin.

In the *Plant Disease Reporter*, Cook and L.L. Harter (U.S.D.A.) described tests in which wettable Spergon was compared with bichloride of mercury for disinfesting sweet potatoes (P.D.R. 26:222). Spergon at 6oz./gal. was ineffective while $HgCl_2$ was nearly perfect in preventing black rot.

The papers by Cook, Nugent, Miller, and Spasoff would be their last until after World War II.

At the May meeting of the Virginia Academy of Science (VAS), Henderson and Wingard reported their results with tomato fungicides (Proc. VAS p.216, 1942). On 'Earliana", 'Pitchard" and 'Marglobe", tribasic copper sulfate, Bordeaux mixture, yellow copper oxide sprays and tribasic and red copper oxide dusts were tested. Earliana received 6 applications; others received 5. Highly significant yield increases were obtained with all treatments on Earliana; only Bordeaux failed to produce significant increases on Pritchard; and on Marglobe, only tribasic produced a significant increase over untreated plots. *Septoria* and *Alternaria* leaf spots were the only diseases observed. Groves contributed observations on, "Ground sprays as supplementary scab control measures" [Va. Fruit (4):13-14, 1942]. He concluded that ground sprays are "in the category of special or supplementary measures to be used in special situations, not as a justifiable addition to the regular schedule" because they were expensive and would not allow elimination of any of the regular sprays. Fenne in the same journal, wrote about, "Garden sanitation and care of spraying (and dusting equipment) and save dusts and spray materials" [Va. Fruit (12) :14]. The title was garbled but the message was to conserve supplies and equipment during wartime storages. He also emphasized destruction of diseased plants and composting healthy plant residues.

W. A. Jenkins who had replaced Pinckard at Chatham contributed an article to the *Southern Planter* entitled, "Tobacco black shank disease strikes" [S.P. 103 (1):6]. He described the symptoms and reported that in 1937 and 1938, downy mildew severely damaged tobacco seedlings, and farmers were forced to import plants and with the plants came the black shank fungus. He distinguished black shank from sore skin wherein affected plants topple. There are no satisfactory control measures so he warned growers that if their farms were not infested, don"t import plants, grow your own, and control downy mildew. In the future, black-shank-resistant varieties may become an alternative. This was Jenkin"s first publication on Virginia plant pathology.

Fenne followed with an article on, "Preparation of the tobacco plant bed" [S.P 103 (2):15]. He described narrow (6') plant beds with walkways between and advised growers to control blue mold and weeds so that 100 sq. yds. would produce 10 to 15 thousand plants.

In the 1942 apple spray calendar, no new materials or procedures were included. [S.P. 103 (3):14]. To date, only organic mercury (Ceresan, Semesan) and organic sulfur (Spergon) among the forthcoming myriad of organic fungicides were available and these were seed treatment chemicals.

In the *Plant Disease Reporter* (P.D.R.), there were several reports by Fenne: A summary of the 1941 tobacco disease situation (P.D.R. 26:52-53), and in 1942 (P.D.R. 26:432-434). An occurrence, first in U.S.A., of *Cercospora atropae* on a war emergency experimental planting of belladonna, *Atropa belladonna*, (P.D.R. 26:280). Anthracnose in beans grown from seed produced in the arid west was causing farmers to lose faith in western grown seed (P.D.R. 26:337). Soybean frog-eye leaf spot appeared in Stafford Co., the first time it had occurred in Virginia (P.D.R. 26:382-383). Potato and tomato late blight spread rapidly in western Virginia during August (P.D.R. 26:283). Corn leaf blight was very severe on Pioneer 300, Dekalb 816, Funk G94, U.S.13, and Kentucky Dent; resistant varieties were Funk 135, Illinois 448, U.S.99, U.S. 109, Tennessee 15, and Kentucky 201 (P.D.R. 26:257). The susceptible/resistant categories must have been obtained from experimental plots because in 1942, only 7.6 per cent of Virginia"s corn acreage was planted with hybrid varieties [Sou. Planter 104 (10):4. 1943]. On small grains, stem rust was widespread but late; even so a 10 per cent loss occurred. The amount of leaf rust was the highest in 10 years (Fenne, P.D.R. 26:478-479). H. B. Humphrey (U.S.D.A.) reported that in Southwest Virginia, stem rust occurred in nearly every field, varying from trace to heavy by June 20 (P.D.R. 26:288).

White pine blister rust was found on currants in Bland, Giles, Grayson, Pulaski, Smyth, Wythe Cos. and on pine in Bath and Shenandoah Cos. for the first time (R.G. Pierce, P.D.R. 26:54).

Jenkins published a wordy account of "Diseases of bright tobacco in Pittsylvania County, Virginia during the 1942 season" (P.D.R. 26:434-437).

A War Emergency Committee of the American Phytopathological Society was created following an A.P.S. summer meeting in Toledo. Its stated purpose, "Is to provide for coordinated effort in research, experimentation and extension work designed to control destructive diseases of plants" (Phytopathology 32: 831-832; 917-918). Emphasis would be on converting accumulated knowledge of diseases into measures for controlling them. Because of a shortage of plant pathologists, individuals were encouraged to discontinue work on diseases of plants not vital to the war effort. Of high priority was the creation of a nation-wide plant disease survey service in order to detect quickly newly introduced, potentially damaging diseases of crops vital to the war effort. The Victory Garden program had been established and home production and canning of foods would be expected to allow diversion of commercially produced fresh fruits and vegetables to the military. In this respect extension plant pathologists had to devote much time to teaching disease control to home gardeners. Fenne was appointed to the subcommittee on Extension. Within this group, he was named chairman of a committee to select Kodachrome slides for duplication and distribution to states that cooperated by contributing slides for selection. Fenne was also a member of the War Service Committee of Southern Plant Pathologists, appointed to make recommendations for control of cereal diseases. His service on these committees was brief; in late December he departed for Brazil.

I returned to V.P.I. in January, 1942 and took up where I had left off in January of 1941. Under E. K. Vaughan I took Phytology and Plant Pathology. I was also assigned to work for him as a student aide in the National Youth Administration Program. To me, Vaughan was friendlier than Harrar had been. We began generating a friendship that would last to the end of his life.

The grim realities of war were brought home by the rationing of sugar, meat, gasoline and tires. The sale of new automobiles ceased and the military draft intensified. I was drafted in December 1942 but because my right arm had been partially paralyzed at birth, I was classified 4F and allowed to continue my education.

On June 1, 1943, E. K. Vaughan moved laterally into the position as Extension Plant Pathologist. I had just graduated and expected to have him as my advisor in a plant pathology M.S. program. Naturally, I was concerned for my own welfare but he agreed to see me through to graduation, provided I did my part.

Before I initiated my M.S. program, I spent two weeks on the Barberry Eradication Project with R. S. Mullin, State Leader, as my supervisor. I put out some brush control chemicals in Wythe Co. near Speedwell on square-rod plots. Chemicals including ammate, sodium chlorate, and 2-,4D were employed. The corners were marked with stakes made from trees 2 to 3" in diameter. Water for mixing solutions came from nearby Cripple Creek. A map was prepared so that the plots could be identified later. On one occasion, I interrupted a baptismal ceremony being conducted in the creek by a local church. Whatever the denomination, they almost drowned the new members before they felt they were appropriately baptized. During the remainder of the 10 working days, I drove around Wythe and counties adjacent, hunting for grain fields and stem rust. I was instructed to make 3 or 4 collections of grain stems per county and send them to the Rust Laboratory at the University of Minnesota. Later (in 1947) when I met W. Q. Loegering who did the rust identification work at the Laboratory, I asked him about the collections I had made. To my astonishment, he had thrown them all away. Mullin had not told me to dry them before I mailed them; they had arrived in St. Paul as a moldy mess. Despite my wasted effort, Bill Loegering and I became life-long friends.

Late in the summer of 1943, I asked Mullin what he learned about the chemical treatments. He replied that he had some difficulty in locating and identifying the treatments. Someone had pulled up the corner stakes and used them for firewood. However, the chemicals had killed all the barberry bushes in treated plots and a few big pine trees to boot. He seemed satisfied with the results.

During that same stint with barberry work, Mullin and Vaughan set up a meeting with me at a certain crossroad. They were bringing E.C. Stakman who was Head of Plant Pathology and in charge of the Rust Laboratory at the University of Minnesota. At that time, I didn"t know it but in September 1944, I would start my Ph.D program under Stakman, but on that day in 1943 at some remote crossroad in Wythe Co., I was to meet the world"s leading authority on cereal diseases, the man who had trained both Harrar and Vaughan. I arrived at the appointed time and designated place and waited, and waited and waited. Finally I resumed my mission of examining grain fields and estimating the severity of rust. Later I learned that Stakman and company had arrived at the designated place soon after I had left. I would have to wait until fall of 1944 to meet the famous Stakman. C"est la vie!

From my two-week experience, I learned much about the distribution of native or Allegheny barberry, the destructive potential of black stem rust, the rugged beauty of southwestern Virginia, and how to climb over fences without damaging them or tearing my pants.

In the years 1942 and 1943, grains in southwestern Virginia were heavily rusted. Stakman, R.U. Cotter and W.Q. Loegering of the Rust Laboratory, gave a paper in 1943 on, "Regional spread of wheat stem rust from barberry-infested areas of the Virginians in 1942" (Phytopathology 33:12. 1943). They deduced that because race 38 predominated the rust population in the Virginians and because prevailing winds had blown northward during urediospore production, and because race 38 had been rare north of the Virginians but in 1942 was destructive to wheat in Ohio, Indiana, Michigan and Illinois, that the inoculum had originated in the Virginias. This probably precipitated Stakman"s visit to Virginia during the rust epidemic of 1943. He had to see for himself. Believe me, he was not disappointed.

The faculty issued four bulletins in 1943. Wingard described, "New Rust-resistant Pole Beans of Superior Quality" (Va. Agri. Expt. Sta. Bul. 350). He reviewed the project which was started in 1916; namely, the selection of rust-resistant pole bean varieties to be crossed with susceptible, high quality varieties; genetics of resistance; and selection of high quality beans from F_3 and F_4 progenies. Wingard and Fromme had been the first to study the inheritance of rust reaction in bean. Ten selections were named "Virginia Victory No. (1 through 10)". They were very popular with home gardeners but a failure in the commercial seed business. Pole beans were a nuisance to seed producers. Wingard maintained them well into the 1960's but I never heard anyone call them Victory; everyone called them "Wingard"s Wonder Beans".

E. M. Matthews, Superintendent of the Chatham Station, and R. G. Henderson described, "Yellow Special Tobacco, a New Flue-cured Variety Resistant to Black Root Rot" (Va. Agri. Expt. Sta. Bul. 346). The variety originated as a selection of a cross between "Harrison Special" and probably "Lizard Tail" and was grown and tested for 10 years before it was released in 1942 for production in 1943. Quality and growth on black-root-rot-infested soil was excellent. The variety possessed some resistance to black shank, sore shin and damping-off. It was the first disease-resistant tobacco variety released by the Virginia Agricultural Experiment Station.

A. B. Groves (Winchester), H. J. Miller (Penn.) and C. F. Taylor (W.Va.) described their cooperative "Tri-State Cherry-Spray Investigations" (Va. Agri. Expt. Sta. Bul. 354; also Pa. A.E.S. Bul. 447 and W.Va. A.E.S. Bul. 310). Leaf spot was the most destructive disease. After testing several copper and sulfur fungicides and comparing them with Fermate (ferbam) Spergon, Thylate (thiram), and what became Dithane (nabam), they concluded that early applications of lime-sulphur and later applications of Bordeaux mixture gave best leaf spot control and caused the least damage to fruit.

Henderson summarized the "Testing of Copper Fungicides for Control of Tomato Blight in Southwest Virginia" (Va. Agri. Expt. Sta. Tech. Bul. 89). Five copper products were evaluated for control of early blight, late blight, *Septoria* and

Stemphyluim leaf spots. In dry years, there was little difference between fungicides but Bordeaux mixture reduced the number of marketable fruits. In wet years, Bordeaux mixture was superior and all materials increased the yield of marketable fruits.

The Virginia Department of Agriculture and Immigration (V.D.A.I.) reported a revision of quarantine no. 3, effective May 1, 1943 (V.D.A.I.Bul. 414:8. 1943). The revision allowed planting and movement of currants and gooseberries where previously it had not been permitted in the counties of Clark, Faquier, Loudoun, and Scott. The report did not give the rationale for the change. In Bulletin 419:11-12, it was reported that commercial damage to white pine had been found in Augusta, Bath, Highland, Madison, Page, Rappahannock, Rockingham, and Shenandoah Cos. In Bulletin 420:11, it was reported that rust was found on *Ribes* in Bedford and Washington Cos. In Bulletin 419:12, a report reviewed briefly the barberry eradication project. The State had initiated it in 1934. In 1942 and 1943, the heaviest rust ever was in the block of counties Augusta, Rockbridge, and Rockingham and the southwestern counties of Bland, Carroll, Smyth, Tazwell, and Wythe (See also Pl. Dis. Rept.. 26:54).

Due to war-time travel restrictions, the Tobacco Disease Council could not meet but written reports were submitted to Chairman Wingard and he assembled the reports for distribution. Wilbert Jenkins reported that high winds reduced the effectiveness of PDB in controlling downy mildew. Fumigation under these conditions allowed established infections to linger and, thus, treated beds were no more useful than untreated beds. Jenkins also reported on laboratory studies on black root rot and Granville wilt and on breeding for resistance to black shank in the crosses Yellow Special X Bullock"s No. 45 and Y.S. X Bullock"s No. 72. Henderson reported on breeding for black root rot resistance and the problems of testing large numbers of hybrids; intensity of black root rot infestation varied within blocks such that the use of the lattice design was introduced to gain precision over the randomized block design.

The Emergency Plant Disease Prevention Project was established by the Plant Disease Survey on July 1, 1943 from emergency funds made available by President Roosevelt. "The purpose of this project was to help protect the country"s food, feed, fiber, and oil supplies by insuring immediate detection of enemy attempts at crop destruction through the use of plant diseases, and by providing production specialists and extension workers with prompt and accurate information regarding outbreaks of plant diseases, whether introduced inadvertently or by design while still in incipient stages" (P.R. Miller and J. I. Wood. An Evaluation of Certain Phases of the Emergency Plant Disease Prevention Project. Plant Dis. Reptr. Supp. 167. 1947). R. E. Atkinson was assigned at first to survey in Virginia in 1943 but C. F. Taylor soon succeeded him. Atkinson had been a Minnesota buddy of Vaughan, and although there is no mention of Atkinson"s visits to V.P.I. and his emergency survey work in Vaughan"s annual reports (1943, 1944), they made several trips together. Most of Vaughan"s cooperative surveys were with Taylor as noted by Taylor in his survey reports (C.F. Taylor. 1943. Reports on plant disease survey, Virginia and West Virginia. Plant Dis. Repts. 27:410- 412, 471-473, 501, 521, 609-610, 622, 625, 627-828, 632-633. 1943). There were no reports of new or unexpected losses from old diseases.

In a *Plant Disease Reporter* article, R. P. Porter reported studies on, "Seed-borne inoculum of *Phomopsis vexans* - its extent and effects" (P.D.R. 27:167-169). He found 22% of 27 samples of eggplant seed had *P. vexans* spores and that seedling infections could be induced by soil-borne inoculum. Thus, there was a need to obtain *P. vexans*-free seed and plant in *P. vexans*-free soil. Jenkins reported on, "Downy mildew of bright tobacco in Virginia during the 1943 plant bed season" (P.D.R. 27:227-228). The disease was first detected in Pittsylvania Co. on April 25; average first date for the bright belt was May 5. Downy mildew was blamed for 15 to 60% losses in production. P.D.B. gave the best control; Fermate gave encouraging results. G. K. Parris reported, "Reduction in the yield of celery caused by root-knot nematode" (P.D.R. 27:234), on a farm where poor growth brought an inquiry. Nematodes caused a 48% reduction of trimmed celery. Parris and R. A. Jehle reported on, "Root knot on lima beans in Maryland" (P.D.R. 27:235), and R. P. Porter on "Arasan (Thiosan) as a spinach seed treatment" (P.D.R. 27:262-263). He found Arasan was superior to ZnO and cheaper, $9.00 to 12.00 for treating 2000 lbs. of seed with ZnO and $5.00 to 6.45 with Arasan. Arasan did not require addition of graphite. E. K. Vaughan reported that black shank and Granville wilt were spreading; black shank caused damage in Franklin and Charlotte Cos. and Granville wilt was found in nine old-belt counties (P.D.R. 27:272-273).

The acreage of hybrid corn in Virginia nearly doubled from 7.6% in 1942 to 13% in 1943. [S.P. 104 (10):4. 1943]. The editor in the "Work for the month" column plugged the dusting of peanuts. A schedule for different types was provided [S.P. 104 (6):8.1943]. Nothing else related to plant pathology was published in *The Southern Planter* in 1943.

Hurt had two articles in the 1943 *Virginia Fruit*. The first, "Cryolite as a lead arsenate substitute," was entomology, not plant pathology [Va. Fruit 31 (1):47-50]. In the second, "Methods of bitter rot control", Hurt reported that bitter rot had caused little damage to apples in the preceding years but in 1942, conditions were favorable for the establishment of the bitter rot fungus in orchards and some losses occurred. This article was a reminder for orchardists to be vigilant and to carry out the proper control measures. He described symptoms, disease cycle and control measures. They had not changed for many years. One should remove mummies and dead twigs from trees, and apply 2 to 4 sprays of Bordeaux mixture, depending on the susceptibility of the varieties. "Red Delicious" and "Winesap" were considered non- susceptible and required but 2 or 3 sprays of 2-4-100; "Pippin", "Jonathan", required 3 or 4 sprays of 3-6-100. The third cover spray was the most critical for bitter rot control [Va. Fruit 31 (4):10-14].

Despite it being war time, there was a considerable volume of publication by Virginia plant pathologists in 1943. The most significant events were the introduction of Fermate for use in orchards and tobacco seed beds, and the transfer of Vaughan from instruction to extension.

Vaughan was very much interested in history and geography. In his 1943 report of extension project work (actually June 1 to Nov. 30), he made comprehensive summaries of diseases in Victory Gardens (only early and late blights occurred in epiphytotic proportions), small grains (scab and stem rust were epiphytotic), tobacco (downy mildew, black shank and Granville wilt were the most damaging), peanuts (only leaf spot was of major importance) and corn (seedling blight, stalk and ear rots, and smut but not leaf blight, caused most damage). His most elaborate report was on black stem rust of wheat and barberry eradication. Here he demonstrated his flair for history. Although his report was based on information provided by R. S. Mullin, Associate Pathologist, U.S.D.A., in charge of barberry eradication for Virginia, it is the most comprehensive report I have found. Original reports by Mullin and earlier by Matheny have not been located. The impact of barberry eradication was demonstrated during the 1942 and 1943 stem rust epiphytotics. Brine or salt was still being used to kill bushes. The curtailment of activities by the Works Project Administration in 1942 greatly reduced the intensity of eradication work; thus resurvey of areas in which bushes had been previously eradicated was emphasized. Survey and eradication on new properties was curtailed.

In 1944, A. B. Massey taught Plant Pathology in the winter and spring quarters and I was his teaching assistant. R. P. Porter resigned from the Truck Station on January 30, to go into pesticide distribution and sales work. E. K. Vaughan resigned September 9, to return to tomato disease research, U.S.D.A. at Tifton, Georgia. Henderson received the Ph.D. degree from Iowa State College and I was awarded the M.S. degree in September. After my graduation, graduate studies in Plant Pathology at V.P.I. were shelved for the next decade. Not until 1953 would the Department of Plant Pathology and Physiology be authorized to grant M.S. degrees in its two disciplines. R. S. Mullin, until fall of 1944, was State Leader of the Barberry Eradication Project. In September he resigned his position and took up graduate study at the University of Minnesota under E. C. Stakman. I joined him as a fellow student.

The abstracts of the 1943 Society meetings had been published in 1943, not in January 1944 as was the pattern previously. Virginia pathologists did not participate. The talk given by Groves at the December 1943 meeting of the Virginia State Horticultural Society was published in January 1944. Hurt was not on the program. Groves spoke on, "Controlling cedar rust with fungicides" [Va. Fruit 32 (1):33-36]. He described the pros and cons of the cedar eradication program and a need for an effective fungicide for use where cedar eradication was either not practicable or the law had not been adopted locally. He described the success he had in 1943 with the new fungicide "Fermate" and recommended it for inclusion in spray programs on rust-prone varieties.

Immediately following Groves, W. H. Tisdale of the DuPont Co., Wilmington, Delaware, spoke on "Fermate ---A promising fungicide" [Ibid. 32 (1):36-40]. He gave a brief history of the development of organic fungicides and cited "Semesan" and "Ceresan" for cereal seed treatment, "Arasan" and "Thiosan" for seed and soil treatment, and "Fermate" for fruit and foliage diseases. In addition to its fungicidal properties, Fermate needed no safener and, indeed, acted as a safener for lead arsenate. He listed pears, cherries, peaches, tobacco, tomatoes and several ornamentals as crops that would benefit from use of Fermate. He warned that Fermate is corrosive; therefore, sprayers should be thoroughly cleaned after its use.

With the introduction of Fermate, a whole new era began; freedom from dependence on sulfur and copper sprays was in sight. However, much testing would be necessary before each new product could be put to use. In Virginia, orchardists and tobacco farmers would be the first major benefactors.

Later in the year, Groves contributed a note, "Organic fungicides in 1944" [Va. Fruit 32 (9):13-14] elaborating on his results with "Fermate" in 1944. Results were encouraging in that Fermate proved compatible with summer oil and nicotine sprays but on peaches, it left a dark, objectionable residue. Groves found it had a narrow spectrum of disease control.

In another note, Hurt declared that a new phase of fungus and insect control is in the making [Inorganic spray materials versus organic materials as fungicides and insecticides. Va. Fruit 32 (10):8-9]. He found as Groves had that Fermate was effective for apple scab and cedar rust.

The only research bulletin published by plant pathologists in 1944 was prepared by Groves (A.B. Groves. Sulfur Sprays. Va. Agri. Expt. Sta. Bul. 359. 1944). Here he described the types and forms of sulfur fungicides, the preparation, use, and disadvantages of lime- sulfur. The latter was highly recommended for use on apples to control early infections of apple scab and as a dormant spray for eliminating peach leaf curl. It would sometimes injure apple fruit, and would interfere with the efficacy of lead arsenate. Several other aspects of sulfur were discussed. Elemental sulfur products were described as universally useful on peaches.

Vaughan published an extension bulletin, "Control Victory Garden Pests and Diseases (Va. Agri. Ext. Div. Bul. 158) in which he provided the gardeners with general principles of disease and insect control, described various pesticides, and listed various insects and diseases the gardener might encounter. Emphasis seemed to be on insects.

In *Phytopathology*, Vaughan published two papers based on work he had done before coming to V.P.I. In the first "The use of ethyl mercury phosphate for treating tomato seed in New Jersey" (Phytopathology 34:175-184), New Improved Ceresan dissolved in tap water (1 g in 1200 ml) proved satisfactory for eliminating *Alternaria solani*, the primary seed-borne organism causing seedling diseases in tomato. In the second, "Bacterial wilt of tomato caused by *Phytomonas solanacearum*" (Ibid. 34:443-458), Vaughan presented his Ph.D. dissertation. He emphasized edaphic factors in relation to wilt development.

Shear and Wingard published, "Some ways by which nutrition may effect severity of disease in plants" (Ibid. 34:603-605). This was a discussion of the effect of nutrients in conductive tissue on the development of bacterial wilt of corn.

G. K. Parris, the Acting Plant Pathologist at the Truck Station, published a note on "A simple nuclear stain and staining technique for Helminthosporia" (Ibid. 34:700-702). It was an agar-slide culture technique; acid fuchsin was used to stain the cultures. The cover slips could be sealed in place with paraffin.

In May, at the Virginia Academy of Science meetings, Henderson described a, "Technique for measuring resistance to black root rot in tobacco" (Proc. Va. Acad. Sci. 1944:73). In replicated field plots, using a lattice design, 30 entries were measured 3 times during the growing season. The most critical measurements were those taken first. The lattice design gave greater accuracy than did the randomized block.

Vaughan spoke on, "Black shank, a little known but serious threat to tobacco production in Virginia" (Ibid. 1944:48). He reviewed the history of black shank in Virginia, its spread and potential for great destruction in the bright tobacco belt. He stated that a program for breeding resistant varieties was under way at Chatham. A further elaboration which was published in *The Southern Planter* is reviewed below. Roane and Vaughan published the abstract of a paper read by Roane, "Studies in the physiology and genetics of *Colletotrichum phomoides*, the tomato anthracnose organism" (Ibid. 1944:42). This was a summary of my M.S. thesis in which I found the fungus grew optimally at temperature of 24- 33° C., that it would grow at a pH ranging from 3.0 to 10.0, that growth was greater on carbohydrate than on nitrogen media, and was greater on ripe tomato agar than on green tomato agar. This was my first presentation before an audience of peers and I was very nervous and did poorly. In later years, my presentations were much improved but the nervousness remained.

The Virginia Department of Agriculture and Immigration published occasionally on plant disease situations in Virginia. In Bulletin 429, white pine blister rust was noted to have spread to counties south and west of Roanoke. Ceresan was acknowledged to be the most popular grain seed treatment material, however, some treated lots showed depressed viability. Seedsmen were warned not to store treated seed for long periods or to reduce the dosage to 1/4oz/bu for seed to be stored (V.D.A. & I.Bul. 429:10-11. 1944).

The barberry eradication work for 1944 was reviewed. W.M. Watson had been named Federal-State Leader following Mullin"s resignation. He reported that for 1944, resurvey work had been conducted in Augusta, Grayson, and Wythe Cos. (Ibid. 435:10. 1945).

Two reports focussed attention for the first time on a nematode disease caused by *Pratylenchus* spp., the meadow nematode. C. F. Taylor in, "Distribution of the meadow nematode in Virginia. I. On boxwood" (Pl. Dis. Reptr. 28:339-340), found *Pratylenchus* to be generally distributed on Virginia boxwoods and suggested that winter injury may be nematode damage. Jenkins called attention to meadow nematode damage in "Root rot disease complexes of tobacco with reference to the meadow nematode: A preliminary report" (P.D.R. 28:395- 397). In addition to accounts on the distribution of nematodes, he pointed out that black root rot would not occur in some soils unless meadow nematodes were also present, even though *Thielaviopsis basicola* was also present.

Vaughan summarized the results of "Peanut seed treatment in Virginia - 1944" (P.D.R. 28:672-675). Spergon increased stands by 67%, 2% Ceresan increased them by 94%, and Arasan by 100% over untreated. Although hand-shell seed stands were increased only 38%, machine-shelled stands were increased 99%. Arasan became the standard peanut seed treatment chemical. It would emancipate growers from the laborious task of hand shelling and would eliminate the need to treat seed with kerosene to prevent rodent and bird damage.

C. F. Taylor of the Emergency Plant Disease Survey Project found *Coniothyrium fuckelii* invading arsenic-damaged peaches where zinc sulphate safeners had not been used (P.D.R. 28:718-719), and found anthracnose of tobacco in Virginia (P.D.R. 28:828, reported by G. A. Walker), and *Diaporthe sojae* causing stem rot of peanut at the Holland Station (P.D.R. 28:1096). The last two diseases were new to Virginia. There were about 20 survey reports on Virginia plant diseases but most cited commonly occurred diseases without evidence of severe damage. R. E. Atkinson apparently replaced Taylor after July 1.

Vaughan and Jenkins summarized the incidence of tobacco diseases (P.D.R. 28:848-849); Vaughan summarized the small grains disease situation and reported rye ergot was severe in Washington, Tazwell, and Russell Cos. (P.D.R. 28:891-892); and Vaughan and Shear reported the discovery of boron deficiency by Taylor in 1943 and experiments that led to application of 10 lbs/ac. of borax to soils to be planted with cole crops (P.D.R. 28:1069- 1072).

Parris reported that seed treatment of peas decreased fertilizer injury (P.D.R. 28:1152) and that tests with chemicals to control sweetpotato soft rot caused by *Rhizopus nigricans* revealed nothing better than the already recommended borax (P.D.R. 28:1168-1170).

Vaughan contributed an article to *The Southern Planter* entitled, "Black shank, new disease of tobacco" [Sou. Planter 105 (6):12-13. 1944], in which he reviewed the history of black shank in Virginia. This was the subject of his Virginia Academy of Science paper mentioned earlier. He described the symptoms of black shank and compared them with those of Granville wilt and sore skin. All varieties of all types of tobacco grown in Virginia were susceptible to black shank; relief in the form of resistant varieties was not expected for a number of years. All recommendations were aimed at preventing contamination of uninfested lands.

Vaughan collaborated with G. M. Shear in preparing an article, "Boron deficiency of rutabagas" [G.M. Shear and E.K. Vaughan. Sou. Planter 105 (11):24-25.1944; also in P.D.R. 28:1069-1072], in which they described the symptoms of boron deficiency and the discovery of the problem in Smyth Co. by C. F. Taylor who was working on the Federal Emergency Plant Disease Prevention Project. Shear and Vaughan found that the addition of 20 lbs. of borax per acre nearly eliminated the problem. Although rutabagas are a minor crop, cabbage is a major crop in southwestern Virginia and in a survey of cabbage and rutabaga crops, boron deficiency was identified in Wythe and Smyth Co. cabbage fields. Since water core, the primary symptom, is destructive only in dry years. Shear and Vaughan recommended that 10 lbs/ac. of borax be applied to cabbage and rutabaga fields.

H. H. Zimmerley, Horticulturist and Director of the Virginia Truck Experiment Station, died at the age of 54 of a heart attack on October 15, 1944 [S.P. 105 (11):24-25. 1944]. He had contributed actively to the breeding of disease-resistant spinach and through leadership to the development of disease-resistant watermelons and tomatoes and to projects on control of nematodes and truck crop diseases in general. He was very well liked by the station staff and growers.

The 1944 meeting of the A.P.S. was held in Cincinnati December 9-11; Groves read two papers, Henderson one. In, "Soil treatments and apple replant survival in *Xylaria mali*-infested locations" (Phytopathology 34:1001), Groves reported that carbon bisulfide was the most promising treatment found to-date; urea and chloropicrin also showed promise. In, "Compatibility of organic fungicides and summer oils" (Ibid 34:1001), Groves reported that Chloronil, Puratized N5X, and two proprietary compounds were phytotoxic with summer oil but compound 341 and Fermate were compatible.

Henderson described, "Growth of tobacco seedlings stimulated by the addition of peanut-hull meal to plant-bed soil" (Ibid 34:1002-1003). He had observed that calcium cyanamid or urea added to tobacco seed bed soils for control of weeds was toxic to tobacco for several weeks. Organic matter added to the soil was known to bring the soil quickly back to productivity. Two lbs./sq.yd. of peanut hull meal was found to be a suitable adjunct.

The first annual meeting of the Potomac Division of the A.P.S. was held in Beltsville, Md., Feb. 23-24, 1944. No one from Virginia contributed a paper. In summary, 1944 was the year that the organic fungicides Fermate and Arasan were demonstrated to be beneficial to Virginia crops; borax would prevent water core in crucifers in southwestern counties; Vaughan and Mullin resigned; meadow nematodes were reported as the causes of brown root rot and winter injury of plants; and June 6 was D-Day, signifying the landings of Allied troops in Normandy.

In 1945, there was only one staff change at V.P.I.; S. B. Fenne returned from Brazil in January and resumed his duties as Extension Project Leader in Plant Pathology and Entomology.

R. S. Mullin, having completed the residence requirements for the Ph.D. degree, returned to Virginia expecting to become Associate Professor of Biology at V.P.I. but the student enrollment was so small that I. D. Wilson, Department Head, could not appoint him. Instead Mullin received an appointment on July 1, as Plant Pathologist at the Truck Station. G. K. Parris had resigned from there in January. H. T. Cook and T. J. Nugent were still in service, so, fortunately for Mullin a position was available. L. I. Miller returned from military duty in either late 1945 or early 1946 to resume his appointment as Assistant Plant Pathologist at the Holland Station. J. O. Rowell was hired as Extension Entomologist on October 15. Thereafter, Fenne could devote full time to plant pathology.

At the December 5-7, 1944 meeting of the Virginia State Horticultural Society, Groves spoke on "Promising new fungicides on apples and cherries" [Va. Fruit 33 (1):139-142. 1945]. Groves was speaking on the third anniversary of Pearl Harbor Day. He first highlighted the inadequacies of current spray programs, i.e., that summer oils against the codling moth were incompatible with sulfur sprays and, consequently, if oil was used protection from scab would be lacking for at least half of the scab-fungus-infecting period. The control of leaf spot and brown rot of cherries has been only partially successful. The available products adversely affect fruit size and quality. Of several organic fungicides tested, only Fermate has been found useful on apples but not cherries. Spergon, Chloronil, and Dithane have not been effective on either fruit. New organic products will be tested in the future and no doubt efficacious products will be found.

For the first time in years, Hurt did not appear on the program nor did he contribute to the 1945 volume. Both in 1944 and 1945, the editor urged growers to destroy regrowth cedars.

Two bulletins were issued in 1945 addressing plant diseases. Wingard and E. T. Batten, Superintendent at the Holland station, published, "Treat Seed Peanuts for Profit" (Va. Agri. Expt. Sta. Bul. 382. 1945). In three years of testing at the Holland station, Arasan, Ceresan, Yellow Cuprocide, Spergon, U.S.R. 604 (= Phygon), Dow 9 B, and Fermate were applied and data obtained by planting 100 seeds per plot to hand-shelled and machine shelled seed. The field plan was a factorial design of six replications. For hand-shelled seed fungicides did not improve stands, but for machine-shelled seeds fungicides gave much greater stands than untreated. Results from Vaughan"s 1944 farm demonstrations were also included. Arasan emerged as the material of choice although Ceresan was almost as good. Planting of machine-shelled treated seed was calculated to save more than $200,000 a year for Virginia growers. An additional saving of 10-20% was obtained by machine shelling because laborers ate that amount while shelling. Crude methods of treating the seed were described. These experiments led to a major change in the peanut industry.

Henderson, E. M. Matthews, and W. A. Jenkins published, "Tobacco Plant Bed Management" (Va. Agri. Expt. Sta. Bul. 384. 1945). They described soil preparation, soil treatment with urea or cyanamid in October for weed control, the construction of plant beds including size and shape, and fertilizing. They emphasized procedures that would avoid introducing tobacco diseases into uninfested soils, and the control of blue mold with Fermate. This bulletin became the model for a number of Extension Service circulars that followed.

Henderson published his Ph.D. dissertation, "Further testing of copper fungicides for control of tomato blight in Southwest Virginia" (Phytopathology 35:120-128), in which he compared tribasic copper sulphate and yellow cuprous oxide dusts for control of early, late, and Septoria blights on three varieties of tomatoes. Commercially prepared cuprous oxide gave 10% higher yields than the tribasic copper. No evaluation was given for foliage protection in the field.

Jenkins described, "A Cercospora leaf spot on cultivated *Physostegia*" (Phytopathology 35:324-331). The original name, *Cercospora physostegiae*, was soon relegated to synonymy when the ascospore stage was found in June 1944 and named *Mycosphaerella physostegiae*. This was the fourth *Mycosphaerella* described by Jenkins.

Parris reported on "The nematocidal and fungicidal value of D-D mixture and other soil fumigants" (Phytopathology 35:771-780). As others had found, D-D proved to be an excellent nematicide which could be applied in cold soils and would be cheaper and as effective as chloropicrin. It had little effect on soil fungi. Parris asked, "Does the Sequoia variety of potato possess resistance to leaf roll virus and to frost?" (Pl. Dis. Reptr. 29:126-127). He found that Sebago reacted more violently to the virus than Sequoia and perhaps because of a mild reaction to virus was more frost resistant.

From his plant disease survey work, R.E. Atkinson found much splitting and Penicillium rot in apples from Virginia (Pl. Dis. Reptr. 29:263-265).

C. Cottam reported that the Mycetozoan *Labyrinthula* was believed to cause the loss of eelgrass along the Atlantic Coast and in the Chesapeake Bay area (Pl. Dis. Reptr. 29:302- 310). Through 1944, there was considerable recovery. Brant and other geese had been most adversely affected.

Fenne reporter that tomato late blight was the worst it had been in 20 years. In south- western Virginia, all tomatoes were destroyed by the end of August unless they had been given fungicidal protection. Five percent copper dusts gave adequate protection (Pl. Dis. Reptr. 29:729-730).

In 1945, bulletins from the Virginia Department of Agriculture and Immigration, several plant diseases were cited. Blue mold control on tobacco with PDB or Fermate was emphasized (Bul. 436:8-9,May). In a white pine blister rust control report, rust of pine had been found in Grayson Co. for the first time (Bul. 438:8-9, July). Dutch elm disease appeared in Loudoun Co. along the Potomac river opposite infested areas of Maryland; this was the first occurrence of the disease in Virginia since 1936 (Bul. 439:9-10, Aug.). There were reports on barberry eradication, new outbreaks of white pine blister rust in southwest Virginia, and progress on cedar eradication (Bul. 442, Nov.). H. E. Yost was mentioned for the first time as Area Leader of the blister rust campaign.

According to S. B. Fenne"s annual report, there were severe outbreaks of tomato late blight and tobacco blue mold in 1945. As a precaution, there were 82 tobacco seed bed demonstrations, 70 with Fermate, 10 with PDB, and 2 with yellow cuprocide, for blue mold control. These were very successful in that blue mold was prevented. Farmers who did not spray had to buy plants. For the first time, the Granville wilt resistant variety, 'Oxford 26', was grown in demonstrations on infested soils. The variety proved to be highly resistant and of satisfactory quality. Jenkins also reported this (see below). Peanut seed treatment with Arasan was stressed; the era of commercial machine shelling and Arasan treating had begun. Dusting peanut fields with sulfur had become a standard practice but due to the war, there was a shortage of dusting machinery. Farmers formed dusting rings (co-ops) to overcome this problem.

In the 1945 *Southern Planter*, Three important tobacco diseases were discussed.. W.A. Jenkins described "A new control for blue mold" [Sou. Planter 106 (1):32-33]. He illustrated healthy plants grown in PDB- and Fermate-treated beds and destroyed plants in untreated beds. The spring of 1945 was considered to be the worst blue mold season ever. The new control Jenkins proclaimed was Fermate and growers who used it in demonstration beds in cooperation with the Experiment Station successfully produced disease-free seedlings. Farmers who did not use Fermate or PDB suffered big losses. Fenne described "Granville wilt of tobacco" [S.P. 106 (10):10]. He gave the diagnostic symptoms, encouraged the use of rotations involving non-susceptible crops by naming those which were susceptible, and highlighted the use of Oxford 26, a resistant flue-cured variety, on infested farms. Fenne also discussed the "Control of tobacco blackshank" [S.P. 106 (12):18-19]. He described long rotations for growers with infested farms and the precautions to be taken by growers with uninfested farms. The major admonishment was to use homegrown plants. Despite taking all precautions, blackshank found its way to uninfested farms. Fighting diseases whose pathogens were spread through soil was described as very difficult and frustrating. Fenne reviewed the work of Jenkins who was involved in breeding blackshank-resistant varieties. However, such varieties were as yet several years in the future.

Two anonymous articles featured S. A. Wingard and his Virginia Victory Beans. In January, the vigor, fecundity, and disease-resistance of Virginia Victory were proclaimed, but alas, seed companies had shied away from it while favoring bush beans [S.P. 106 (1):10]. The choice for the home gardener was a paradox, the back-breaking job of picking bush beans or the problem of picking beans from a ladder. In an October article, "Wingard"s Wonder bean makes record yields" [S.P. 106 (10):12], the editor, P.D. Sanders, wrote, "We saw poles 10 to 12 feet tall breaking down under the burden of beans that measured up to a foot long. They were as brittle as icicles and as tender as a mother"s love." In response to the January article, Wingard received and honored 8,533 requests for seeds.

May 8 was V E day, victory over the Axis in Europe. Because the Japanese were in retreat toward the home islands, the danger from introduced plant pathogens was apparently gone; therefore, on June 30, the Emergency Plant Disease Survey ended. V J day was August 14.

In 1946, H. T. Cook returned to the Truck Station on January 1, after a tour of duty as a naval Lieutenant and T. J Nugent rejoined him as Associate Plant Pathologist after serving as a 1st. Lieutenant in the army. R. S. Mullin, after a year at the Truck Station, was appointed Assistant Professor of Biology at V.P.I. and in the fall began teaching botany and plant physiology. A. B. Groves was promoted to Professor on July 1. Luben Spasoff returned from military service and was appointed Assistant Plant Pathologist at Chatham.

For the first time in several years, some plant pathology courses were deleted from the College Catalogue. Cereal and Fruit Diseases, Diseases of Special Crops, and Bacterial Diseases were no longer listed but the catalogue was still padded with untaught courses.

M. B. Waite, fruit pathologist in the Bureau of Plant Industry, U.S.D.A., died June 5, 1945. His obituary appeared in March 1946 (Phytopathology 36:175-179). Waite had worked closely with Virginia"s fruit growers and had been a featured speaker at annual meetings of the Virginia State Horticultural Society between 1901 and 1910, and in 1932. He is credited with convincing growers in the Shenandoah Valley that cedars must be eradicated if defoliation of apple trees by rust were to be prevented. He made many contributions to fruit pathology that greatly benefitted the Virginia fruit industry.

At the December 1945 meeting of the Virginia State Horticultural Society, there were three presentations pertaining to plant pathology. C. R. Willey, State Entomologist, asked, "Shall we let the cedars grow?" [Va. Fruit 34 (1):17-20. 1946]. He reviewed the history of cedar eradication, litigation, and more recently, a failing interest in eradication. Willey ended with the warning that, "you better get busy---and that right soon---with the axe; or, shall we let the cedars grow?" Groves spoke on, "Choose a sulfur fungicide for the particular job" [Va. Fruit 34 (1):36-40]. He listed six categories of sulfur products; but even though lime- sulfur was the superior fungicide, the elemental sulfurs were less phytotoxic. Hurt spoke on the, "Incompatibility of fungicides with DDT" [Va. Fruit 34 (1):119-122]. He reported that DDT was compatible with sulfurs, Bordeaux mixture and lead arsenate; it was safe with Fermate through the second cover spray. It was incompatible with lime-sulfur and other soluble sulfurs.

Professor William B. Alwood died at his home "Mountain Hollow Orchards" near Greenwood, Virginia on April 13, 1946 [H.L. Price Va. Fruit 34 (5): 14-20]. He was the first Vice-Director of the Experiment Station and Professor of Horticulture, Entomology, and Mycology. In 1888-1890 he conducted the first experiments, wrote the first articles and published the first bulletins on plant pathology at V.P.I.

The annual meetings of the American Phytopathological Society, usually held in December, were delayed until March 1946. Cook described how his training as a plant pathologist aided in the procurement, production, and handling of food supplies for the Armed Forces. Many established procedures were discarded or modified and improved methods were initiated (Phytopathology 36:397). Henderson described his experiments with 16 tobacco hybrids and varieties in an effort to find new germ plasm with resistance to black root rot. 'Yellow Special' was the only resistant commercial variety. Six highly resistant hybrids were found. The experiments demonstrated that greenhouse procedures with seedlings were adequate for selection of resistant plants (Phytopathology 36:400-401).

Five Experiment Station bulletins were published by the plant pathologists in 1946. In, "Vahart Wheat, a New Variety for Virginia", T.M. Starling, Assistant Agronomist, S.A. Wingard, and M.H. McVickar, Associate Agronomist state that Vahart was selected by T.B. Hutcheson from 'Redhart' in 1930 (Va. Agri. Expt. Stat. Bul. 386). Wingard and Fromme had found it to be highly resistant to loose smut (Va. Agri. Expt. Sta. Tech. Bul. 70), and later it was found to be moderately resistant to powdery mildew. It was the first awnless variety released by the Station.

In March, Groves published, "Weather Injuries to Fruits and Fruit Trees" (Va. Agri. Expt. Sta. Bul. 390). The bulletin was a photo-essay of winter and drouth damage to trees, frost injury to foliage and fruits, hail damage, wind injury, and problems caused by extreme fluctuations in temperature and moisture mostly on apples but with one plate devoted to stone fruits.

Henderson prepared a summary of his work on, "Tomato Blight Control in Southwest Virginia" (Va. Agri. Expt. Sta. Bul. 394), in which he described early and late blight and Septoria leaf spot and the effectiveness of various copper fungicides in controlling them. The best products were insoluble compounds, cuprous oxide and tribasic copper sulfate, applied either as dusts or sprays. For best results, treatment were to be started 10 days after transplanting and to be continued at 7-to 10-day intervals. Henderson described this work at the spring meeting of the Virginia Academy of Science (Proc. V.A.S. 46:72).

Groves published, "Comparative Effect of Lime-Sulfur and Flotation Sulfur on Tree Growth and Fruit Yield" (Va. Agri. Expt. Sta. Tech. Bul. 103) which was a summary of 5 years of tests on 'Starking Delicious'. He found that flotation sulfur gave a significant increase in fruit yield but had no measurable effect on tree growth or fruit size and finish.

L.I. Miller produced his first major publication since returning from military service, "Peanut Leafspot Control" (Va. Agri. Sta. Tech. Bul. 104). This was a thorough review of the world"s literature on leafspot and a report on a comprehensive investigation of factors affecting the development and control of leafspot. The various aspects of peanut hay and nut production were analyzed.

H.W. Thurston (Pa. State), J.B. Harry (Crop. Prot. Inst.), T.H. Lewis (Pa. State), Groves and C. F. Taylor (W.Va.) collaborated to publish their results with three derivatives of glyoxalidine (Glyoxalidine derivatives as foliage fungicides. II. Field studies. Contrib. Boyce Thompson Inst. 14:161-171). One of three compounds tested was found to be effective against apple scab and cherry leafspot and was eventually sold as Glyodin. This publication represented a good example of interstate cooperation.

The 8th Annual Conference of the Tobacco Disease Council met at Tifton, Ga.; S.A.

Wingard presided. Virginians attending reviewed their work; emphasis in early 1946 was on fungicidal control of blue mold. Jenkins described results with various diluents he used with Fermate, his research on meadow nematodes, and progress in breeding black shank resistant varieties. Henderson described results from chemically-treated seed beds, tests with mosaic resistant flue-cured lines, and procedures and results from indexing tobacco seedlings for black root rot reaction. Wingard and Henderson were elected to continue as Chairman and Secretary, respectively, of the council. They would serve through 1947. Twelve varieties in the Vesta series were released for use on black shank infested soils. Although their resistance was adequate, yield and quality did not satisfy growers.

In the 1946 *Southern Planter*, Fenne contributed two articles on tobacco blue mold control. In the February issue he contributed, "A new control for tobacco blue mold" [Sou. Planter 107 (2):26-27] which seemed to be the same article Jenkins had in the September 1945 issue. The use of Fermate sprays and dusts was emphasized. In November, he reminded growers to plan on using "Fermate to control blue mold" [S.P. 107 (11):28-29]. He stated that growers should spray twice a week or 8 to 12 times. There was an error in the print; it read "eight to 122 applications will probably be required"! Blue mold had been very destructive recently and Fenne wanted growers to be ready for the next onslaught. The editors also reminded growers to spray tobacco in their "Work for the month" column in April.

Fenne also contributed an article, "Treat peanut seed to improve yields" [S.P. 106 (3):10]. This information was based on the bulletin by Wingard and Batten "Treat Peanut Seed for Profit" (Va. Agri. Expt. Sta. Bul. 382. 1945).

Wingard contributed an article, "Chemical dust checks Irish potato sprouts" [S.P. 107 (10):44]. This was not plant pathology but rather growth regulation. It was an account of treating shredded paper with methyl ester of naphthalene acetic acid (supplied by American Cyanamid and Chemical Corp.) and mixing the paper among tubers from his garden. The potatoes were stored in his basement. I think this product was later sold as Barsprout.

The editors described the, "Apple spraying program for 1946" [S.P. 107 (3):24]. Elgetol and Fermate were the organic products recommended to replace sulfur and copper inorganic sprays.

Fenne reviewed the major events in Extension Plant Pathology in his annual report. Tomato late blight was very destructive in western Virginia. Tobacco blue mold did little damage; farmers controlled it with Fermate. They purchased over 250,000 lbs. In demonstrations showing the differences between western and locally grown bean seeds, "you could tell to the row" by the absence of anthracnose which were western. Tobacco black shank continued to spread; in 1946 it was known on 90 farms in 8 counties. Dusters became available to peanut growers; as a consequence sulfur dusting to control leafspot greatly increased. Alfalfa bacterial wilt was found in new areas and the variety 'Williamsburg', newly released from the Virginia Agricultural Experiment Station, was found to be tolerant of stem rot. Some of these reports were elaborated in the *Plant Disease Reporter* (See below)

Fenne, C.L. Lefebvre, (Plant Pathologist, U.S.D.A.), Henderson and T. J. Smith (V.P.I. Agronomist) conducted a survey of "Alfalfa and clover diseases in Virginia" (Pl. Dis. Reptr. 30:242-243), mostly in the Piedmont. They found only common diseases on alfalfa and clover. A field of clover was heavily damaged by root knot where it was planted after several years of tobacco.

Apparently, late blight came early to tomato and potato crops in 1946. Both Cook and Fenne in separate reports indicated there would be large losses a result of low temperature and frequent rain (Pl. Dis. Reptr. 30:266-268). This same weather caused snap bean halo blight to spread rapidly in eastern Virginia (Cook, Ibid. p. 271). Fenne gave a detailed account of tobacco blue mold situation (Ibid. pp. 275-276). Farmers endured heavy losses unless they sprayed or dusted their tobacco plant beds. He later summarized the results of 85 farm demonstrations where Fermate was used for blue mold control. All growers achieved excellent control and vowed to use the product in 1947 (Ibid. pp. 382-383). Fenne, acting as Chairman of a Row Crop Legume Committee, summarized the results from four states on peanut seed treatment (Ibid. pp. 468-470). The most obvious result was the enhancement of stands obtained with machine-shelled seed. Nearly all products gave excellent stands and provided convincing evidence that treated machine-shelled nuts would result in nearly perfect stands.

In 1947, Curtis W. Roane was hired as Assistant Plant Pathologist on July 1 to work with plant breeders to produce disease-resistant varieties of barley, oats, wheat and corn. He filled the first new position to be established in the pathology group at Blacksburg since 1929. However, since then new positions had been established, one at Chatham and one at Holland. Also, in 1947, R.H. Hurt was promoted to Associate Plant Pathologist.

At the December 16-18, 1946 meeting of the Virginia State Horticultural Society, all who worked in fruit pathology were on the program. Hurt, being the first, spoke on "Fungicides old and new" [Va. Fruit 35 (1):42-47. 1947]. He pointed out that liquid lime- sulphur and Bordeaux mixture are two old fungicides which will be in use for a long time. In addition, they will be the standards by which the performance of new products will be measured. Only if new products prove to be equally effective, less phytotoxic, and are reasonable priced will they become established. Hurt reviewed sulphur fungicides including carbamates with sulphur compounds, copper, and organic mercuries. In comparative tests, organic mercuries were top performers.

Groves spoke on, "Chemical treatment of the soil for control of black root rot of apples" [Va. Fruit 35 (1):54-56]. Once a tree dies of black root rot, subsequent replants also die. Groves reported on survival of trees following site treatment with Bordeaux mixture (33 of 34 survived), carbon disulfide (135 of 135) and Uramon (not evaluated yet).

Wingard followed with a discussion of, "Quince rust, a serious disease of apples " [Ibid. 35 (1):57-61]. Actually, he compared cedar-apple, cedar-quince, and cedar-hawthorn rusts. On apple, apple rust attacks fruit and foliage, quince rust attacks only fruit, and hawthorn rust attacks only foliage; other differences were described. A spray program utilizing Fermate was presented. Quince and apple rusts were illustrated.

C. R. Willey followed with a brief reminder that, "Cedar rust really hit some sections of Virginia this year "[Ibid. 35 (1):62]. Willey said rust had cost Augusta Co., "four or five thousand dollars. It cost the Augusta orchardists more (in 1946) than to cut all the cedars in twenty-five years." Willey admonished orchardists that, "the only cure is plain old muscle grease---cut down the cedars".

The American Phytopathological Society met at Cincinnati at the end of December 1946. In abstracts published in January 1947, Cook described, "A method of forecasting late- blight epiphytotics in Eastern Virginia" (Phytopathology 37:5). He reported that late blight had occurred only when rainfall was above average and temperature was below 75° F from May 15 to June 15. Thus, when conditions such as this occurred, growers would be urged to spray to prevent losses. At this meeting Cook was appointed to the Public Relations Committee and the National Security Committee. Fenne was appointed to the Extension Committee. No other plant pathologists from Virginia participated in the meetings.

Cook, T. J. Nugent, G. K. Parris, and R. P. Porter, all of whom had worked or were working at the Truck Station published, "Fusarium Wilt of Spinach and the Development of a Wilt Resistant Variety" (Va. Truck Expt. Sta. Bul. 110). Wilt was found in 1930 in Tidewater Virginia. In 1936, Cook and Nugent selected resistant plants from a commercial field of "Virginia Savoy"; further selection and roguing was continued through 1942 when yield trials were conducted. Performance on uninfested soil was about equal to the original Virginia Savoy. On infested soil about 70 per cent of the plants survived compared to 33 per cent for susceptible Virginia Savoy. The new variety provided resistance to wilt and the virus disease blight. Even though the variety provided a measure of resistance, Cook, et. al. advised growers to practice rotation to gain a further modicum of performance.

Late blight was thoroughly monitored in the eastern states in 1947. In Virginia, it flared up in several isolated spots of Tidewater and Eastern Shore. In most areas, unfavorable, blight-checking weather followed out-breaks and damage was minimal. The fall potato crop was expected to be protected by fungicides beginning in mid-September.

The Plant Disease Reporter published a supplement on "Tomato late blight in the warning service area in 1947" (P.D.R. Supp. 171, Dec. 1947) in which two reports from Virginia were included. Cook contributed a, "Summary of late blight in Eastern Virginia in 1947" (p. 210-212). His opening statement was, "Late blight was not important in Eastern Virginia in 1947." Thereupon, he wrote two and one half pages on why it was not important. A small pocket of blight was found in Accomac Co. Fenne and Wingard reported a 15 to 20 percent loss of tomatoes due to "late blight in tomatoes in Western Virginia." (p. 209-210). They thought the weather was ideal for blight during July but widespread damage did not occur.

The annual alfalfa and clover disease survey was held during the week of April 14. Pathologists participating were S.B. Fenne, C.L. Lefebvre (U.S.D.A.), and V.P.I. Agronomist T. J. Smith. Bacterial wilt was found in Botetourt Co. for the first time. Root knot was also damaging in Botetourt (Pl. Dis. Reptr. 31: 301-303).

Fenne reported an unusual amount of loose smut in barley and wheat and powdery mildew on wheat. He also reported severe damage to clover and alfalfa caused by a lack of snow cover on certain fields (Ibid. pp.281-282).

Nugent found azalea petal blight in Virginia for the first time on May 8. Petal blight was collected in several gardens of the Norfolk area (Ibid. p.244).

Cook"s article, "Forecasting tomato late blight", originally published in the *Food Packer* was reprinted (Ibid. pp.245-249). Since epiphytotics occurred in only 2 of 17 years (1930-1946), spraying or dusting to control blight each year was considered wasteful. Thus, years in which conditions favored blight had to be recognized and growers were to be warned to protect their crop. Rainfall and temperature were the only factors considered.

At the 1947 meeting of the Virginia Academy of Science, Henderson reviewed, "Studies on damping-off of alfalfa" (Proc. Va. Acad. Soc. 1947:70). Among several varieties tested, "Williamsburg" selections were superior. In, "Further experiments with chemicals applied to the soil to control weeds in tobacco plant beds", he reported that best control was obtained with urea and calcium cyanamide; 2,4-D was ineffective at nontoxic levels (Ibid. p.80). Mullin spoke on the, "Economic importance of stem rust of small grains in Virginia" (Ibid. p.79). From 1935 to 1944, Virginia lost $4 million, 3.75 million in wheat, to rust. The 1943 epiphytotic was the most damaging when $1.081 million in wheat was lost. Two papers were presented on breeding disease-resistant crop varieties. Henderson in "Breeding tobacco for disease resistance," reported success in breeding for resistance to black root rot, mosaic (virus), and black shank (Ibid. p.55). He stated that use of resistance was the only way to control soil-borne organisms and viruses. Cook reviewed the history of, "Breeding plants for disease resistance of the Virginia Truck Experiment Station" (Ibid. p.57). Varieties already released were 'Virginia Savoy' spinach (blight resistant), 1921; "Old Dominion" spinach (also blight resistant), 1929; wilt resistant 'Virginia Savoy' spinach, 1947; and "Hawkesbury" watermelon (fusarium wilt resistant), 1936. Attempts are also being made to breed spinach resistant to downy mildew, kale resistant to fusarium wilt, sweet potato resistant to stem rot, and cucumbers and cantaloupe resistant to downy and powdery mildew.

In his annual report for 1947, Fenne reported the first occurrence of sweet potato internal cork in Virginia. The disease originated from virus-infected seed roots purchased from southern states. He also said that black shank had spread into three more counties.

Wingard served as Chairman and Henderson as Secretary of the Tobacco Disease Council for the last time in 1947. Both had held their office since 1936, the first year of Council meetings. Considerable emphasis was given to meadow nematode-induced brown root rot. Jenkins gave a detailed account of his findings and conclusions: (1) Tobacco is not a natural host of meadow nematodes. (2) Injury by meadow nematode is comparable to the hypersensitive reaction in small grain rust resistance. (3) Nematodes are conditioning agents for the entry of secondary invaders (which do more damage than the meadow nematodes). (4) Parasitism is not equivalent to pathology. Although the nematodes are parasitic, it is difficult to demonstrate they cause disease. (5) Considerable variation occurs among species and strains of meadow nematodes in response to temperature, nitrate and calcium variation. Jenkins also reviewed the breeding of black shank-resistant varieties. About 95 to 98 percent of the plants in the VESTA lines are resistant; the level of resistance has neither increased nor declined since 1944. Seed are saved only from plants which survive to the end of the growing season.

An interesting article about S. A. Wingard appeared in the *Extension Service News*, November 1947. The headline read, "Modern version of Jack"s beanstalk developed by research man at V.P.I." This was a popular article on Wingard"s pole bean project. The writer pointed out that harvesters used stepladders, no helicopters being available.

In the 1947 *Southern Planter* the first full-page advertisement for Fermate appeared; DuPont was promoting its use for blue mold control. Both dusting and spraying were featured. In March, Jenkins contributed a brief note, "New type covers for tobacco plant beds" [S.P. 108 (3):3] in which he touted plastic glazing. Its assets were excellent light quality transmission, heat retention, protection from chewing insects, and possibly, exclusion of blue mold. The material was in for further evaluation.

Fenne contributed two articles. In April, he pointed out that, "Tomato late blight could come early" [S.P. 108 (4):23,27]. In 1946, late blight was brought into Virginia on southern- grown tomato transplants. Conditions soon became ideal for its spread resulting in early destruction of unprotected plants. Fenne said that a late blight forecasting service was functioning for Atlantic coastal states and that growers should heed any warning by applying copper or organic fungicides promptly. H. T. Cook of the Truck Station in, "Late blight control" [S.P. 108 (5):27], warned growers of early potatoes in Eastern Virginia that while late blight on the early crop occurs only rarely, they should be prepared to apply copper fungicides should conditions favor late blight. No organic fungicides were mentioned.

Fenne contributed another article on, "Control of diseases injuring vine crops," in which he was referring to cucurbits [S.P. 108(5):30-31]. Fenne listed downy and powdery mildew, bacterial wilt, anthracnose, scab, mosaic and leaf spots as the usual diseases. He described the disease cycles, and emphasized the need for rotation and sanitation. Only copper fungicides were recommended. A downy mildew warning service (like that for late blight) that was especially helpful to commercial growers had been implemented.

Wilbert A. Schaal became the Agricultural Editor for the Experiment Station in 1945. In 1947, he contributed three articles about research involving the plant pathologists. In "New wheat variety for Virginia", he described Vahart wheat. This variety was one selected originally by Wingard as being resistant to loose smut [S.P. 108(8):38-39]. It has been described in Bulletin 386. Vahart was a beardless wheat with good resistance to mildew. In the same article, Schaal listed other recommended wheats, barleys, and oats. Wong barley was newly introduced from New York and had resistance to powdery mildew. Strangely, several recommended winter oats were susceptible to Victoria blight (*Helminthosporium victoriae*) but did not succumb to the disease. However, several recommended spring oats were susceptible and did succumb. (We were able to grow Victoria blight-susceptible winter oat varieties for several years after susceptible spring oat varieties disappeared.)

Schaal interviewed Henderson about, "Weed control in tobacco beds" [S.P. 108(10):46-47]. Henderson and E.M. Matthews had found that urea (sold as Uramon) and calcium cyanamid (Aero Cyanamid) or a 50:50 combination of both would control weeds in seed beds if applied by October 20 preceding tobacco seeding. This simple procedure saved 50 to 60 hours of weeding for each 100 sq. yds.

Schaal interviewed me (C.W. Roane) and wrote on, "Corn disease research underway" [S.P. 108(11):42-43]. It was my first chance to tell what Clarence

Genter, corn breeder, and I had decided was important for improving hybrid corn in Virginia. Stalk rot and leaf blight were our initial target; both contributed to stalk breakage and corn stalks had to remain erect if the grain was to be machine harvested. I was pictured inoculating a stalk with stalk rotting organisms and holding split stalks about five weeks later. We proposed to inoculate all the plants in our breeding nursery with stalk rotting and leaf blighting fungi and we spilt a 10- plant sample of every plot of plants in our Blacksburg yield trials every year (and we did so for about 15 years). In addition we proposed to select only smut-free and rust-free plants in the breeding nursery. After only one year, we greatly modified the list of recommended hybrids for Virginia. In retrospect, I found that agricultural journalists enjoyed writing about new projects and great expectations. These made for large doses of glorified speculation, but it was only rarely they wrote about actual accomplishments. Accomplishments came in such small increments that laymen could not see their impact. In short, they were more interested in people who were going to do than people who had done! Nevertheless, I welcomed the opportunity to give my work a little publicity.

Some things are never documented in print. When I joined the faculty in 1947, I had completed the residence requirements for the Ph.D. degree at Minnesota but had made no progress in research toward a dissertation. I needed a topic that was related to cereal crops. About July 10, Clarence Genter brought me corn leaves with bright tan circular spots. I did not know the causal agent so after a few days I identified the cause as *Helminthosporium carbonum*. It completely destroyed the female line in a crossing block of K44 X K41. I found it on some lines in an inbred line nursery. I decided to make it the subject of my dissertation. To certain corn scientists, *Helminthosporium* leaf spot was proclaimed to be an obscure disease and thus it remained until the 70's when it became a hot topic.

A bulletin entitled, "The 1947 Official VirginiaVarietal Tests of Corn Hybrids, Barley, Oats and Wheat" by C.F. Genter, Edward Shulkcum, C.W Roane, and M.H. McVickar was published in late December. (Va. Agri. Expt. Sta. Bul. 412); this was the first bulletin to recognize the cooperation between the Agronomy Department and the Plant Pathologists in evaluating cereal crops.

In 1948, R.G. Henderson and G.M. Shear were promoted to Professor of Plant Pathology and Professor of Plant Physiology, respectively and C.W. Roane was promoted to Associate Professor of Plant Pathology.

H. T. Cook resigned his position as Plant Pathologist at the Virginia Truck Experiment Station in 1948 to become Senior Plant Pathologist in the Section of Fruits and Vegetables of the U.S.D.A. Then R.S. Mullin resigned his position of Associate Professor of Biology (Botany) on July 1 to return to the Virginia Truck Experiment Station as Plant Pathologist to replace Cook. This brought A.B. Massey back to teach plant pathology after a two year release from this chore.

The General Assembly appropriated funds to construct a new Piedmont Fruit Research Laboratory at Charlottesville, adjacent to the Virginia Forest Service Nursery. The University of Virginia wished to resurrect the current laboratory site for other purposes. The Assembly also provided funds to purchase land for a Tobacco Disease Research Station. This land was soon put to use as a tobacco seed production farm, especially for the VESTA lines.

At the December 15-17, 1948 meeting of the Virginia State Horticultural Society, A.B.Groves chaired a panel of growers who discussed their experiences in making the transition from inorganic to organic pesticides [Va. Fruit 37(1):50-60. 1949]. The only organic fungicides discussed were iron carbamates and organic mercurials. The latter were very effective against scab in that they eradicated the scab fungus but because there was a zero residue tolerance for mercury, they could not be used after the first cover spray. The iron carbamates were only moderately effective against scab but highly effective against cedar rust. There were no other talks on diseases at this meeting.

The 1947 annual meeting of the American Phytopathological Society was held in Chicago December 28-30; three Virginians read five papers. The abstracts appeared in January 1948. Cook presented his method for forecasting late blight in eastern Virginia and results obtained in 1947. The forecast indicated spraying in 1947 was unnecessary; it proved to be correct. This saved potato and tomato growers about $2 million (Phytopathology 38:6). Groves discussed, "Apple rust controlled by airborne application of Fermate" (Ibid. p 11). A single application reduced infection from 18 lesions per leaf to one per leaf. In "Compatibility of organic fungicides with acaricides and DDT", Groves found that several useful fungicides seemed compatible with commercial acaricides and DDT (Ibid. p.11). Jenkins discussed, "Root-rot complexes of tobacco and small grains in Virginia" (Ibid. p.14-15). Damage to rootlets by nematodes caused stunting and malnutrition of small grains, even winter killing. In tobacco brown root rot resulted from nematode feeding. Jenkins also discussed, "Strains of flue-cured tobacco resistant to black shank (*Phytophthora parasitica* var. *nicotianae*) and tolerant to certain root-rot complexes" (Ibid. p.15). He crossed "Yellow Special" with North Carolina lines having 'Florida 301' resistance to black shank. The black shank-resistant parental lines survived about 80 percent. Hybrid lines survived 95-98 percent and combined black shank resistant with black and brown root rot resistance. L.I. Miller conducted experiments in greenhouses (at Minnesota) on, "Root nodulation of Holland Jumbo strain peanut grown from seed treated with a fungicide" (Ibid. p.18); the fungicide was Spergon and it had no measurable affect on nodulation.

In the annual report of the Chicago meeting, (Ibid. 316-325), Fenne was listed as a 1948 member of the Extension Committee, Cook as a member of the Public Relations Committee and of the subcommittee on Utilization of Plant Pathologists and Field Facilities in National Emergencies. This was a subcommittee of the Plant Disease Prevention Committee. Cook also was listed on the Subcommittee on Seed Treatments (of the Fungicides Committee).

Only one bulletin was published by the staff in 1948. Groves collaborated with F. H. Lewis (of Pa. Agri. Expt. Sta.) to publish, "Cherry Leaf Spot Control in the Cumberland - Shenandoah Valley" (Va. Agri. Expt. Sta. Bul. 415; Pa. Agri. Expt. Sta. Bul. 498). They described and illustrated the disease, caused by *Coccomyces hiemalis*, and its effect on trees and fruit. Sanitation (removal of fallen leaves) was shown to reduce disease severity but reliance on fungicides was essential for profitable production. Lime-sulfur and copper compounds were recommended. A product known as Compound 341 (later call glyodin) gave excellent leaf spot control but was not yet commercially available.

The Southern Division of the American Phytopathological Society met jointly with the

Potomac Division February 11-12, 1948 at Beltsville Maryland. Cook described "Control of sweet potato scurf by vine cuttings", (Phytopathology 38:568). Cook concluded that "Scurf infected sprouts were the most important source of scurf and that scurf-free potatoes may be obtained by planting vine cuttings.", Henderson and T. J. Smith discussed, "A crown rot of alfalfa caused by *Colletotrichum trifolii*" (Ibid. p. 570). Apparently, *C. trifolii* plays a major role in destroying stands of alfalfa during the summer. Henderson and Smith also discussed the, "Relative susceptibility of alfalfa varieties to certain foliage diseases" (Ibid. p.570). Among nine varieties, Williamsburg, Kansas Common, Buffalo, and A-27 were consistently most healthy both in midsummer and in early fall. Roane and C. F. Genter described their experiences with the appearance of "*Helminthosporium carborum* in Virginia" (Ibid. p. 572). The striking differences between resistant and susceptible lines was portrayed.

Since 1942, Jenkins had been writing and talking about root-rot complexes and the initial role of meadow nematodes in these complexes. In 1948, he published two papers on this subject. Jenkins summarized his observations in the papers, "A root disease complex of small grains in Virginia" (Phytopathology 38:519-527) and, "Root rot disease-complexes of tobacco in Virginia. I. Brown root rot" (Ibid. pp. 528-541). In both cereals and tobacco, it was no doubt that nematodes, especially meadow nematodes (*Pratylenchus* spp.) caused a predisposing root damage that was soon colonized by opportunistic soil organisms. Although Jenkins alerted pathologists to nematodes as an overlooked cause of root problems, his descriptions of symptoms and damage did nothing to clarify the nightmare entailed in diagnosing ectoparastic nematode damage. In his illustrations and descriptions of field symptoms on barley, barley yellow dwarf virus could very well have caused the yellowing and stunting with or without the nematodes. These two papers caused much controversy and confusion and helped precipitate more attention to the role of ectoparasitic nematodes in plant health.

There were several reports in the 1948 *Plant Disease Reporter* pertaining to disease situations in Virginia. Fenne summarized, "Tobacco diseases in Virginia - 1947" (Pl. Dis. Reptr. 32:16-18). Blue mold was a threat through the entire growing season but because Fermate was so widely used, little damage occurred. Black shank was found for the first time in Amelia, Brunswick and Dinwiddie Cos., bringing the number of infested counties to 11. In 1947, 18 black shank-resistant VESTA strains were released to growers for evaluation. They were found acceptable to growers having black shank but not to others. Most of the other common diseases were observed. In several cases, lighting injury was mistaken for black shank or Granville wilt. Fenne, Lefebvre (U.S.D.A.), Henderson, Tysdal (U.S.D.A.), and Smith (V.P.I. Agronomy) summarized the results of their November 1947 alfalfa and clover disease survey in eastern Virginia, (Ibid. pp. 63-64). Along with common diseases, bacterial wilt was found in Richmond Co., the first known occurrence in eastern Virginia.

Cook summarized, "1947 results of late blight forecasting in eastern Virginia" (Ibid. pp.54-56; also, Food Packer, December 1947). He claimed growers saved up to $2 million in Virginia by not spraying, a saving made possible by predicting that the weather was unfavorable for late blight.

Roane reported on "Varietal reaction of oats to powdery mildew in Virginia" (Ibid. p.391). This was Roane"s first publication in the *Plant Disease Reporter*. He found the range of reactions to be very narrow; only some winter varieties remained free of mildew. Fenne et al. reported on the late summer alfalfa and clover disease survey (Ibid. p.44). Stem nematode (*Ditylenchus* sp.) damage was found in Henrico Co., the first report of it in Virginia.

Nugent summarized, "Late blight in Virginia in 1948" (Pl. Dis. Reptr. Suppl. 178:213-214); apparently, Cook had taken a position in the Marketing Division of the U.S.D.A. Blight appeared in the lower Eastern Shore area in May and was estimated to cause only a 5 to 10 percent loss. After Cook moved to the U.S.D.A., he published an article, "Forecasting late blight for the Charleston, South Carolina area from Norfolk, Virginia" (Pl. Dis. Reptr. Suppl. 178:217-219). He had correctly predicted there would be no spread of late blight although blight was found in isolated patches early in the growing season.

The only new diseases reported from Virginia in 1948 were the stem nematode on alfalfa (Pl. Dis. Reptr. 32:445) and dogwood spot anthracnose (Ibid. pp.253-255), caused by *Elsinöe* sp.

In contrast to the 1946 annual meeting of the Virginia State Horticultural Society where four plant disease topics were discussed, there were no disease topic on the program for the December 1-3, 1947 meeting. Beginning with the April 1948 issue of *Virginia Fruit*, fruit diseases were a popular topic. A. H. Teske once again discussed "The peach brown rot situation" [Va. Fruit 36 (4):31-34]. Apparently heavy losses were sustained by Virginia peach growers in 1947. Teske seemed to be scaring growers into taking better care of their orchards. According to him, pruning cankers and destroying mummies is necessary if fungicides are to be effective.

Hurt followed with a general discussion of "Peach fungicides [Va. Fruit 36 (5):9-14]. In the brown rot section he emphasized ridding the orchard of inoculum sources. Hurt had stressed this practice for many years.

Both Groves and Hurt (above) addressed the Fruit Growers School at V.P.I. in January. Groves spoke on "Fungicides for apples", [Ibid.:14-18]. He divided his talk into three topics; types of materials available, seasonal requirements and varietal requirements. There was nothing new in his paper.

Fred Dreiling, Extension Horticulturist, spoke at the Institute of Rural Affairs, V.P.I. on "Horticultural practices and brown rot of peaches" [Va. Fruit 36(12):20-23]. He emphasized disking to bury or disrupt spore-forming structures on the ground, thinning fruit and coveringn the maturing fruit with sulphur. Thus, he emphasized coordination of horticultural and pathological practices. His talk was much like Teske"s earlier report on the brown rot situation, (Ibid. 36(4):31-34]. Both talks were based on Hurt"s research and reports.

There were several articles in the 1948 *Southern Planter* (vol. 109) on plant diseases. Jenkins discussed "Disease resistant tobacco varieties" and included an excellent history of black shank [Sou. Planter 109(1):16-17]. It had been discovered in Georgia in 1915, North Carolina in 1930, and Virginia in 1939. The Oxford lines 1, 2, 3, and 4 were flue-cured varieties bred in North Carolina that kept N.C. farmers in business. However, only Oxford 1 was of acceptable yield and quality when grown in Virginia. With this as a resistant parent, Jenkins had bred and released the VESTA lines of four types:

- Jamaica leaf type - VESTA 11, -26, -30, -33.
- Yellow Special type - VESTA 44, -52, -53.
- Yellow Mammoth type - VESTA 55, -64.
- Mammoth type - VESTA 46, -47, -62.

Jenkins had begun releasing these in 1946 and claimed they were 95 to 98 percent resistant to black shank and as good as 'Yellow Special" for root rot resistance and they yielded well.

Later, Jenkins discussed, "Plastic glazing for farm plant beds" [Ibid. 109(2):17]. He claimed glazing offered several advantages over cloth, namely, heat retention, high quality light transmission, protection from insects, and plant disease control. In tests, insect and blue mold control was absolute and seedlings were more robust than under cloth. On the negative side, glazing had to be mounted on sashes, and plants had to be watered.

Fenne published three articles, "Start planning early to control blue mold" [Ibid. 109 (3):10-11], "Three serious diseases of tobacco "[Ibid. 109(5):47-48], and "How to control tobacco diseases" [Ibid. 109(6):18-19], in which he reviewed the contents of some Extension Service bulletins. In the first article, he emphasized the need to produce healthy seedlings at home, rather than risk importing plants and their diseases. Thus, there is a need to control blue mold. In the second, Fenne described and compared black shank, sore shin, and Granville wilt. These are described as soil-borne diseases and each damages the stem. For control (a) prevent their introducion or (b) on infested soils, grow resistant varieties. In the third article, emphasis was on root knot, meadow nematodes and black root rot. Growing resistant varieties is the best way to control these diseases but certain rotations and soil amendments enhance growth in the presence of the pathogens.

Gene Smith Moody, Assistant Agricultural Editor, interviewed R.C. Moore, Assistant Horticulturist, V.P.I., and wrote that "Chestnuts resist blight disease" [Ibid. 109(4):16]. She reviewed the history of breeding for blight resistance in chestnut. Hybrids (F_1) between American and Chinese species produced by the U.S.D.A. were planted in Floyd Co. near the Rocky Knob camp ground. Plants which survived blight were selected for nut quality but not for tree type. (Some of the original trees still survive in 1997).

During May, Henderson served as Chairman of the Agricultural Section of the Virginia Academy of Science and Cook was Vice-chairman. Henderson discussed, "Studies on damping-off of alfalfa" (Proc. Va. Acad. Sci. p. 70. 1948). *Rhizoctonia* sp. was the primary cause of damping-off; 41 percent of seedlings of the variety 'Williamsburg' survived in infested soils, much more than any other variety tested, once again proving its adaptability to Virginia conditions.

In 1949, the Section of Plant Pathology and Botany was separated from the Department of Biology and the Department of Plant Pathology and Physiology was established. The events leading up to this reincarnation will be discussed later. The separation occurred about September 7, and the Wingard Era III was under way. Events that occurred in 1949 will therefore be described in both the Wingard Era II and the Wingard Era III.

Lawrence Miller returned to peanut research at Holland after completing residence requirements for the Ph.D. degree at the University of Minnesota. He had been promoted to Associate Professor. John L. LaPrade was named Associate Professor to manage tobacco seed production at the Tobacco Disease Research Station in Chatham. This station had been newly established in 1949 in order to produce seed of black shank-resistant varieties and to test germplasm for black shank resistance. Jenkins was promoted to Professor of Plant Pathology and was placed in charge of the station. LaPrade"s arrival gave Jenkins relief from plot management, hybridization, seed harvest, storage, and progeny tests.

T. M. Starling returned from Iowa State College to resume his position as small grains breeder in the Department of Agronomy. Roane and Starling would work together for 38 years to produce disease-resistant varieties of wheat, oats, and barley.

John Amos was hired as Extension Specialist to work half-time on weed control and half-time on insect problems. This relieved Fenne from the weed work and allowed him to devote full-time to extension plant disease work.

Only Miller presented a paper at the 40th meeting of the American Phytopathological Society held in Pittsburgh December 6-8, 1948. He described, "Cultural and parasitic races of *Cercospora arachidicola* and *Cercospora personata*" (Phytopathology 39:15). No doubt, the data were obtained while he was completing his residence requirements for the Ph.D. degree at the University of Minnesota. At the same meeting the list of committees showed Fenne to be continued as a member of the Extension Committee. No other Virginian"s participated actively in the meeting and no research papers were published in *Phytopathology* by Virginia"s plant pathologists.

Only two major publications were issued by Virginians in 1948. Although Cook had left the Truck Station in 1948, he published a paper, "Forecasting late blight epiphytoties of potatoes and tomatoes", based on work done at the Truck Station (J. Agr. Res. 78:545-563). Cook established a critical cumulative rainfall line. If the rainfall rose above the critical line and average of minimum and maximum temperature fell below 75° F, late blight could become epiphytotic if the conditions met these criteria for 7 days. The procedure proved accurate for Tidewater, Virginia and Charleston, S.C.

In 1948, Henderson released, "Vamorr 48 and 50, Two New Flue-Cured Tobacco Varieties Resist Mosaic and Rootrot", (Va. Agri. Expt. Sta. Bul. 427.10 pp). In the bulletin, he gave descriptions of mosaic and rootrot, described the performance of the new varieties in comparison with popular commercial varieties. He gave no yield data and did not give the pedigrees of the varieties.

Donald P. Limber, U.S.D.A. Pathologist reported on collecting *Curuvlaria* sp. from gladiolus corms grown near Norfolk. He offered an explanation as to how this fungus was brought in from Florida (Pl. Dis. Reptr. 33:66-68). Fenne reported on, "Tobacco diseases in Virginia, 1948" (Ibid. pp. 75-76). The usual diseases were encountered. Black shank appeared for the first time in Sussex and Greensville Cos. Hollow stalk (*Bacillus carotovorus*) occurred on tobacco where growers topped and suckered during wet or humid weather. Fenne also reported that only common diseases of small grains occurred in 1948 and crops were of high quality and yield (Ibid. p. 80).

In a report on, "Alfalfa and soybean diseases in Virginia, 1948", Fenne stated that stem rot was the most damaging disease of alfalfa (Ibid. pp. 90-91). Stem nematode damage was found in Henrico Co. In soybean seed treatment tests with Arasan, stands were improved only on lower quality seed. R.A. Jehle and Anna E. Jenkins made a roadside survey in 1949 for dogwood spot anthracnose in four states. (Ibid. pp. 198- 201). In Virginia, they surveyed only on Eastern Shore and found it in three locations of Accomac Co. It had been found only in Princess Anne Co. before. In the March 1949, Fenne et al. made another "Alfalfa-clover disease survey in Virginia" (Ibid. pp. 255-257). Several varieties of alfalfa had been planted on *Ditylenchus*-infested land in Henrico Co. Surprisingly, 'Nemastan" which had been bred for stem nematode resistance, was nearly completely destroyed. There were some resistant selections but stands of all commercial varieties were very poor. Bacterial wilt was found in James City Co. for the first time. Roane reported on results from inoculating barley varieties with *Ustilago nuda* spores (Ibid. pp. 344- 345). Five entries (CC X Sel 43, Hooded 5, Huga, Texan, and Trebi) of the 36 inoculated in 1948 showed no smut in 1949. Nugent reported that, "Web blight of snap beans in Eastern Virginia" destroyed the majority of plants in a five acre field at Toano (James City Co. in August 1949 (Ibid. p.402). This was a new disease for Virginia. Fenne reported heavy damage to tobacco and peanuts from stem rot, *Sclerotium rolfsii* (Ibid. p. 403) in Sussex, Greensville, and Brunswick Cos. Paul Miller and Muriel O"Brian reported severe damage from blue mold in Virginia in 1949 (Ibid. p. 418). Roane described "The occurrence of diseases of small grains in Virginia in 1949", (Ibid. pp. 480-482). Although no new diseases were reported, a curious situation occurred in barley fields on the Curls Neck Farm in Henrico Co. The farmer had planted 250 acres of Wong in September, 1948; the plants in this field were very healthy. In December, he planted a 400-acre field from the same seed lot; this field was completely destroyed by stripe (*Helminthosporium gramineum*). This was the most spectacular damage to barley by stripe ever recorded in Virginia.

At the Virginia Academy of Science meeting in May, Nugent discussed, "The control of scurf of sweet potatoes" (Proc. Va. Acad. Sci. 1949:76). He reported cuttings produced less scurf (3.7) than sprouts (54 on a scale of 0 to 100); clean roots produced roots that scored (16), scurfy roots (39); roots in sand (25) vs roots in soil (31) and roots dipped in $HgCl_2$ + S produced (19), $HgCl_2$ (30), and no treatment (35). Thus, cleanest crops should be grown from cuttings produced from clean treated roots sprouted in sand.

A. H. Teske, V.P.I. Extension Horticulturist described "The Virginia apple spray program for 1949" [Va. Fruit 37 (2):26-30]. This was the time when DDT was used extensively in orchards and sulfurs and Fermate were the primary fungicides. Hurt contributed an article, "Apple scab and its control" [Va. Fruit 37(3):30-32]. He gave a nice description of the disease cycle and the materials for scab control. Liquid lime-sulphur, wettable sulphurs and organic mercury compounds were discussed. He emphasized that mercurial residues on fruit were not tolerated and that workmen using mercury materials should clean up well before handling food or eating. Hurt also wrote about the "Number one peach disease in Virginia" [Va. Fruit 37 (4):27-29]. Brown rot received the honors but leaf curl, scab and bacterial shot-hole were also discussed. No organic products were recommended, only various sulphurs were discussed.

Groves contributed an article, the "Number one disease problems in apple orchards"

[Va. Fruit 37 (4):24-27]. He report apple scab as the No. 1 disease and that cedar rust was No. 2. He described spray programs for controlling them but made the point that DDT had modified apple insect control especially late in the season. In the past, insects controlled the spray schedule; with DDT fewer insect controlling sprays were needed and hence the number of times fungicides were applied was also reduced. As a consequence, black rot, bitter rot, sooty blotch and fruit spot were increasing.

Two horticulturists got into plant pathology; Frank Horsfall, Jr., described, "Peach leaf curl in 1949" [Va. Fruit 37 (6):20-22]. A. H. Teske wrote about, "The peach brown rot situation" Ibid.:16-18]. Both of these articles were interesting accounts but neither offered new information.

William M. Watson was in charge of barberry eradication work in Virginia and West Virginia; his office was in Bluefield, V. Va. He gave a good account of the work in, "Barberry eradication controls rust" [Sou. Planter 110 (4):26-27, 1948]. He gave a life/disease cycle in the text accompanied by an explicit diagram. *Berberis canadensis* (known as Alleghany or native barberry) occurs in Southwest Virginia and *B. vulgaris* (known as bush or common barberry) grows in northwestern counties, especially the Shenandoah Valley. Where eradication had taken place, an eight-bushel gain had been achieved without changing varieties. He described the progress made since 1934 and the need to re-work cleared areas. With the advent of 2,4-D and 2,4,5-T, Watson thought farmers could easily help their own cause.

About September 10, the Department of Plant Pathology and Physiology was established. The teaching program facilitated it. The events leading up to our separation from the Biology Department were reviewed earlier, but for emphasis, they are repeated here. In 1948, Mullin who had held the teaching position, resigned to return to the Truck Station. In the academic year 1948-9, A. B. Massey was resurrected from the Wildlife Unit to replace Mullin. Massey had held the position after Vaughan left in 1944, so he knew what to do. I. D. Wilson, Head of the Biology Department sought help from E. C. Stakman (he had trained Harrar, Vaughan, and Mullin) for a replacement. Huey I. Borders, Pathologist at the Homestead, Florida Station agreed to take the job. Two weeks before the fall quarter was to begin, Borders came to Blacksburg to find housing. He had waited too long; nothing satisfactory to him was available. In essence he said, "The heck with it", and went back to Homestead. With classes bearing down on him, Wilson suggested to President Walter S. Newman that the people in the Section of Plant Pathology and Botany should assume responsibility for pathology and physiology courses. Newman agreed. He approached Wingard who accepted, provided the Section became a department again. Again Newman agreed. So, about September 10, with classes scheduled to start about September 20, the Department was established. Shear, Henderson and Roane were designated to assume the teaching responsibilities. In the fall quarter, Shear would give lectures in Plant Physiology and Roane would instruct the laboratory. In the winter and spring, Roane would teach Plant Pathology and in the spring Henderson would teach Forest Pathology. Our qualifications and facilities will be discussed in the Wingard Era, III.

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A History of Plant Pathology in Virginia: The Wingard Era - III (1949-1964)

The Department of Plant Pathology and Physiology came into being about September 10, 1949, at the same time it also became a part of the College of Agriculture. Events leading to its creation were described at the end of the Wingard Era II. During the period 1935 - 1949, no one in the newly created department had held any teaching assignments. From 1949 on, instruction in plant pathology and plant physiology was an obligation of the Department. Since there had been no graduate program in botanical sciences from 1944 to 1949, the Department's immediate concern was to organize an undergraduate course in plant physiology; Plant Physiology 301 was to begin about September 25. G. M. Shear was to give the lectures and C. W. Roane was to be the laboratory instructor. Although Shear was a well educated plant physiologist, Roane's qualifications were somewhat questionable. He had taken one quarter of plant physiology (essentially the same course he was to help teach) taught by a plant pathologist, J. G. Harrar. To further complicate the matter, there was no laboratory manual available; therefore, some sort of instructions had to be prepared for handing out. Shear chose the textbook "Plant Physiology" by Meyer and Anderson, and fortunately, there was a companion laboratory manual by the same authors. Unfortunately, it was out of print. Fortunately, Shear had one copy. Roane and Shear decided to abstract several exercises each week, mimeograph them, and thus prepare hand-outs. They selected the exercises that illustrated the principles elucidated in the preceding lectures. They required the students to record the objectives, observations, and conclusions or inferences for each exercise and to hand them in within one week for grading. This caused much grumbling among the students who were mostly Aggies. The heaviest burden actually fell on Roane who had to read and grade up to five exercises from 60 students each week.

In order to present the laboratory, equipment and laboratory space had to be borrowed from the Biology Department. Fortunately, I. D. Wilson, Head of the Biology Department remained cooperative and the new department persevered through the first quarter. The experience provided numerous lessons in how to and how not to teach. An extensive wish list of equipment and space needs was generated. Roane found the quarter to be very difficult as the teaching was an add-on. He had to work with the corn breeder during the fall to score plants for stalk rot reaction, had to prepare lectures in plant pathology to be presented in the winter quarter, and was trying to generate a suitable dissertation and show some leadership in the relatively new Experiment Station grain pathology projects. So much for the most pressing fall quarter needs; our personnel and missions for 1950 and beyond should be outlined.

The new department was staffed by five professors, S. A. Wingard, Head, S. B. Fenne, R. G. Henderson and A. B. Groves, plant pathologists and G. M. Shear, plant physiologist; five associate professors of plant pathology, R. H. Hurt, W. A. Jenkins,

J. L. LaPrade, L. I. Miller, and C. W. Roane; and one assistant professor, Luben Spasoff. Groves was stationed at Winchester, Hurt at Charlottesville, Jenkins and LaPrade at Chatham, and Miller at Holland in Nansemond Co., now Suffolk. Spasoff had been transferred from Chatham to Blacksburg in April 1949. Among the assistant and associate professors, only Jenkins had earned the Ph.D. degree; all others had earned M.S. degrees. However, Miller and Roane had completed residence requirements toward the Ph.D. By the time Wingard retired in 1964, the staff would have grown to 28 faculty, and the coverage of plant diseases would have extended into nematology, ornamentals, pasture crops, lawn and turf grasses. Plant physiology would have grown into weed control research. Extension man-years would also increase. Much of the growth of the Department can be determined from examining the document for the "Comprehensive Review of the Department, September 30 to October 4, 1963" and from the Agricultural Research Reports of the Virginia Agricultural Experiment Station published between 1950 and 1959 (5 reports). The history of plant pathology in Virginia gradually becomes more difficult to relate from 1950 onward because the number of people, programs, publications, students, and disciplines gradually increased. It will be earier to assemble the facts and present them chronologically, but a second crop-by-crop, discipline-by-discipline, person-by-person might lead to a more comprehendible text. On the other hand, by reporting chronologically, the author feels that he is less apt to omit pertinent facts; therefore, Era III will be covered year-by-year.

The most obvious event in 1950 was the teaching of Plant Pathology 311 and 321 in the winter (II) and spring (III) quarters by Roane and the teaching of Forest Pathology in spring by Henderson. In Roane's case, he had as a graduate student in 1943-44, helped A. B. Massey teach Plant Pathology but had never been wholly responsible for a course. However, it helped that he was to teach the course he had taken in 1942. Choosing a textbook was more difficult. Three were available; one by Melhus & Kent, one by Heald, and one by Chester. Chester's book "Nature and Prevention of Plant Diseases", 2nd ed., 1947 was the most modern and had the most pertinent information, but since the winter quarter syllabus stated that principles, generalities, structure and classification of pathogens, symptoms, and disease control measures would be discussed, after the first two chapters were covered, one would skip to chapters 15 through 20. Chapters 3 through 14 would be covered in the spring quarter. Students were accustomed to proceeding chapterwise through the text. Although Roane had to adapt the book to the course and not the course to the book, the winter quarter proceeded smoothly.

The spring quarter was more difficult. Plant Pathology 321 carried 4 credits, 3 lectures and one 3-hour laboratory. This tied Roane to Blacksburg and made trips to field stations where small grains had to be scored for disease reactions very difficult. Fortunately, in the early years of the breeding program, most of the work was at Blacksburg. Among students in the first class of Plant Pathology was W. W. Osborne who would later join the faculty as Extension Plant Pathologist.

Henderson had a difficult time, also. Forest Pathology 302 carried 3 credits; 2 lectures and one 3-hour laboratory. Henderson had field work to do in the spring quarter at Chatham, Charlotte Court House, and Glade Spring. He also had a number of farmer-cooperators in Lee and Prince Edward Cos. Having never taught before, and not having been trained in forest pathology, he had to develop laboratories and field trips of interest and satisfactory quality. He quickly made friends with the

U.S.D.A. white pine blister rust agent Henry E. Yost of Harrisonburg, the State Forester at Charlottesville, and George Hepting of the U.S.D.A. Forest Disease Laboratory at Asheville, N.C. These people gave Henderson considerable competent help and enabled him to present a very fine course from the outset.

When we began teaching the laboratory portion of our courses, Plant Physiology was taught in room 301 Price Hall which was divided half into tables and half into chairs. This room is now subdivided into office space. Later, we were allotted room 401 for teaching Plant Pathology and Forest Pathology. The Biology Department had stripped it. We inherited 4 walls and an undulating floor. The floor was leveled and we acquired 4 tables that looked like discarded conference tables. We placed the tables near the south windows and armchairs in the remainder. We had to wire the tables to install light sources for illuminating microscopes. We placed pull- chain sockets on the tables and inserted bulbs and turned on the power. Sparks flew and fuses blew. We had to insulate the chains and wiring before students could cause mayhem or get shocking results.

According to the 1950 college catalogue the following courses were scheduled for 1949-50:

- 301 - Plant Physiology - I, 2H, 3L, 3C.
- 302 - Forest Pathology - III, 2H, 3L, 3C.
- 311, 321 - Plant Pathology - II, 3H, 3C; III 3H, 3L, 4C.
- 401 - Applied Mycology - III, 2H, 3L, 3C.
- 501 - Diseases of Agronomic Crops - II, 2H, 3L, 3C.
- 502 - Diseases of Horticultural Crops - II, 2A, 3L, 3C.
- 505 - Research and Thesis, Plant Pathology or Plant Physiology - Hours and Credits arr.

The last four items were residual courses from Harrar's days. They would not be offered again for a few years.

As to non-instructional activities, the Virginia State Society of Horticulture held its annual meeting in December 1949; the proceedings were published in January 1950. In a panel discussion entitled, "Insect and disease situation and compatibility of spray materials", Dr. J. M. Goldsworthy of the U.S.D.A. at Beltsville, Md., discussed, "A new approach to the control of apple scab. Elgetol (=dinitro ortho cresol) was used as a ground spray and Puratized Agricultural Spray (phenyl mercury triethanol ammonium lactate) as a foliage spray; in combination the two reduced the number of leaf lesions but not sufficiently for commercial use [Va. Fruit 38 (1):141- 147].

"The effects of timely blossom sprays on the control of brown rot of peaches" was also discussed by Goldsworthy. As a result of surveys in 1947, 1948, and 1950, it was shown that wettable sulfur applied beginning with blossoming gave best results [Va. Fruit 38 (1):147-151]. Groves discussed "Compatibility of Spray Materials". Compatibilities are physical, chemical, and biological. In chemical compatibility, there is no reaction between materials; in physical, there is no mixing effect that would be deleterious to the solution or suspension; in biological, there would be no impairment of arachicidal, fungicidal or insecticidal effectiveness. Groves reviewed the results of compatibility tests among benzene hexachloride, Bordeaux mixture, DDT, DDD, dinitro materials, Ferbam HETP, TEPP, lead arsenate lime lime-sulfur, mercurial products, oil, parathion, sulfur, and zinc sulfate-lime, [Va. Fruit 38 (1):151-157].

Compatibility charts would be featured on the cover of the annual spray bulletin (Ext. Bul. 131) for many years.

In a later issue of *Virginia Fruit*, efforts to obtain a new building for the Piedmont Fruit Research Laboratory were described. The new building south of Charlottesville and the old building it replaced were pictured [Va. Fruit (6):4, 6, 8].

The 41st meeting of the American Phytopathological Society was held in New York December 28-30, 1949. The abstracts were published in January 1950. Only Henderson and Roane attended from Virginia. Henderson described, "Flue-cured tobacco resistant to mosaic and root rot" (Phytopathology 40:11-12). Vamorr (Virginia Mosaic Root Rot) 48 and 50 were described. Holmes' *Nicotiana glutinosa* was the source of mosaic resistance and 'Yellow Special' was the source of root rot resistance. Henderson claimed Vamorr 48 and Vamorr 50 had greater root rot resistance than the Yellow Special parent. From Virginia, only Fenne was appointed to a Society committee (Extension) for 1950. Jenkins was elected President of the Southern Division of the Society after serving as Vice-President at the Biloxi meeting in February. He also presented a paper, "Some aspects of breeding tobacco for disease resistance", in which he expressed the opinion that resistance to most diseases improved as the vegetative cycle was lengthened (Ibid. 40:789).

At the Potomac Division meetings, Nugent of the Truck Station described, "The relative importance of the various control measures for sweet potato scurf" (Ibid. 40:873). Of all the treatments and planting media tested, using cuttings was the most effective control measure. No research bulletins were issued by the Department in 1950; however, Roane was an author with Edward Shulkcum and five other agronomists of, "The 1949 Official Virginia Varietal Tests of Corn Hybrids, Barley, Oats, Wheat, Soybeans, Peanuts, and Tobacco" (Va. Agri. Expt. Sta. Bul. 432, 1950). Roane scored all the small grain nurseries for disease reactions and helped describe the various entries in the nurseries. Except for lodging and breaking of corn, diseases were not considered in data on other crops.

Only Groves published journal article in 1950 (J. S. Cooley and A. B. Groves. Root and collar winter injury of apple trees. Phytopathology 40:355-362). Cooley and Groves concluded that most of the injuries observed were caused by a sequence of weather conditions which they suggested be called "physicochemical injury."

Groves published a review of the use of, "Sulfur fungicides in fruit production" (Soil Sci. 70:67-72). This was a contribution to a symposium on the use of sulfur in agriculture sponsored by the Soil Science Society of America.

The *Plant Disease Reporter* vol. 34, 1950, contained several articles on Virginia plant pathology. Jenkins described nematode injury to tobacco seedlings attributed to *Panagrolaimus* sp. and *Chiloplacus* sp. (P.D.R. 34:177-178). No doubt dead tissue had been inhabited by these saprophytes; the true cause of the seedling damage was not disclosed. Fenne, Henderson, and others reported on their spring alfalfa-clover disease survey (Ibid. 34:204-205). No new diseases were reported. Bacterial wilt apparently damaged fields of alfalfa in Roanoke, Botetourt, and Rockbridge Cos. Fenne and Extension Agronomist W. C. White discussed the significance of seed treatment of soybeans of various quality. Although treatment with Arasan produced a 5% increase in germination, laboratory tests did not yield results that would warrant seed treatment as a requirement for certification. G. H. Hepting, Forest Pathology, U.S.D.A., reported severe damage to dogwoods caused by *Ascochyta cornicola* along the Blue Ridge Parkway south of Roanoke (Ibid. 34:227). Fenne and J. O. Rowell, Extension Entomologist, reported extensive yellowing of alfalfa caused by the three-cornered alfalfa hopper (Ibid. 34:344). Fenne reported numerous occurrences of tomato internal browning, cause not given (Ibid. 34:352). Roane summarized the corn disease situation for 1947-1950 (Ibid. 34:394-396). Stalk rot, ear rot and leaf blight were the most destructive diseases. Northern leaf blight was the most destructive leaf fungus but in 1950, southern leaf blight which usually was severe only in the southeast quarter spread over the entire state. *Gibberella fujikuroi* caused most of the stalk rot and breakage in eastern Virginia. Damage was so severe that stalks in the peanut area would not pass through a corn harvester. Most of the ears fell to the ground. Gray leaf spot, caused by *Cercospora zeae-maydis*, was found at Blacksburg in 1949, the first time in Virginia. In 1950 it was very destructive to hybrid varieties in yield trials; no resistance was observed. It was also found in Roanoke and Tazwell Cos. In commercial fields, gray leaf spot was more of a novelty than a menace. The introduction of no-till corn farming in the 1970's would change that.

In 1950, the Virginia Academy of Science began publishing the *Virginia Journal of Science* and used it to publish the abstracts of papers presented at the annual Academy meetings. In the Agricultural Section over which Fenne presided, five papers were presented on plant disease topics. Wingard and Henderson described, "New fungicides for tomato late blight control" (Va. J. Sci. 1:331). Zineb was superior to tribasic copper sulphate and copper dust; all were superior to no fungicide. Mullin of the Truck Station described, "Results of some of the newer fungicides in controlling mildew of fall snap beans" (Ibid. 1:331). He tested a number dithiocarbamate derivatives, tribasic copper sulphate, and sulfur. Only S controlled powdery mildew and produced marketable beans. F. S. Andrews, V.P.I. Horticulturist reported on "Resistance of lima beans to nematodes at Walkerton, Va., 1949" (Ibid. 1:332). 'Henderson' was the most susceptible; nine selections were more resistant. Henderson described his work with the, "Stem nematode, the cause of a new alfalfa disease in Virginia" (Ibid. 1:332). Two lines obtained from O. F. Smith, U.S.D.A., Nevada, were resistant to *Ditylenchus dipsaci* on the W. J. Burlee farm in Henrico Co.; 18 other lines and varieties were susceptible. Miller described, "The effect of nematicide and fungicide soil treatments on root knot, pod rot, nodulation, and yield of peanuts" (Ibid. 1:334). Several compounds reduced the incidence of root knot but no useful data were obtained on pod rot.

In 1950, the Virginia Academy of Science published a book, "The James River Basis: Past, Present and Future". Wingard contributed a chapter, "Plant pathology: A major factor in Agriculture" (pp. 91-106). This article must have been written in late 1942 because there are no references to accomplishments after 1942. I suspect the book was scheduled to be published in 1943 or 1944 but the war may have caused it to be deferred. Wingard wrote a very eloquent, concise essay on the history plant pathology in Virginia up to 1942. This publication has not been seen by many plant pathologists nor has his 1951 essay that appeared in the obscure *Plant Disease Reporter Supplement* 200 of 1951.

The Agricultural Experiment Station issued a report for the year July 1, 1949 - June 30, 1950. All plant pathologists contributed items. Red leaf appeared for the first time in oats. Later it would be found to be caused by the barley yellow dwarf virus.

Combinations of copper sulfate and sulfur were found to be better dusts for peanut leaf spot control than was sulfur alone. Other plant disease reports have been discussed previously. The burley tobacco variety 'B-29' having mosaic and root rot resistance was released.

Only Fenne contributed an article to 1950 *Southern Planter*. He discussed control of blue mold of tobacco [Sou. Planter 111(2):14, 56] and emphasized the use of narrow seed beds, Fermate sprays or dusts, and prevention of the appearance of blue mold.

The former head of the Department, 1908-1915, H. S. Reed died May 12, 1950, in Berkeley, California. He was the first person at V.P.I. to be called "Plant Patholgist". In the fall, John I. Shafer, Jr., was hired as Associate Professor of Plant Physiology. He was to teach the Plant Physiology Laboratory in the fall quarter and to take over the entire course in 1951. He was also to conduct plant physiology research. His appointment relieved Roane of responsibility for Plant Physiology Laboratory, and placed the responsibility in the hands of a competent physiologist.

In Fenne's 1950 annual report, late blight was considered the most damaging vegetable disease. Tomato growers who protected their crops with fungicides were well rewarded. About 80% of the tobacco seed beds were dusted or sprayed to prevent blue mold. In soybean seed treatment demonstrations, spectacularly improved stands resulted from treating seed of poor quality but little gain resulted from treating high quality seeds. Fenne was a consultant to fungicide dealers and was able to convince formulators to prepare a copper-rotenone dust for gardeners. In 1950, it was the most popular dust sold to gardeners.

In 1950, the new Department taught Plant Pathology and Forest Pathology for the first time and a new position in plant physiology was created. A new greenhouse facility was occupied; the Department had sufficient space to carry out plant disease research for the first time.

In 1951, John Shafer's father died so John resigned to manage the family lumber business at Logansport, Indiana. Maynard G. Hale, having just earned the Ph.D. degree at Ohio State University, was hired on September 1 as Associate Professor to teach Plant Physiology and to expand the offerings in that field. His wife Polly was hired as a technician to work with Henderson and Roane. William E. Chappell was hired as Professor of Plant Physiology to develop a program in brush control and herbicide research.

The course offerings were continued as in the 1949-50 academic year but it was apparent that there would be changes soon. Other departments had a growing number of graduate students who would be well served by the addition of advanced courses. There was a corresponding need to reinstate the Masters degree in plant pathology and physiology. Hale would spearhead this project. J. C. Walker of the University of Wisconsin had published a new plant pathology textbook in 1950. The order of chapters was more logical than that of Chester's book so Roane opted to use it as the textbook from winter of 1951 onward.

The Virginia State Horticultural Society held its 55th annual meeting January 15-17, 1951. No V.P.I. pathologists were on the program. However, Groves participated in some of the discussions and provided technical clarification about some diseases. Dr. A. B. Burrell of Cornell University spoke on, "How we fight apple scab in New York"

[Va. Fruit 39 (2):29-39]. He gave some interesting information about the incubation period and temperature; 61-75o F was optimum. Dr. J. C. Dunegan, U.S.D.A., Beltsville, Md., contributed an article "Control of scrab fungus on the Delicious Apple" [Ibid 39 (8):10-14]; note the misspelling of "scab". He discussed the failure of mercury sprays to eradicate sepal infections (A blessing; Hg would have created residue problems), and presented an early season program that included dinitro, sulfur, and fermate. Neither the *Southern Planter* nor *Virginia Fruit* published fruit spray schedules in 1951.

Surprisingly, only Fenne published a research paper in *Phytopathology* in 1951 (W. C. Price & S. B. Fenne. Tomato rosette, a severe disease caused by a strain of tobacco mosaic virus. Phytopathology 41:1091-1098). Tomato rosette was observed in the Roanoke area in 1949 and 1950 and the Norfolk area in 1950. Rosetted plants resembled those injured by 2,4-D. They were severely stunted, had distorted foliage and failed to fruit.

The American Phytopathological Society met at Memphis December 1-3, 1950; abstracts appeared in January 1951. No Virginia workers presented papers. Fenne was reappointed to the Extension Committee for 1951 (Phytopathology 41:382). Groves presented evidence at the Potomac Division meeting that orchards of 'Rome' apples which had received applications of naphthalene acetic acid in 1949, had a high incidence of black rot in 1950 (Ibid. 41:561). Partially developed fruit which normally would have fallen remained attached and became infected with *Physalospora obtusa* which spread to other fruit and foliage.

Groves reviewed the status of, "Black Root Rot of Apple" Va. Agri. Expt. Sta. Tech Bul. 118) and reported that no control measures had been discovered. Although the disease may be locally serious, it is not a major cause of tree losses in Virginia orchards. Replanting after a tree had died from black root rot was deemed futile.

Wingard reviewed, "The role of plant pathology in Virginia agriculture" (Pl. Dis. Reptr. Supp. 200:36-41). This publication has been a valuable resource for preparing a history of plant pathology in Virginia. In smooth prose so typical of Wingard's writing, it provided a good review of the accomplishments of Virginia's plant pathologists up through 1950. No references were included but it filled the gap from 1942 to 1950 that had been omitted from Wingard's chapter in *The James River Basin* book of 1950.

There were a number of brief articles pertaining to Virginia plant diseases in *The Plant Disease Reporter* for 1951. Nugent, Fenne, and W. C. White, V.P.I. Extension Agronomist found that Arasan seed treatment significantly increased stands of soybean but gave only a minor increase in yield (Pl. Reptr. 35:82-83). Wingard and R. D. Sears, Agronomist at Charlotte Court House, reported an occurrence of fusarium wilt of sesame in a variety test (Ibid. 173). Reference was made to the occurrence of internal cork of sweet potato in Virginia; it was first reported by C. J. Nusbaum (Ibid. 227) of South Carolina (S.C. Agri. Expt. Sta. Bul. 381. 1950). G. H. Hepting reported a first occurrence of stem rust (*Peridermium* sp.) on Virginia pine in four western Virginia counties (Pl. Dis. Reptr. 35:335). Roane cooperated with R. J. Leukel, U.S.D.A., Beltsville, on seed treatment tests with oats (Ibid. 445-451). Oak wilt was reported from Augusta Co. in Virginia Extension Circular 621 (1954).

At the spring meeting of the Virginia Academy of Science, Nugent was secretary of the Agricultural Section. Miller spoke on, "The effect of ethylene dibromide soil treatment on root- knot control, nodulation, and yield of peanut". Treatment controlled root knot, increased nodulation, and gave significant increases in root weight, hay and nut yields (Va. J. Sci. 2:109- 112). Hurt spoke on, "Organic mercury as fungicides" (Ibid. 299-300). They acted as eradicants for apple scab.

Fenne published the first edition of, "Diseases of Forage Crops" (Va. Agri. Ext. Bul. 188). He covered diseases of alfalfa, clover, soybean, and lespedeza. Grasses were ignored. Only black and white illustrations were used. Only Fenne had an article in the 1951 *Southern Planter*. He promoted, "Better control for blue mold" [Sou. Planter 112 (3):26-27]. Dusts and sprays of ferbam and zineb were recommended for prevention and paradichlorobenzene fumigation for prevention and eradication. Copper materials were no longer recommended.

The American Tobacco Company began the publication of full-page advertisements on tobacco culture. The first, "Research makes it possible to produce finer tobacco" [Ibid. 112 (10):11], emphasized efforts by experiment stations to breed black-shank resistant varieties. In the second, "Granville wilt controlled through research discoveries" [Ibid. 112 (11):2], the efforts by U.S.D.A., North Carolina and Virginia workers in breeding Oxford 26 flue-cured tobacco and subsequent efforts to combine Granville wilt and black-shank resistance were described. In the third [Ibid. 112 (12):3]. Sand drown (= magnesium deficiency) and the effects of excessive chlorine were described. These advertisements were continued through 1952.

There were no personnel changes in 1952 nor were there any changes in course listings for the Department. In referring to the grade sheets for Plant Pathology, W. M. Powell was listed; Powell became an outstanding tobacco pathologist at North Caroline State University. Groves spoke at the annual meeting of the Virginia State Horticultural Society in January 1952 on, "Fruit disease problems in 1951" [Va. Fruit 40 (2):127-130]. He pointed out that the importance of reviewing the situation in the previous year lies in its application to the present year. The weather was unfavorable for most disease development; consequently, there may be less inoculum in orchards in 1952. There yet may be enough to cause serious damage if orchards are not protected. There are no changes in the spray recommendations for 1952.

At the 1952 Southern Division of the American Phytopathological Society (A.P.S.) meetings, Atlanta, Ga., Feb. 4-6, Jenkins in two papers reported the occurrence of a lethal virus and attempted to explain some erratic behavior flue-cured varieties resistant to Granville wilt and black shank (Phytopathology 42:284).

Miller spoke at the annual meeting of the A.P.S. held at Cornell University, September 8-10. In his paper, "Control of the sting nematode on peanuts in Virginia" (Phytopathology 42:470), he reported that the sting nematode (*Belonolaimus gracilis*) had been first found in Virginia 1949. Fumigation of infested soils with ethylene dibromide two weeks prior to planting was found to result in profitable yields of hay and nuts. Tolerance to injury associated with sting nematodes was found in several bunch, runner, and Spanish type peanuts.

Roane read two papers at the same A.P.S. meeting. The subjects, "Nuclear cytology and morphologic variation in *Helminthosporium carbonum* Ullstrup", and "A method of preparing fungi for cytological studies", were based on a portion of a dissertation being prepared for the University of Minnesota (Phytopathology 42: 480). From observations of nuclear phenomena in this fungus, it was concluded that the fungus could propagate a heterokaryon indefinitely. Fenne was reappointed to serve on the Extension Committee of A.P.S. for 1952; he was the only V.P.I. person on an A.P.S. committee (Ibid. 42:224).

At the annual meeting of the Virginia Academy of Science, W. L. Howe and Miller reported on the systemic control of thrips and leafhoppers (Va. J. Sci. 3:279). These insects cause feeding injuries that are confused with symptoms of pathogenic origin. Systox at 16 or 32 ml/l controlled both insects but was phytotoxic at these levels. Nugent was secretary of the Agricultural Section at this meeting.

Several items related to plant pathology in Virginia appeared in the 1952 *Plant Disease Reporter*. Jenkins reported on early season diseases of tobacco in southside Virginia (Plant Dis. Reptr. 36:278). Blue mold was scarce in 1952; anthracnose, first noted in 1944, incited enough damage to cause a 6-acre field to be replanted. Dry weather inhibited the development of several common diseases; however, it favored the development of charcoal rot in plants treated with mineral oil for sucker control (Ibid. 36:368-369). Jenkins also noted a first-time occurrence of fusarium wilt in the flue-cured area (Ibid. 36:391). It was associated with root knot damage in Pittsylvania Co.

Fenne and Roane reported a wide-spread occurrence of soil-borne wheat mosaic in Buckingham, Essex, Richmond, and Westmoreland Cos. (Ibid. 36:212). This disease had been reported only from Arlington Farm, the former U.S.D.A. experimental farm and now the site of the Pentagon. The outbreak was coupled with the introduction of 'Atlas 50' and 'Atlas 66' wheats which display striking symptoms of the disease. Mild symptoms were also observed on 'Thorne' and 'Vahart' wheats. No doubt the virus had long been present but mild symptoms on previously grown varieties did not allow for diagnosis.

Roane and T. M. Starling, small grains breeder in Agronomy Department reported that 'Oldambster' barley was resistant to scald caused by *Rhynchosporium secalis* (Ibid. 36:312). Roane was a cooperator with R. W. Leukel, U.S.D.A., Beltsville, on oats seed treatment experiments for smut control in 1952 (Ibid. 36:428-433). Helen S. Sherwin, U.S.D.A., reported target spot of soybean (*Corynespora cassiicola*) at the Truck Station, the northernmost occurrence of this disease through 1952 (Ibid. 36:491). Fenne reported a severe virus disease of Ladino clover in Hanover and Henrico Cos. (Ibid. 36:491). Paul Miller and G. F. Gravatt reported on a new disease killing sweet gum trees in the Southeast, including Virginia (Ibid. 36:247-252). M. E. Fowler reported oak wilt was found in Virginia in 1951 for the first time (Ibid. 36:162-165; also Va. Ext. Ser. Cir. 621, 1954). Jenkins called attention to a root rot complex in tobacco seed beds treated with calcium cyanamide (Ibid. 36:254).

In his annual report for 1952, Fenne stated that plant clinics were held at various locations for the first time; these were well attended. He also stated that root knot nematodes had become so serious that fumigation with DD and Dowfume (bromine products) was being practiced in gardens and tobacco. However, although Miller had shown that these products also protect peanuts from sting nematode damage, because of dangerous bromine levels in hay and nuts, these products could not be recommended.

Fenne prepared the only *Southern Planter* article from Virginia. He wrote comprehensively on, "How to control tobacco diseases" [Sou. Planter 113 (10):6, 18-19]. This article was aimed at the control of soil-borne diseases. It also pointed out how dry weather had made diagnosis of these disease difficult.

The American Tobacco Company continued its full-page advertisements on tobacco production; No. 4 was, "The story of the fight against blue mold" [Sou. Planter 113 (1):7]; No. 6 described "Root-knot and root-rot...twin threats to tobacco" [Ibid. (3):11]; No. 10 explained, "Tobacco breeding defeats disease" [Ibid. (7):9]. The wild sources of resistance to five diseases were listed:

- *Nicotiana debneyi* - resistance to blue mold and black root rot.
- *N. longiflora* - resistance to wildfire.
- *N. megalosiphon* - resistance to root knot.
- *N. glutinosa* - resistance to mosaic.
- *N. plumbaginifolia* - resistance to black shank.

No. 11 admonished growers to, "Choose tobacco varieties to suit soil and climate", especially where soil-borne pathogens were present; [Ibid. (8):11]; No. 12 told how, "Flue-cured growers profit from tobacco extension work" [Ibid. (9):4]; No. 13 described how "crop rotation systems reduce tobacco diseases" with emphasis on root knot, black shank, Granville wilt and fusarium wilt [Ibid (10):11]; No. 15 addressed, "Seeding and fertilizing tobacco plant beds" [Ibid. (12):6].

All pages were well written and illustrated. Collectively they provided a short course in tobacco production and disease control. Much of the information transmitted had been generated by V.P.I. pathologists.

There were no personnel changes in 1953 but Miller and Roane were awarded Ph.D. degrees by the University of Minnesota as was Mullin at the Truck Station.

There were changes in the course offerings and the Department was authorized to offer M. S. degrees. Plant Physiology, PPP 301, was changed to 3 lectures (from 2), 6 laboratory hours (from 3) and 5 credits (from 3) for Agronomy and Horticulture majors. The Forestry-Wildlife majors were offered only 3 laboratory hours. Plant Pathology, PPP 303, was reduced to a spring quarter course of 3 lectures, 6 laboratory, 5 credits (down from 7 credits in two quarters). PPP 401, Applied Mycology; PPP 501, Diseases of Agronomic Crops; and PPP 502, Diseases of Horticultural crops were deleted from the catalogue. PPP 302, Forest Pathology was changed to PPP 304, 3 lectures (from 2), 3 laboratory hours, 4 credits (from 3). PPP 600, Directed Study (hours and credits arrange, content subject to approval of the Graduate Committee) was added. Carlos Pineda, a graduate student in Agronomy and long-time employee of FAO in Rome and with whom the writer remains in contact, was in PPP 303.

No V.P.I. pathologists participated actively in the 1953 annual meeting of the American Phytopathological Society. Fenne continue as a member of the Extension Committee but did not attend the meeting.

At the January 1953 annual meeting of the Virginia State Horticultural Society, Groves chaired a panel discussion on, "Research and development of the Virginia spray program [Va. Fruit 41 (2):109-113]. Groves outlined the principles involved in development of spray programs and pointed out that only in the last decade had any new materials (organic pesticides) become available. Cleaner fruit with better finish and quality can be produced in 1953 than was possible a decade ago. A. H. Teske, Extension Horticulturist followed Groves with a discussion of the spray schedule (Ibid. 113-114).

Hurt, who had not published for several years, explained the, "Prevention of excessive foaming of concentrated spray mixtures" [Ibid. 41 (5):33-34], and wrote about, "Peach brown rot and its control" (Ibid. 35-36). In the first paper, newer wetting agents were blamed for excessive foaming. This may be countered by adding octyl alcohol or di-isobutyl carbinol at the rate of two ounces/100 gal. of spray. Destruction of old fruit, liquid lime-sulfur for the pink-bud application and Phygon at the full bloom application reduced brown rot of ripening fruit. Sulfur cover and preharvest sprays were also necessary.

Groves published a discussion of, "New fungicides for control of fruit diseases" [Ibid. 41 (6):40-46] in which he described the advantages and limitations of old and new fungicides. The new fungicides were captan, Crag-341 Fruit Fungicide, ferbam, phenyl mercury fungicides, and zineb. These new fungicides have not totally replaced Bordeaux mixture and sulfur fungicides.

There was only one research paper published by the faculty in 1953. Jenkins, D. G. Sharp, and F. A. Wolf (of Duke Univ.) described "A strain of tobacco mosaic virus inducing systemic necrosis in flue-cured tobacco" (J. Elisha Mitchell Sci. Soc. 69:161-169). The strain was found to be similar to the *Plantago* strain originally described by Holmes and others.

Wingard and Groves were selected to prepare chapters for "Plant Diseases, the Yearbook of Agriculture, 1953"; this was one of a series of yearbooks published by the U.S.D.A. on special agricultural topics. Wingard's chapter was "The nature of resistance to disease" (pp.165-173). In many respects, this article is a paraphrasing of Wingard's 1941 article in the *Botanical Review*. It provides explanations in lay language of some of the intricacies of resistance. Once again, the article was a demonstration of Wingard's ability as a lucid writer.

Grove's article, "Sooty blotch and fly speck" (pp. 663-666) addressed two diseases he had been studying and attempting to find better fungicides to control them. He gave detailed accounts of their cycles and pointed out that organic fungicides would control either disease, but not both whereas Bordeaux mixture would control both.

In the "Agricultural Research Report of the Virginia Agricultural Experiment Station, July 1, 1950 - June 30, 1953", brief accounts of Experiment Station projects are included. Among the reports involving plant pathologists were the release of corn hybrid varieties V.P.I. 645, - 802, and -900W (Genter and Roane, P.34), progress in breeding disease-resistant small grains (Starling and Roane, pp. 42-44), tests of fungicides for control of wheat bunt and oats smuts (Roane, pp. 45-46), the diagnosis and control of soil-borne wheat mosaic (Roane, p. 46), control of alfalfa stem nematode (Henderson et al., p. 48), control of peach brown rot (Hurt, pp. 85-86), study of spray material compatibilities (Groves et al., pp. 86-89), control of peanut nematodes with ethylene dibromide (Miller, pp. 100-101), testing new seed treatment products for peanut (Miller, p. 102), improving disease resistance in tobacco (Henderson and Jenkins, pp. 110-112), discoveries of two new tobacco diseases (Jenkins, pp. 112-114), control of diseases and management of tobacco seedbeds (Jenkins, pp. 114-116), breeding disease-resistant burley and dark-fired tobacco for disease resistance (Jenkins and Henderson, pp. 119-121), and control of late blight with old and new fungicides (Wingard and Henderson, pp. 128-129). No break- through discoveries were reported, only steady increments of success.

Fenne revised Extension Bulletin 152, "Important Tobacco Diseases in Virginia and Their Control". New varieties and new chemicals were mentioned. Soil fumigation with bromides for weed and disease control was included for the first time. He also published an article, "Tobacco blue mold control" [Sou. Planter 114 (2):20, 43] in a continuing effort to prevent this destructive disease from causing a catastrophe. Ferbam and zineb dusts or sprays were the only products recommended. The American Tobacco Co. advertisement no. 20 plugged plant clinics under the title "Diagnosing plant diseases helps flue-cured growers" [Ibid. 114 (5):13]. It pictured C. J. Nusbaum, Plant Pathologist at N. C. State University and cultures of four tobacco pathogens.

There were no reports of new diseases in Virginia in 1953 *Plant Disease Reporter*. However, there was a report of tomato collar rot causing 10-75% destruction on various farms (Va. Dept. Agriculture and Immigration Bul. 526). This disease was traced to one grower- distributor. The Tomato Plant Quarantine Commission had enforced an 8-county quarantine to prevent the importation of diseased seedlings from the South (Ibid. 522). Thus, 1953 seems to have been a ho-hum year in Virginia plant pathology; 1954 promises to be different.

Two new positions were established for research in plant pathology in 1954. Albert S. Williams was appointed Associate Professor of Plant Pathology, July 1, to work on diseases of forage crops at Blacksburg. Wirt H. Wills was appointed Assistant Professor of Plant Pathology, June 1, to study effects of environment on fungus diseases and effects of physical factors on injury to tobacco. Wills would work at Chatham.

There were no changes in courses offered for the 1954-55 session.

At the January 25-27 meeting of the Virginia State Horticultural Society, both Hurt and Groves contributed papers. Hurt spoke on, "The effects of cultural and pruning practices on the control of peach diseases" [Va. Fruit 42 (2):112-113]. He reported that clean cultivation and thorough pruning helped control brown rot but had no effect on peach leaf curl, scab, and bacterial spot. Groves spoke on, "Problems in cherry disease control and slants on stock for new plantings" [Ibid. 42 (2):120-123]. Cherry leaf spot and brown rot were listed as diseases that could be controlled with, sulfur, ferbam, captan or glyodin sprays. He listed yellows and necrotic ring spot as virus diseases that had to be controlled by planting virus-free nursery stock. So far as the writer could find, there were no technical journal or bulletin publications issued by the staff. Hurt submitted a brief article on, "Peach leaf curl and its control" [Va. Fruit 42 (3):36-40]. He described the disease cycle and listed the alternatives to its control. Control may be obtained up to the pink bud with lime-sulfur as a dormant spray, and with Bordeaux mixture or Phygon applied later.

On October 15, 1954, Hurricane Hazel blew over thousands of apple trees in the eastern Piedmont. In addition to the loss of 'Winesap' and 'Delicious' fruit that was blown off, trees were damaged both east and west of the Blue Ridge. This would result in future problems for pathologist due to fungi which would colonize damaged trees [Va. Fruit 42 (10):4, 6, 8]. An Extension Service Circular (No. 621) was issued in 1954, stating that a single oak tree infected with the oak wilt fungus had been found in 1951 in Augusta. In 1953, additional infected trees had been found in Augusta, Bath, Highland, Warren and Wise Cos. This had been a fearsome discovery and it was expected that oaks would go the way of chestnuts. It hasn't happened.

Fenne published a new bulletin, "Nematode Control in Tobacco" (Va. Agri. Ext. Service Bul. 215) in which he illustrated nematodes, root knot, lesion nematode damage, and implements for applying nematicides. He described the symptoms of nematode damage, rotations, and cultural and fumigation procedures for lessening damage and reducing losses.

Jenkins reported on, "Outbreak of Pythium rot in newly set flue-cured tobacco in Virginia" (Pl. Dis. Reptr. 38:421), which he attributed to cool, wet weather following the transplanting period. Species identified were *Pythium debaryanum*, *P. aphanidermatum*, and *P. arrhenomanes*.

Roane was co-author of two articles on wheat soil-borne mosaic. In "Observations on wheat mosaic in Virginia" (C. W. Roane, T. M. Starling, and H. H. McKinney, Pl. Dis. Reptr. 38:14-18), it was reported that the disease had occurred on the Arlington Farm (U.S.D.A. Research Farm, now site of the Pentagon) from 1925 to 1941. It was rediscovered in 1952 in several Coastal Plain and Piedmont Cos. as a result of the introduction of two highly susceptible varieties, 'Atlas 50' and 'Atlas 66'. In experiments conducted on the W. D. Edwards Farm in Westmoreland Co. near Lyells, effects on yield of grain and evaluation of breeding lines convinced us that the development of mosaic resistant lines was a necessity. Furthermore, in our tests comparing reactions of lines and cultivars at Statesville, N.C. and Westmoreland Co., some lines and cultivars were severely mottled and stunted in Virginia but not in North Carolina (J. G. Moseman, H. H. McKinney, and C. W. Roane. Reaction of wheat varieties and selections to the soil-borne viruses in Southeastern United States, Ibid. 38:19-24). It would be fifteen years later that the Edwards Farm would be found to be infested with both wheat soil-borne mosaic virus and wheat spindle streak mosaic virus (S. A. Tolin and C. W. Roane. Identification of wheat viruses in Virginia, Ibid. 53:751-752, 1969). Apparently the spindle streak virus was absent from the Statesville site in 1954, but we could not verify this because the Statesville site had been destroyed for an interchange on I-40. As a result of our studies, we found the Atlas wheats produced only 25% of their potential yield on some infested soils, so we removed them from the list of recommended cultivars and urged farmers to grow resistant cultivars on infested land. In addition, Atlas wheats were discriminated against in the market because they were intermediate to soft red wheats of the East and hard red wheats of the West. The Southern States Cooperative got caught with 300,000 bushels of Atlas seed wheat when farmers switched back to typical soft wheat cultivars. Roane got a lot of heat from Southern States which blamed him for destroying their market for high yielding (but atypical quality) Atlas wheats. It was Roane's duty to inform the agricultural community of the truth not to protect seedsmen who had made an unwise choice.

There were two first-time reports in 1954 of pathogens and diseases in Virginia by investigators who collected or had cooperative work in Virginia. J. G. Moseman (U.S.D.A., Beltsville, Md.) reported finding race 11 of *Erysiphe graminis hordei* (Pl. Dis. Reptr. 38:163- 166); Linford and McKinney (also U.S.D.A.) found *Polymyxa* *graminis* in roots of wheat infected with soil-borne mosaic in Virginia and other states. Although they did not name the fungus as a vector of the virus, circumstantial evidence was accumulating for that contention (Ibid. 38:711- 713). It is now known to be the vector.

Fenne reissued, "Diseases of Forage Crops" (Va. Agri. Ext. Ser. Bul. 188). The only changes from the 1951 version were the deletion of the illustration of lightning injury to soybean and changing the cover from common leafspot of alfalfa to Stemphylium leafspot of clover and the inclusion of a section on wheat mosaic. Fenne also published, "Nematode Control in Tobacco" (Ibid. Bul. 215). Nematode disease symptoms were described and illustrated as was equipment for fumigating soil.

Fenne contributed an article to *The Southern Planter* on, "Control of tobacco blue mold" [The Sou. Planter 115 (3):24-25]. The fungicides recommended were ferbam and zineb. This article was similar to all previous ones by Fenne on this subject. It was a springtime ritual and rightfully so, because even though growers were annually reminded via radio, newspapers, magazines, meetings and circulars, there were heavy losses to blue mold on farms where growers gambled that weather would not favor blue mold. They lost.

The American Tobacco Co. continued its advertisements featuring the culture of tobacco. Those stressing plant diseases were No. 29, "Controlling nematodes in flue-cured tobacco" [Sou. Planter 115 (2):11]; No. 30, "Soil fumigation may help flue-cured growers" [Ibid. 115 (3):11], also targeted nematodes; No. 32, "Chemicals can protect flue-cured tobacco" [Ibid. 115 (5):6]; The two advertisements No.36, "Take care of plant beds for finer flue-cured tobacco" [Ibid. 115 (9):9]; and No. 37, "Rotate crops for protection against soil-borne tobacco diseases" [Ibid. 115 (10):13], had root knot, Granville wilt, and black shank as the target diseases. Much of the information provided was generated by Virginia's researchers.

During the year, Miller read papers on the parasitism of *Cercospora arachidicola* and *C. personata* (Va. J. Sci. 5:239) and with Rodney Young and R. W. Engel (Biochemistry Dept., V.P.I.) on the bromide content of peanuts that had been fumigated for nematode control (Ibid. 5:241). Peanut hay and hulls were high in bromide but nuts were free of it. Fenne, in his annual report, cited the first occurrence of black shank in the southwestern counties, in this case Lee. This would be the beginning of a new problem for burley tobacco growers. He also announced that streptomycin would become available for control of bacterial diseases and that in experiments it had been demonstrated to control wildfire and angular leaf spot of tobacco in seedbeds. In 1954, the General Assembly appropriated funds for construction of the Tobacco Disease Research Station. To be constructed were a laboratory, greenhouse, and office building; a cinder block barn; a machine shed; a frame pack barn; an one-family brick dwelling; and two tobacco curing barns. These structures were erected in the period 1954-1957 (H. N. Young. The Virginia Agricultural Experiment Station, 1886-1966. Univ. Va. Press, Charlottesville. 1975. pp. 36-37).

At the Virginia Truck Experiment Station, T. J. Nugent, H. T. Cook, and L. L. Harter summarized the, "Relative Importance of Control Measures for Scurf of Sweet Potato" (Va. Truck Expt. Sta. Bul. 113). They reported that treatments with chemicals never satisfactorily controlled scurf although some reduced the incidence of it. Some chemicals actually increased scurf. Cutting sprouts one inch above the bedding was the most successful means of reducing scurf. At the time the bulletin was published, Cook was in the Marketing Division of U.S.D.A. and Harter who had conducted experiments at the Truck Station from its inception was dead. In 1955, the faculty grew in a way. Kenneth H. Garren was appointed Plant Pathologist, U.S.D.A., to study fungous diseases of peanut at Holland (=Suffolk); his appointment was effective February 1. On the V.P.I. faculty, he was Professor of Plant Pathology. L. I. Miller, also of Holland, was promoted to Professor.

There were no changes in the courses but we initiated a seminar involving faculty in which we reviewed physiology of plant diseases. Hale spearheaded this effort. W. W. Osborne was the first student to enroll in the M.S. program which was authorized to begin in 1955.

No Experiment Station bulletins were published by faculty of the Department but there were several papers read at meetings and several semi-technical publications. Henderson and Williams reported that the insecticides aldrin and parathion disked into soil infested with *Ditylenchus dipsaci* (stem nematode) controlled nematode damage to alfalfa (Phytopathology 45:348). Fenne summarized the, 'Alfalfa disease survey in Virginia of April 20, 21, and 26' for mostly Piedmont Cos. Stem nematode infestations were found in Halifax, Pittsylvania, and Prince Edwards Cos. Other common diseases were observed (Pl. Dis. Reptr. 39:520). Roane and Fenne reported several new plant disease records for Virginia in 1955 (Ibid. 39:695-696). Speck rot of potato (*Stysanus stemonitis*) occurred in tubers from a garden in Page Co. Downy mildew (*Sclerospora macrospora*) occurred on barley, oats, and wheat from a mixed stand in Henrico Co. Yellow leaf blister (*Taphrina populina*) of Lombardy poplar occurred in Montgomery Co. Needle rust of loblolly pine was collected in Augusta Co. Wheat soil-borne mosaic occurred on rye in Accomac Co.

Some out-of-state people reported new records for Virginia. Q. L. Holdeman of South Carolina listed Greensville, Isle of Wight, Nansemond, Southampton, Surry and Sussex as counties having sting nematode-infested soils (*Belonolaimus gracilis*) and peanut, cotton, corn, and soybean as crops being damaged. The information was supplied by Miller (Ibid. 39:5-8). John A. Stevenson reported cankers of Japanese pagoda tree (*Sophora japonica*) on specimens from Richmond city (Ibid. 39:597).

At the May meeting of the Virginia Academy of Science, D. L. Hallock, Soil Scientist at Holland, and Miller reported on crop response to various rotations involving peanut (Va. J. Sci. 6:230); J. W. Midyette, Jr. (Va. Dept. of Agri. & Imm.) reported a high correlation between the percent of chipped or cracked pericarps covering embryos and mercury-treated seed wheat stored at high temperatures (Ibid.); Miller reported on control of sting nematode damage with a mixture of ethylene dibromide and vermiculite (Ibid. 6:235).

Fenne prepared several Extension Service publications. He distributed, "Diseases and Insects of Cucumbers, Melons, Squash, etc" (M.R. 212); "How to Control Fire Blight (Cir. 643); and "Crown and Stem Rot of Alfalfa and Clover (Cir. 660). In the fire blight circular streptomycin was recommended for the first time. The editor of *Virginia Fruit* also addressed this subject [Va. Fruit 43(3):16; see below]. There was a letter to County Agents in February explaining the use of streptomycin for control of wildfire. Fenne also paraphrased his letter to burley area agents in a *Southern Planter* article, "New way to control wildfire on tobacco" [Sou. Planter 116 (3):66]. Thus, in 1955 antibiotics were being marketed for control of bacterial diseases for the first time. Fenne also initiated a monthly Plant Disease Newsletter which later evolved into the Plant Protection Newsletter covering diseases, insects, and weeds.

At the January 24-26, 1955 annual meeting of the Virginia State Horticultural Society, Groves moderated a symposium on, "The influence of spray treatments on apple set and yield". Scientists from West Virginia, Maryland and Pennsylvania were on the program [Va. Fruit 43 (2):133-139]. It was pointed out that there can be a reduction in fruit set caused by sulfurs and Bordeaux mixture, that lime-sulfur interfered with bud formation and thus affected growth the following year, that sulfur caused a reduction in fruit size, and that captan produced the greatest average return per acre. Preliminary to this symposium, Groves and C. H. Hill, Entomologist at Winchester, had published in January a discussion of three completely different spray schedules and tables comparing the cost of the captan, glyodin-mercury, and sulfur-ferbam schedules [Va. Fruit 43 (1):26-34]. These were $21.41, $18.11, and $15.70, respectively. This was followed by a paper from M. L. Bobb, Entomologist at Charlottesville, and Hurt on, "The 1955 peach spray program" [Ibid. 43 (1):36-38]. They discussed two schedules, one for Tidewater areas and one for the Piedmont-Valley areas. The latter was simply an abbreviated schedule of the Tidewater schedule. It was pointed out that captan led to the build-up of mites.

Groves also discussed, "Pest control for plums" [Ibid. 43(2):128-130]; brown rot, black knot, leaf spot and bacteriosis were primary targets. He pointed out that the program was similar to that for peaches.

Bobb and Hurt published a follow-up on the, "Cost of 1955 spray programs" [Ibid. 43 (3):34-35]. For the Piedmont-Valley programs, costs per 100 gallons of spray were projected at $16.03 for captan; $14.06 for sulfur-Phygon- captan; $10.06 for sulfur-Phygon; and $8.16 for sulfur.

The editor of *Virginia Fruit* cited work by R. N. Goodman of Missouri Agricultural Experiment Station in an item, "Antibiotics and fireblight" [Ibid. 43 (3):16], which suggested that streptomycin would probably be used in future spray schedules. The products tested were Agrimycin, Phytomycin, and Agri-Strep. (Could these products give hope for the restoration of the pear industry in Virginia?).

The U. S. Congress passed legislation in 1954 amending the Food and Drug Act of 1938 such that the quantity of pesticide residues on raw fruits and vegetables would be limited. The legislation is known as the Miller Amendment. A. H. Teske, V.P.I. Extension Horticulturist, described its impact on fruit growers and provided a table of tolerances for apples, pears, peaches, and cherries. The law went into effect July 22, 1955 [Va. Fruit 43 (7): 36-38]. Teske explained how to keep residues within the tolerances allowed.

Not all progress in plant pathology was reported in publications. Henderson and other tobacco workers released the flue-cured tobacco variety 'Virginia 21' which was resistant to black root rot. Genter (Agronomist) and Roane released corn hybrid V.P.I. 646 which was stalk rot and leaf blight resistant. This was the first of a series of hybrids that would greatly improve the standing ability, disease resistance, and quality of corn.

Miller and Williams participated in a nematode workshop at Auburn University and Miller attended one at Raleigh. Miller would become an expert on peanut-damaging nematodes. Root knot and sting nematodes would be his specialty. Williams, as a result of his work with the stem nematode, foresaw the need to improve his competency in nematology. In 1955, not many plant pathologists were trained in nematology.

There were three appointments to new positions in 1956. Allen H. Kates was appointed Associate Extension Weed Specialist on June 1. John Amos who had served half-time on weed work and half-time on insects was appointed full-time Associate Extension Entomologist. Walter W. Osborne who had been an Assistant County Agent in the flue-cured area was appointed Associate Extension Plant Pathologist. Osborne was one of the first to earn an M.S. degree in plant pathology in the new graduate program. He completed degree requirements in May 1958. Wesley Witcher also started an M.S. program in 1956. He had been an Assistant County Agent in Charlotte and Halifax Cos. specializing in tobacco. Although in plant physiology, Maggie Ru Chih Huang under the guidance of M. G. Hale was awarded the first M.S. degree from the Department of Plant Pathology and Physiology. Her thesis was entitled, "Effect of a respiratory poison and two auxins on resistance to leaf spot of corn" (M.S. Thesis, May 1956). Huang went on to earn a Ph.D. degree and to become a Professor at Johns Hopkins University. In August 1956, Mason C. Carter earned the first M.S. degree in discipline of weed science under tutorage of W. E. Chappell. His thesis was entitled "The effects carrier, formulated phytocide, and time of treatment on the reactions of certain woody plants to chemical sprays" (M.S. Thesis, Aug. 1956). Carter earned a Ph.D. degree and later became Dean of Agriculture at Louisiana State University. Charles R. Drake was appointed Plant Pathologist in a new U.S.D.A. project to study diseases of birdsfoot trefoil. There was a great deal of emphasis on introducing new forage crops into Virginia and birdsfoot trefoil was the prime candidate. Drake would cooperate with John D. Miller, U.S.D.A. Agronomist on the project. Drake would also be Assistant Professor of Plant Pathology. W. A. Jenkins of the Chatham Station resigned May 31 for health reasons. On June 11 he died of cancer (Research Report of the Va. Agri. Expt. Sta., July 1, 1953 to June 30, 1957, p.7).

In the instruction program, A. S. Williams relieved Roane of teaching Plant Pathology, the introductory course; Roane then initiated Pl.P.P. 501, Diseases of Field Crops (3H, 3L, C, I). At first, Williams was unhappy with this new duty but grew to enjoy teaching and later was reluctant to give up this course. Pl.PP 511-521, Seminar was listed in the catalogue for the first time. S. A. Wingard was on the College Resolutions Committee, the first University-wide assignment to the Department since Fromme's departure.

In an early publication in 1956 by Groves, "Antibiotics and the possible development of an eastern pear industry" [Va. Fruit 44 (1):38-40], it was pointed out that limited experiments have been conducted with apple and none with pear. Blossom blight of apple is controlled with streptomycin and it is anticipated that blossom blight of pear would also be controlled. However, it is uncertain whether the twig blight phase to which pear is more susceptible than apple could be controlled. Therefore, until successful tests with pear could be conducted, Groves made no rash predictions.

At the annual meeting of the Virginia State Horticultural Society, Groves spoke on, "Dwarf tree performance to-date at the Winchester fruit research laboratory [Va. Fruit 44 (2):72- 73]. The Clark dwarfs of 'Stayman' planted in 1954 showed a steady decline in 1955 and by late summer many had died. Groves thought a masked virus introduced from 'Virginia Crab' during grafting was the source of the problem. Trees of 5 other varieties planted in 1954 remained healthy.

Groves and C. H. Hill, Entomologist at Winchester discussed, "Complications that arise from schedule modifications: Apples "[Ibid. 44 (2):110-113]. Their topics included omission of sprays, substitution of materials, changes in dosages and timing, and use of non-recommended combinations. They noted the weather may sometimes force modifications. M. L. Bobb, Entomologist at Charlottesville and Hurt discussed the same topic for peaches [Ibid. 44 (2) 113- 115. Their discussion was similar but they emphasized that anything that led to excessive residues could result in penalties under the Miller Amendment.

"The Miller Bill" was carefully explained in an article by the editor of *Virginia Fruit* using information prepared by L. S. Hitchner of the National Agricultural Chemicals Association [Ibid 44 (3):21-24]. Industry is required to show that tolerance levels established when a product is used according to label instructions shall not be exceeded. The article described the five categories of residue tolerance established by the Food and Drug Administration: Exemption from the law (sulfur), no tolerance (2,4-D on small grains), exemption from tolerance (pyrethrum), tolerance level not to be exceeded (DDT), zero tolerance (mercury). The onus is upon the manufacturer and the grower to conform to the law. The Miller Amendment drastically changed the industry and usage of pesticides. It made development of new products much more expensive but it is of great benefit to the consumer.

Hurt contributed an article, "Peach bacterial spot (bacteriosis)" [Ibid. 44 (3):36-38]. Shot- hole of leaves and cracking of fruit are the primary symptoms of bacteriosis. A zinc-lime spray was recommended for control; Hurt did not mention antibiotics. In another article, "Constriction canker of peaches" [Ibid. 44 (3):44-46], Hurt described this relatively new disease as being adapted to Seaboard counties, much like bacteriosis. He emphasized punctual pruning and sanitation procedures. Spraying with ferbam or dichlone reduced but did not eliminate the disease.

There was more on the Miller Amendment in a reprint of an article from N.A.C. News, "Growers have nothing to worry about from the Miller Pesticide Amendment," by W. B. Rankin [Va. Fruit 44(4):44-48]. When a statement of tolerance is issued by the Federal Government, it means (1) that residues up to the tolerance level are safe, (2) the pesticide can be used in agriculture without leaving excessive residues, (3) if used properly according to the label, residues will be within the permitted level. From the grower's standpoint (1) food can be produced without hazard to the consumer, (2) growers will not be in violation if they follow directions on approved labels, (3) carelessness leading to excesses will not be tolerated, (4) deviation from label instructions should occur only if tolerances can be met, (5) use sprays only on crops specified, in amounts and at times specified. Thus, having an approved label became the prime necessity of manufacturers. The Miller Amendment was landmark legislation for U.S. agriculture. The Virginia State Horticultural Society took the initiative to keep its members informed. Many scare tactics surfaced to confuse the consuming public. Even though our food is safer and of higher quality than in pre-Miller days, many factions attempted to sabotage the use of any chemicals [ex. Va. Fruit 44(10):10-12]. Organically grown foods had taken a place in the market.

Hurt contributed another article on, "Fall spraying for peach leaf curl control" [Va.

Fruit 44(11):32-34]. He recommended the use of Bordeaux mixture, dinitro compounds, ferbam, or dichlone in the fall after defoliation. He also advised grower's to clean out sprayers as all these compounds are corrosive to idle equipment.

No one from Virginia read a paper at the 1955 meetings of the American Phytopathological Society. However, A. B. Groves was appointed an Associate Editor of Phytopathology for the period 1956-1958. Groves thus became the first Virginian to serve on a Society wide editorial committee since the days of Fromme and Schneiderhan, a span of more than 25 years.

The 1956 meeting of the American Phytopathological Society was held December 5-8. Reports and abstracts appeared in 1957. Miller was junior author of a paper on radicle injury to peanut seeds with N.C. Teter, U.S.D.A. Agricultural Engineer at the Tidewater Research Station (Phytopathology 47:34). Roane was a junior author on a paper with D. M. Stewart, W. Q. Loegering, and B. J. Roberts, all U.S.D.A. cereal rust pathologists. They reported on finding a subrace of the oat stem rust fungus with a factor for virulence on 'Saia', a variety that had remained resistant to all stem rust collections from North America. The rust had been collected by Roane in a barberry-cereal nursery in the creek bottom about 200 yards south of the junction of S. Main Street and Ellett Road.

Only T. J. Nugent of the Truck Station read a paper at the May 1956 meeting of the Virginia Academy of Science. With R. N. Hofmaster, Entomologist as co-author, he spoke on, "Bean seed treatment trials in Eastern Virginia" (Va. J. Sci. 7:258, 1956). There was no response by snap bean but lima bean germinated better as a result of treatment.

The last Virginia Truck Experiment Station bulletin was published in 1956. Thereafter, information for growers appeared in a newsletter format. Nugent and R. S. Mullin prepared a section on diseases and their control in, "Commercial Strawberry Production in Eastern Virginia" (V.T.E.S. Bul. 115).

A research report on results of 1955 small grains tests was prepared by J. L. Tramel, Jr., T. M. Starling (Agronomists) and Roane (Va. Agri. Expt. Sta. Res. Rept. 2, Mar. 1956). Descriptions of recommended varieties included disease reactions as determined over several years of observation and tables of disease ratings in 1955 for wheat and barley. Although disease ratings were obtained for hybrid corn varieties the Agronomists preparing reports did not include disease ratings. This was a continual source of irritation to Roane as he was hired to cooperate with the corn and small grains breeders. Cooperation with the small grains breeder was always recognized; not so with the corn breeder. However, in the summary of corn performance tests, it can be seen that 5 hybrids (V.P.I. 426, - 645, - 646, - 802, - 900 W) developed by the cooperation between C. T. Genter (Agronomist) and Roane were available to growers. These hybrids provided excellent standing ability (stalk rot resistance) and leaf blight resistance (Va. Agri. Expt. Sta. Res. Rept. 3, Mar. 1956). In experiments during 1953 and 1954, W. E. Chappell, Plant Physiologist (Weed Science), and Miller found that dinetro-o-sec-butylphenol and sodium pentachlorophenate, in addition to controlling weeds, concomitantly caused some reduction in peanut leaf spot, stem rot and sting nematode symptoms, and increased yields (Chappell and Miller. The effect of certin herbicides on plant pathogens. Pl. Dis. Reptr. 40:52-56). This work would be a springboard for Garren in his efforts to reduce the incidence of peanut stem rot.

Roane and P. H. Massey, Jr., Associate Horticulturist, described an outbreak of tomato late blight in a commercial plastic greenhouse at Blacksburg, Va. in 1955-56 (Ibid. 40:313). The grower had started seedlings out-of doors in September and transplanted them to plastic-covered houses about October 1. Tomato late blight is quite common in September on garden tomatoes in the Blacksburg area, and apparently, one or more seedlings had been colonized by *Phytophthora infestans* before being transplanted. Late blight spread rapidly in the greenhouse despite attempts to control it with fungicides. The crop was a total loss.

Nugent of the Truck Station found that the fungicide pentachloronitrobenzene (PCNB) reduced potato scab and resulted in larger yields of marketable tubers (Ibid. 40:428). The soil pH was not given but it must have been high enough to allow scab to develop. Applications of 58 lbs. PCNB/ac., x 2 and x 3 gave similar results.

By now Fenne was confined to a wheel chair as multiple sclerosis had destroyed his mobility. He devoted his time to the plant clinic, especially by preparing and revising Extension Plant Pathology publications. He revised "Diseases of Small Grains" (Va. Agri. Ext. Ser. Bul. 151). Most noteworthy change was the addition of 8 color photographs. He revised "Tobacco Diseases in Virginia" (Ibid. Bul 152). A key to identification of major tobacco diseases, a section on general control measures, and one on curing damage were added. The section on collecting and mailing specimens was deleted and the diseases were listed under sections, viz., plant-bed, leaf, stalk and root, weather and curing. It was much improved over previous editions. In December, Fenne published a, "Sprayer and Duster Manual" (Va. Agri. Ext. Ser. Bul. 247), in which he described and illustrated these implements and explained how to use and maintain them. This was a very useful publication for gardeners. He also prepared Circular 689, "All Purpose Sprays and Dusts for the Home Flower Gardener". Zineb, ferbam, captan and sulfur were the featured fungicides. J. O. Rowell, Entomologist, and A. S. Beecher, Horticulturist, were co- authors.

The tobacco workers released a flue-cured variety, 'Va. 21', having resistance to black root rot. Miller published an article in vol. 1 of *Virginia Carolina Peanut News* describing the control of the sting nematode. Miller and Williams attended the nematology workshop at Louisiana State University in order to further improve their proficiency in this field. Roane attended the 3rd International Rust Conference at Mexico City. Race 15B of the stem rust fungus was the principal subject as it had caused millions of dollars in damage to wheat and threatened to undo years of wheat breeding effort. Roane read a 4-sentence paper, alternately translated into Spanish.

The Virginia Department of Agriculture and Immigration published an alert that the soybean cyst nematode had been found in northeastern North Carolina (V.D.A.&I.; Bul. 560: 10- 11. 1956). Strict controls were implemented to prevent its spread. However, based upon the past history of the SCN, it would not take long to find it in Virginia.

On February 1, 1957, Joseph L. Troutman was appointed Assistant Plant Pathologist to work on tobacco virus diseases at the Tobacco Disease Research Station, Chatham. Osborne, who had been appointed Assistant Extension Plant Pathologist July 1, 1956, was promoted to Associate Extension Plant Pathologist on September 1, 1957. Orvin Rud was appointed Assistant Professor of Plant Physiology to work on weed control in field crops.

Principles of Plant Disease Control (PPP 401 3H, 3C, II) was taught for the first time in the winter quarter of 1957 by Roane. Wingard continued as a member of the College Resolutions Committee. Mason C. Carter received the M.S. degree on June 9, 1957. He was the first to earn a degree in the Department's weed science program. Eventually he became Dean of Agriculture at Louisiana State University.

At the January 14-16, 1957, meeting of the Virginia State Horticultural Society Groves moderated a panel discussing on , "Past experience and a forward look in pest control" [Va. Fruit 45 (2):129-145]. Hurt served on the panel him. Groves pointed out that many growers request personal service and ask questions about items that are well covered and are answered in the spray bulletin. He urged all to consult the bulletin first. Then he described procedures for controlling the difficult-to-control powdery mildew. Hurt was called upon to discuss bacteriosis and constriction diseases of peach. A zinc-lime spray program was outlined for bacteriosis and glyodin was reported as the first organic fungicide to be compatible with zinc-lime. Hurt commented that the constriction disease was so damaging, difficult and expensive to control on 'Golden Jubilee' in Tidewater, Virginia that growers were pulling the trees out of their orchards. As Hurt said, "After all you are in the Peach Industry to make some money and if it is going to cost more to spray than the peaches are worth then the growers feel that they would just as soon do without this variety" [Ibid. 45 (2):134]. Apparently this disease, incited by *Phomopsis amygdali*, caused the virtual disappearance of Golden Jubilee from New Jersey southward, (E. I. Zehr. 1995. Constriction canker *in* Compendium of Stone Fruit Diseases. Amer. Phytopathol. Soc. Press. pp. 31-32).

Howard Rollins, Extension Horticulturist spoke on, "The 1957 spray program". He reiterated Groves recommendations for apple powdery mildew that 1 1/2 lbs of sulfur be added to all the early season sprays. Karathane or Mildex should be added for later cover sprays. [Va. Fruit 45 (2):144-145]. Later in the year Rollins urged growers to use specific sprays for diseases that had been problems in 1957 [Ibid. 45 (4):32; (6):40-41; (7):27].

Hurt contributed two additional articles to *Virginia Fruit* on peach diseases. In, "Peach scab and its control", he described the disease cycle and pointed out that since mild fungicides had been introduced for brown rot and leaf curl, scab had become more prevalent. However, he insisted that if the schedule outlined in the Virginia Spray Bulletin were followed, scab would be controlled [Ibid 45(5):42-44]. In, "Peach leaf curl control in the fall", Hurt stated that liquid lime- sulfur, Bordeaux mixture, ferbam or phygon would effectively control curl if the materials were applied after leaf fall, usually November 15 to early December [Ibid. 45(10):30]. Waiting until late winter or spring may mean getting delayed by an unfavorable weather sequence.

At American Phytopathological Society meetings, Groves read a paper at the Northeastern Division November 8-9, 1956 on, "Apple powdery mildew control studies" (Phytopathology 47:245). The miticide Karathane was found to give good control. At the Southern Division meeting February 4-6, 1957, Garren of the Tidewater Station reported on the, "Efficacy of certain cultural practices as control measures for stem rot of peanuts "(Ibid 47:312). Coupled with chemical weed control, throwing dirt to the plants during cultivation caused more stem rot to develop than when no dirt was thrown to the plants. This became known as non-dirting control of peanut stem rot. Fenne was a junior author of a note, "Tomato rosette caused by a virus complex" (G. R. Doering , W. C. Price, and S. B. Fenne. Phytopathology 47:310-311). It was shown that two viruses comprise the complex; namely, the tomato rosette strain of tobacco mosaic virus and the previously undescribed shoestring virus. The complex had been first detected in southwestern Virginia in 1951 (Ibid. 41:1091-1098).

Groves was in the second year as an Associate Editor of *Phytopathology*. It was noted in the *News* page (following 47:632) that he would function to disseminate the 1956 result of fungicide tests for the Temporary Advisory Committee on Collecting and Disseminating Data on New Fungicide Tests of the American Phytopathological Society (talk about brevity). There were no station bulletins published by the Department in 1957. Roane was an author of "Small Grain Varietal Tests Conducted in Virginia, 1956 (J. L. Tramel, Jr., T. M. Starling, and C. W. Roane. Va. Agri. Expt Sta. Res. Rept. 5). Numerous summaries of research projects appeared in, "Research Report of the Virginia Agricultural Experiment Station, July 1, 1953 to June 30, 1957". All plant pathology faculty contributed. Noteworthy contributions were as follows:

Williams and Henderson reported spring application of aldrin+parathion reduced stem nematode damage to alfalfa but fall applications did not (pp.57-58).

Williams found that the host range of stem nematode includes alfalfa, white Dutch clover, Ladino clover, red clover, sweet clover and lespedeza (p.59). He gave a report on this at the 9th Eastern Alfalfa Conference.

Roane and N. C. Teter (U.S.D.A. Holland Station) found *Aspergillus flavus*, *Fusarium monili-forme* and *Penicillium* spp. to predominate in corn during drying experiments. Exposed surfaces of cracked and broken kernels were primary sites for *Aspergillus* and *Penicillium* propagation (pp.91-92).

Roane and Starling explained mercury damage to treated wheat seeds. Damage occurred only when the pericarp had been chipped or cracked over the embryo (pp.95-97).

Miller had several articles on peanut diseases, including peanut leafspot, *Sclerotium rolfsii* wilt, rootknot, sting nematode stunt, and seed disinfectants (pp.102-105).

Henderson, R. D. Sears (Agronomist, Charlotte C.H.). Spasoff, J. L., LaPrade, and E. M. Matthews (Agronomist, Chatham) reported on progress in breeding root rot, mosaic, and root knot resistant flue-cured, sun-cured and dark fire-cured tobacco varieties (pp.108- 115).

Wills found antibiotics offered no advantage over ferbam or zineb for tobacco blue mold control. Hurt and Groves reviewed progress in using new fungicides for fruit disease control (pp.195-197, 205-208).

Garren and G. B. Duke (Agricultural Engineer, U.S.D.A., Holland Station) summarized the work to control peanut stem rot by the "non-dirting" procedure (Pl. Dis. Reptr. 41:424-431). They gave a history of the disease, having been first reported in the United States by McClintock of the Truck Station in 1917, and gave clues leading to the non-dirting procedure. *Sclerotium rolfsii* colonizes almost any crop residue so the trick was to deep plow, keep residues away from peanut stems and to control weeds with the herbicide pentachloronitrobenzene (PCNB). Significant yield increases were obtained by the "non-dirting" procedure.

Williams and L. H. Taylor (Agronomist, grass breeding) found Rathay's disease of orchard grass in Fauquier, Loudoun, and Prince William Cos. in spring of 1957 (Ibid. 41:598). This disease, caused by *Corynebacterium rathayi*, had been recorded last from Oregon in 1945. A peculiar symptom is "knee-bend" at a lower internode. The bacteria cement the culm to leaf sheaths thereby preventing upward extension. In the zone of elongation at a lower node, the stem pushes to one side. In the report, the photograph was trimmed so that the bend does not show but an arrow points to it. Such are the problems of publication.

According to Fenne (Notes on Plant Diseases June 28, 1957. See p. 75, Fenne's annual report for 1957), Williams also discovered the twist disease of orchard grass (caused by *Dilophospora alopecuri*) in 1957. However, William did not report the discovery himself until 1964 (Pl. Dis. Reptr. 48:119). Even then he gave no records of when and where he had observed it.

Francis W. Holmes of the University of Massachusetts published a map showing the distribution of Dutch elm disease (Ibid. 41:634-635). In 1956, Norfolk Co. was the southern - most center of infestation along the Atlantic Seaboard. Even though the port of Norfolk/ Portsmouth was one of the early entry sites, the disease did not spread southward in 20 years.

Henderson, R. D. Sears (Agronomist, Charlotte C.H.) and L. Spasoff gave a paper at the Virginia Academy of Science meeting entitled, "Virginia 312, a new dark, fire-cured variety of tobacco resistant to mosaic and root rot" (Va. J. Sci. 8:267). The variety carried a gene from *Nicotiana glutinosa* that gave a flecking reaction to TMV. The source of root rot resistance was not named. The variety was released in 1957.

Osborne summarized his M.S. thesis work in the paper, "A greenhouse comparison of the relative phytotoxicity and nematocidal efficiency of certain chemical soil treatments on tomato" (Ibid. p.268). Satisfactory root knot control was obtained with DD, Vapam, Dorlone, and DCB60; Nemagon and Thimet were phytotoxic and VC13 did not control nematodes.

A new building was opened for the Winchester fruit research and extension group in 1957. This building was on a ten-acre property along highway U.S. 11 south of Winchester. In 1954, the staff had made an experimental apple planting on the site which had been purchased in 1949. Fenne prepared a mimeographed history of, "The Plant Pathology Extension Program in Virginia from 1923 to 1957". This has been a useful resource for preparing this history of plant pathology in Virginia. Fenne's annual reports have also been a useful reference. Among the Extension Service publications issued in 1957 were a revision of, "Diseases of Small Grain and Their Control" (Va. Agri. Ext. Ser. Bul. 151). Although mostly a reprint of an earlier edition, Fenne added a section on cold water treatment of barley for control of loose smut.

Other Extension publications and revisions issued in 1957 included "Managing Your Tobacco Plant Bed" (Ibid Cir. 437). Like the "Information for Fruit Growers", this was revised annually for several years and was published jointly by the Plant Pathologist, Entomologist and Agronomist working with tobacco problems. Revisions of "General-Purpose Sprays and Dusts for the Home Flower Garden" (Ibid. Cir. 689) and "Timely control of Garden Diseases and Insects" (Ibid. Cir. 605) were published in 1957. New publications issued jointly by tobacco specialists were "Virginia Fire-Cured Tobacco Varieties" (Ibid. Cir. 752) and "Virginia Flue-cured Tobacco Variety Guide for 1958" (Ibid. Cir. 758). These gave descriptions of recommended varieties including disease reactions. Fenne was the author of "Control Diseases of Strawberries, Raspberries, and Grapes" (Ibid. Cir. 736). A spray calendar for each crop was included. The Virginia Department of Agriculture issued an alert for witchweed, a parasitic flowering plant that had been found in southeastern North Carolina (V.D.A.& I. Bul. 563:9. 1957). Later the V.D.A. & I. stated that counties on the Virginia - N.C. state line had been scouted for witchweed from Mecklenburg eastward (Ibid. 568:10). No witchweed was found nor has it ever been found in Virginia.

On August 1, 1958, R. H. Gruenhagen was appointed Professor of Plant Pathology with time divided between research and extension. He would work on ornamental plant diseases. He had been instrumental in developing methyl bromide as a fumigant against many soil-borne pests (Dowfume MC2 = methyl bromide + 2% chloropicrin in pressurized cans) at the Dow Chemical Co., Midland, Michigan.

W. W. Osborne, Associate Extension Plant Pathologist was granted a 2-year educational leave of absence on September 15, 1958, to pursue a Ph.D. degree at Rutgers University. He would specialize in nematology. He had just completed an M.S. degree. His thesis prepared under the guidance of Henderson was entitled, "A greenhouse and field comparison of the relative phytotoxicity and nematocidal efficacy of certain chemical soil treatments."

Wesley Witcher also completed an M.S. degree under Henderson in 1958. His thesis was entitled, "A greenhouse study of the tobacco root rot complexes." Witcher had been Assistant County Agent/Tobacco Specialist for Halifax and Charlotte Cos. He earned the Ph.D. degree at North Carolina State University and eventually became Professor of Plant Pathology at Clemson University.

Wingard continued membership on the College Resolutions Committee.

R. S. Mullin resigned from the Truck Station to accept a position at Gainesville, Florida as Extension Pathologist for ornamental plants. Had Mullin remained at the Truck Station he would have been transferred to the Station at Painter.

Both Groves and Hurt participated in panel discussions at the 1958 annual meeting of the Virginia State Horticultural Society. Groves was involved in a discussion of, "Maturity and keeping quality of apples" [Va. Fruit 46 (2):82-90]. His participation was very minimal. On the other hand, Groves moderated a panel on "The modern fruit spray programs - five years in retrospect" [Ibid. 46 (2):120-122]. The panel prepared a joint statement covering diseases, insects, and fruit finish. They pointed out how organic fungicides had taken the places of sulfur and Bordeaux mixture. Organics were more target-specific and powdery mildew cropped up in the a absence of sulfur; modifications in captan and glyodin schedules were necessary to suppress it. Streptomycin became available for fire blight control, a disease which had not been satisfactorily controlled before. Resistance to disease controlling materials had not been a problem as it had with insecticides. Specific problems were associated with production of 'York', 'Delicious', 'Rome', and 'Jonathan'. For example, York required special effort to control early rust and scab; Delicious did rot. Rome requires late season attention for good finish, whereas Jonathan being early, required attention to control mildew and early fruit spots. York did not need high quality finish but Delicious did, and so on. Thus, different varieties had different needs and therefore different production costs.

Hurt was in his milieu discussing as a panel member, "The 1958 peach spray programs" [Ibid. 46 (2):123-126]. His only topic was the constriction disease of peach to which 'Golden Jubilee' was the only highly susceptible Virginia-grown peach variety. The disease occurred only in the Tidewater area and no successful control measure had been found. This disease was discussed in the 1958 Virginia Spray Bulletin for the first time.

Howard Rollins, Extension Horticulturist discussed the, "Virginia Spray Service for 1958" [Ibid. 46(2):127-129]. He gave some interesting statistics; three million dollars a year is spent to produce Virginia's apple crop. Each bushel requires more than 20 gallons of spray. Since 1949, with the introduction of new materials and schedules, production per tree rose from 3.8 bu./tree to 5.4 bu. in 1956. In subsequent columns, "Fruit notes for (month)" Rollins hammered away at the need to control apple scab, rust, and powdery mildew [Ibid. 46 (4):32; (5):44; (6):44-46; (7):38] and peach leaf curl [Ibid. 46(11):42]. George Williams was also an Extension Fruit Horticulturist assigned to the Winchester Station. It was obvious that Rollins and Williams were filling a void in fruit extension work, namely, the lack of an extension fruit pathologist. They were also taking a burden off Groves and Hurt who because of their proximity to growers were frequently called upon to fill this need. For them, it had been politically incorrect to ignore requests from their constituents.

The annual meeting of the American Phytopathological Society was held in Bloomington, Indiana, August 24-28. Although several pathologists from Virginia attended the meeting, none participated in the program. It was the 50th anniversary meeting of the Society and most papers were presented in a symposium format and by invitation. Generally, the old guard was in control. However, it was a good time to listen and learn.

Groves was the only Virginian active in Society affairs in 1958. He was an Associate Editor of *Phytopathology* and a member of the Fungicide Advisory Committee. He also read a paper, "The influence of timing and rates of usage of Karathane on the control of apple powdery mildew", (Phytopathology 48:262). Groves defined the dosage and timing necessary to control mildew on 'Rome'.

No Experiment Station bulletins were issued from the Department in 1958; however, several journal papers and a review were published. Roane and T. M. Starling, Agronomist described the "Effects of a mercury fungicide and an insecticide on germination, stand, and yield of sound and damaged seed wheat" (Phytopathology 48:219-223). It was demonstrated that seeds with exposed embryos were subject to mercury (Hg) damage but those with intact seed coats over the embryos were not. Reduction in yield was correlated with the proportion of exposed embryos in a seed lot. Factors favoring Hg injury to damaged seed were dosage of Hg, and duration of high temperature in storage after Hg treatment. Seedsmen were encouraged to have growers slow the threshing machine cylinder speeds, accept chaffier wheat and use seed cleaning equipment rather than threshing machines as cleaners. This was especially important under arid conditions when greatest damage was inflicted by threshing machines. Seedsmen were encouraged to offer premiums to growers for a low percentage of exposed embryos rather than clean wheat. They were also encouraged to delay applying Hg fungicides as long as possible and to avoid high temperature after treatment.

N. C. Teter (Agricultural Engineer, U.S.D.A., Holland Va.) and Roane published, "Molds impose limitations in grain drying", (Agri. Engineering 39:24-27). The molds encountered were *Aspergillus flavus*, *Fusarium moniliforme*, *Penicillium* spp., and *Oospora* sp. During the experiment, field corn in the Holland area was weathered by hurricanes and was moldy from the start. However, the authors were able to generate some satisfactory data for drying corn even though for 1954 and 1955 mold counts were too high even at the optimum temperature and air flow. Teter said that after the experimental drying bins had been emptied for rating the grain, everything in the building was yellow from *A. flavus* spores. This was before aflatoxin had been discovered and had become a no-no word. I have always been glad I was in Blacksburg when the bins at Holland were emptied.

Groves published, "Root diseases of deciduous fruit trees" (Botanical Rev. 24:25-42). This was a follow-up article to that published by J. S. Cooley on the same subject (Ibid. 12:83- 100. 1946). Groves reviewed work on fungi, nematodes, viruses and abiotic factors. Emphasis in the 12 years since Cooley's review had been upon viral and nematode problems and upon control of these diseases. He divided control practices into use of soil fumigants, use of disease-resistant or disease-free rootstocks, and modification of cropping and cultural practices. The *Botanical Review* was the primary outlet for review articles in plant pathology until the *Annual Review of Phytopathology* appeared in 1963.

The Agronomy Department issued, "Results of Barley, Oat, and Wheat Variety Tests Conducted in Virginia in 1957", (Res. Rept. no. 15, May 1958), prepared by J. L. Tramel, T. M. Starling, and C. W. Roane. Roane contributed the disease scores and disease-reaction descriptions. The disease reactions of lines being generated from cooperative Agronomy/Plant Pathology program were excellent. In most cases Virginia lines out-yielded named varieties in the tests. It was nice to be recognized as an author of the small grain reports; such was not the case with the corn test reports. However, it was more important that the Department's contribution to these programs be recognized.

Several articles were published on new or unusual disease occurrences. C. R. Drake reported on foliage blight (*Rhizoctonia solani*) of birdsfoot trefoil from several locations in Virginia (Pl. Dis. Reptr. 42:145-146). Groves, E. L. Wampler, and C. B. Lyon (of Rohm and Haas Co.) described experiments in Virginia and California for, "The development of an efficient schedule for the use of Karathane in the control of apple powdery mildew" (Ibid. 42:252-261). Eight ounces of Karathane per 100 gallons of spray at least every two weeks should effectively control mildew.

K. H. Garren and G. B. Duke (both U.S.D.A., Holland) described, "The effects of deep covering of organic matter and non-dirting weed control on peanut stem rot" (Ibid. 42:629-636). They defined the terms "deep covering" to mean that all surface organic matter was buried to a depth of 4 to 8 inches and "non-dirting" as cultivation without throwing soil around the base of the plants. Weed control in the plant row was facilitated by the use of DNBP (4,6-dinitro ortho secondary butyl-phenol). Bar graphs of the 3-year experiment dramatically show the advantage of the procedure wherein yield of peanuts was greatly increased and incidence of stem rot greatly reduced. While the authors made no claims about originating the procedures, they analyzed the effects of each component and devised a farm-practical program which became standard practice.

C. B. Skotland (U.S.D.A., Raleigh, N.C.) made surveys of soybean fields in the eastern Virginia-North Carolina area and found bean pod mottle virus in one field in Virginia. The exact location of the Virginia collection was not given but this is believed to be the first report of BPMV soybean in Virginia (Ibid. 42:1155-1156). Skotland found for the first time that crimson clover was also a host of this virus. Sometime later, at the Warsaw station a soybean yield trial was planted next to a field of crimson clover. All the soybean plants in the tier nearest the clover displayed symptoms of virus infection then thought to be caused by tobacco ringspot virus; however, no determination was made. The soybeans were so severely damaged that the experiment was abandoned. From subsequent observations on BPMV, it is apparent that this virus caused the damage to the soybeans in the experiment at Warsaw.

Roane and T. M. Starling published, "Miscellaneous notes on small grain diseases in Virginia", a summary of the situations in 1957 and 1958 (Ibid. 42:1268-1271). Diseases new to Virginia in 1958 were scald (*Rhynchosporium secalis*) on rye and sharp eye spot of barley (*Rhizoctonia solani*). This was the first report of sharp eye spot east of the Mississippi R. In 1957, we produced spermagonia and aecia of *Puccinia hordei* on star of Bethlehem foliage (*Ornithogalum umbellatum*) and from aeciospore inoculum we induced uredium formation on barley. Although *O. umbellatum* often occurs near barley infected with *P. hordei*, we have never found naturally infected *O. umbellatum*. Only Mains (1924) had reported producing aeciospores before this report.

Dutch elm disease was spreading in Virginia; F. W. Holmes of the University of Massachusetts reported only scattered pockets of destruction in Virginia through 1957 (Ibid. 42:1299-1300). Although proximal to an original point of entry at Norfolk/Portsmouth, North Carolina apparently remained free of the disease.

The soybean cyst nematode was found for the first time in Virginia in western Nansemond Co. This eventually resulted in a quarantine against the area and created great inconvenience to farmers in the infested area. Movement of soil, agricultural products (peanut hay and pods in particular) was prohibited.

Crazy top, caused by *Sclerophthora macrospora*, occurred on corn in Nansemond Co. (now Suffolk) in two fields (Ibid. 44:696). This was the first report of the disease on corn in Virginia.

There was intensive effort to understand the genetics of reaction to oat stem rust during the late 50's. This research was being carried out by American and Canadian federal workers at St. Paul, Minnesota and Winnepeg, Manitoba. In cooperation with W. Q. Loegering (U.S.D.A., Beltsville, Md.) and D. M. Stewart (U.S.D.A., St. Paul), Roane planted oats of known genotye and reaction to *Puccinia graminis* next to barberry bushes in the creek bottom between S. Main St. and Ellett Rd. in Blacksburg. The bushes were inoculated by scattering telium-bearing oat straw over the bushes. Uredia appeared on the variety 'Saia' which had until then never been observed to host *P. graminis*. A new race, designated Subrace 5A was isolated and characterized at St. Paul (Ibid 42:881-887). Roane had to fight with a muskrat that was dead-set on harvesting the oats before the experiment was completed. A student in wildlife management trapped a muskrat three times but the critter gnawed its leg off and escaped. The fourth time, however, he trapped a muskrat with one leg and three stubs. Why the animal was not dissuaded from raiding the oats after losing a leg, only the muskrat knew.

Fenne reported on an occurrence of stinking smut in Northern Virginia. The smut had built up in farmer-saved, untreated wheat (Ibid 42:1301-1302). There had been no serious complaints about stinking smut in Virginia since the 1920's.

The Extension Service issued several pathology related publications in 1958. Osborne, M. P. Lacy (Extension Agronomist), and K. H. Garren released information on how to "Control Stem Rot in Peanuts by Cultural Methods", (Extension Ser. MR-228). This was an explanation for farmer use of the deep-covering, non-dirting system. Fenne published "Vegetable Seed Treatment", (Extension Ser. Cir. 768), in which he described the chemical and hot water treatments available to home gardeners for most garden crops. "Managing Your Tobacco Plant Bed" (Extension Cir. 437), and "Virginia Flue-Cured Tobacco Variety Guide for 1959" (Ext. Cir. 758) were revised. For plant beds, the use of methyl bromide was encouraged as it appeared to be the most comprehensive soil treatment pesticide available. In the guide, disease reactions of each variety were described. Two Virginia-bred varieties, 'Vesta 5' and 'Virginia 21' gave very good results in regional tests.

Robert Pritou joined the Extension faculty on February 17, 1959 as Associate Professor to replace Osborne who was on educational leave. No other staff additions or changes in status at Blacksburg were noted. At the Truck Station, K. H. McDonald was hired in the position vacated by Mullin; he was stationed at Painter.

Genetics in Relation to Plant Pathology was taught for the first time by Roane. It was offered as a 2H, 2C course during the fall quarter of 1959. According to the syllabus, it would be a 3H, 3C course in 1961. Wingard continued as a member of the College Resolutions Committee. A. B. Massey, Professor of Botany, now a member of the Biology Department Faculty, retired June 30. Massey had been hired by F. D. Fromme in 1918 as Associate Bacteriologist in the Experiment Station to work on bacterial diseases of plants. Later he taught Introductory Plant Pathology in the Department of Botany and Plant Pathology and the Department of Biology. Although he was initially a phytobacteriologist, he became the premier botanist in Virginia and established an herbarium of about 25,000 specimens. The Massey Herbarium is a well-maintained segment of the Biology Department of V.P.I.&S.U.; and the Virginia Museum of Natural History.

The annual report for the 1958 Fiftieth Anniversary meetings of the American Phytopathological Society revealed that A. B. Groves would serve as a member of Advisory Committee on Collecting and Disseminating New Fungicide Data for 1959 and he was also appointed by the Council to become coordinator of the project to publish the report for 1957. L. G. Utter, in the Committee Report praised Groves for initiating new procedures, which would increase the value of the annual publication, "Results of the Year Fungicide Tests". It was announced later that he would coordinate the sales and distribution of the, "Results of the 1958 Fungicide Tests" from his office at Winchester [Phytopathology News, end of Phytopathology 49 (9)]. This became a long-lasting publication of the Society. Groves was also a member of the Fungicide Advisory Committee for 1959. At the February 26-27, 1958 meeting of the Potomac Division of A.P.S., Groves was elected Vice-President. As such, he would act as Program Chairman for the 1959 meeting. Thus, it appears that Groves would have a busy year of service to the Society.

As a part of the celebration of its fiftieth anniversary, the A.P.S. published photographs of all the charter members and presidents for whom pictures were available. A photograph of charter member H. S. Reed, our department head, 1908-1915, was not available. F. D. Fromme, our department head, 1915-1928, and A.P.S. President, 1924, was the only Virginian included (Phytopathology 49:233-248).

At the January 12-14, 1959 meeting of the Virginia State Horticultural Society, both Groves and Hurt served on panels to discuss, "New spray materials in 1959" [Va. Fruit 47 (2):137-139], and "Review of 1958 situation and changes in spray recommendations brought about by new developments in pest control" [Ibid. 47 (2):140-144]. Groves was moderator of the former. Cyprex was the only new fungicide discussed; it was characterized as both a protectant and eradicant chemical with limited systemic action. It was found to be excellent for control of apple scab and cherry leaf spot. The 1958 fruit year was characterized as being a disease-free year. Only primary but no secondary scab infections occurred. However, there was more spray injury than usual. This was attributed to low sugar content and succulence of the early season foliage. The pathologists listed only minor changes for disease control. The glyodin-mercury and sulfur-ferbam programs were changed to a glyodin-ferbam program.

C. Lyman Calahan, Extension Horticulturist of the University of Vermont, discussed experiences with, "Orchard pest control by air dusting" [Ibid. 47 (2):130-137]. Some of the points he made were:

1. Scab control is equal or better than other methods.
2. Excellent finishes are produced.
3. Phytotoxicity is reduced.
4. Labor and equipment costs are reduced.
5. Water requirements are eliminated.
6. There is no damage by rutting the orchard floor with machinery.
7. Pruning season is extended because brush removal could be delayed.

He also noted disadvantages; namely, availability of skilled pilots, break-downs, coordinating with neighbors because of toxic drifts, insect control is more difficult than disease control. It was a good pro-con discussion.

Garren published a technical bulletin covering his work on, "The Stem Rot of Peanuts and Its Control" (Va. Agri. Expt. Sta. Tech. Bul. 144). He gave a comprehensive review of the literature leading up to the deep covering and non-dirting procedures for reducing losses from stem rot. Although the effects of deep covering and non-dirting had been documented when Garren began his work, he provided additional data suggesting that combining the procedures with applications of herbicides for weed control would result in maximum protection from stem rot. He revolutionized and helped modernize peanut culture.

In the publication discussed above, Garren cited two papers concerning the use of herbicides. From work reported in, "An evaluation of role of dinoseb in "non-dirting" control for peanut stem rot" (Pl. Dis. Reptr. 43:665-667), it was concluded that dinoseb was more valuable as an herbicide than as a fungicide in stem rot control. In a companion report, the "Effectiveness of non-dirting cultivation and soil-surface applications of PCNB in controlling peanut stem rot," was evaluated (Ibid. 43:750-752). As in the case of dinoseb, PCNB was found to have little fungicidal value when applied to the soil surface in the non-dirting treatments but had value when used in dirting treatments.

Osborne and M. P. Lacy (Extension Agronomist) publish Extension Service Cir. 825, "Control of Stem Rot in Peanuts by Cultural Methods," in which they described the procedures developed by Garren in lay-terms. This was for general distribution to peanut growers. In 1959, W. S. Hough, A. B. Groves and C. H. Hill (all at the Winchester Fruit Lab.) prepared a summary of their work with pesticide mixtures (Effects of Some Spray Mixtures on Toxicity of DDT, Parathion, and Malathion. Va. Agri. Expt. Sta. Tech. Bul. 143). With each of the insecticides, they tested the toxicity toward the codling moth in orchards when they were mixed with oil emulsion, sulfur, Bordeaux mixture, ferbam, glyodin, captan, zineb, cyprex, and Rhothane, and several miticides. In mixtures, the toxicity of DDT was maintained or only slightly reduced.

Henderson compiled a report on "Performance of Tobacco Varieties and Breeding Lines Tested in Virginia in 1957" (Va. Agri. Expt. Sta. Res. Rept. 14. 1959). Only black shank ratings were provided. Many Virginia selections were scored higher (= better) than the resistant control variety 'Burley 11A'.

J. L. Tramel, T. M. Starling (Agronomists) and Roane published "Results of Barley, Oat, and Wheat Varietal Tests Conducted in Virginia in 1959" (V.A.E.S. Res. Rept. 32). Reactions to diseases were recorded for all crops. Soil-borne mosaic was observed in the winter oat test at Charlotte C.H., the first time it occurred in oat tests in Virginia.

Troutman reported that he could select streptomycin-resistant strains of *Pseudomanas tabaci* by exposing the bacteria to wells of the antibiotic on agar plates and inoculating tobacco with isolates that survived nearest the wells. In 8 streptomycin - tobacco cycles, he was able to increase resistance to streptomycin (Phytopathology 49:553). Streptomycin was used to control wildfire and angular leaf spot in seed beds. Troutman's results were an ill omen.

Three papers were contributed to the *Plant Disease Reporter* by the faculty in 1959. J. G. Moseman, U.S.D.A., Beltsville, and Roane collaborated on a survey of *Puccinia hordei* races in the United States for 1956 through 1958. Six races, 4, 16, 34, 40, 44, 45, were found. Only 4 and 16 were recorded from Virginia (P.D.R. 43:1000-1003). Troutman and Fenne recorded the occurrence of tobacco curly-top in Virginia for the first time. The causal agent was thought to be the sugar beet curly-top virus. Curly-top was found in Appomattox, Charlotte, Franklin, Lunenburg, and Pittsylvania Cos. (Ibid. 43:155-156). Teter (U.S.D.A., Holland) and Miller described the effects of seed injuries upon germination of peanut seeds (Ibid. 43:353-359). Germination percentage was not impaired by injuries to the radicle end of peanut seeds but rate of germination was imparied. Various degree of curvature resulted when damage seeds were oriented differently in the soil.

The Extension Service pathologists were particularly active in the publication arena. Fenne published a new bulletin entitled, "What You Should Know About Plant Diseases" (Va. Agri. Ext. Ser. Bul. 261). Fenne categorized diseases by causal agents and by symptoms; it was well illustrated and fairly comprehensive. Fenne either authored or co-authored several circulars on subjects such as, "Raspberry and Blackberry Spray Calendar" (Ext. Ser. Cir. 819), "Controlling Lawn and Turfgrass Diseases" (Ibid. Cir. 802), "Timely Control of Garden Diseases and Insects" (Ibid. Cir. 605, rev.), "How to Control Fire Blight" (Ibid. Cir. 643, rev.). Fenne also issued four "Plant Disease Notes" which were to alert growers and agents what diseases to expect and how to prevent them if possible. J. M. Amos, Extension Entomologist, wrote a, "Spray Program for Grapes" (Ibid. Cir. 805) including recommendations for disease and insect control. Gruenhagen initiated the "Nurserymen's Notebook" in which he illustrated and described in single sheet publications 13 diseases of ornamental plants or problems associated with nursery materials.

The Truck Station began the monthly *Vegetable Growers News* (VGN) in 1946. This eventually supplanted the Station Bulletins which ended in 1956 when Bulletin 115 by Mullin and Nugent was issued. It is apparent that K. H. MacDonald was hired in 1959 to replace R. S. Mullin who resigned in 1958. MacDonald was stationed at the new site in Painter, Accomac Co. He published items in the VGN from 1959 to 1963. MacDonald's first report appeared in May 1959 and was on nematodes [VGN 14 (5):1]. He described disease research on Eastern Shore [VGN 14 (7):4], tomato wilt diseases [VGN 14 (9):4], foliage and fruit disease of tomato [VGN 14 (11):2], and pepper diseases [VGN 14 (12):2-3].

Nugent also contributed notes in 1959. He described diseases of fall snap beans [VGN 14 (1):3], progress in the development of disease-resistant muskmelons [VGN 14 (9):2], and soil rot of sweet potatoes [VGN 14 (10):2]. The Director, E. A. Borchers, described fusarium wilt of tomatoes and listed varieties resistant to it [VGN 14 (4):2].

Some pathogens reported for the first time in Virginia were oat soil-borne mosaic virus at Charlotte C.H. (Pl. Dis. Reptr. 44:696), *Dothiorella quercina* was found on white oak and chestnut oak in Craig and Shenandoah Cos. (Ibid. 44:351), *Exosporium glomerulosum* was found at Ashland on red cedar (Ibid. 44:527), and the potato Y virus infected a few tobacco plants at Blacksburg (Ibid. 47:187-188). The horsenettle cyst nematode was discovered in tobacco counties by Miller 1959. It was later described as *Heterodera virginiae* (and even later as *Globodera tabacum virginiae*).

The Experiment Station Director authorized a, "Research Report of the Virginia Agricultural Experiment Station for the Period July 1, 1957 to June 30, 1959." Plant pathologists contributed many reports; in order of appearance some of the contributions were:

- A. S. Williams classified alfalfa varieties for resistance to southern anthracnose (p. 53), and reported a 3 or 4 year rotation would control stem nematodes in clovers but not in alfalfa (p. 53-54).
- Drake reported birdsfoot trefoil is totally susceptible to Rhizoctonia foliage blight (p. 57-58).
- Williams found both *Uromyces dactylis* and *Puccenia graminis* on orchardgrass with *P. graminis* predominating (p. 60); he also demonstrated the pathogenicity of *Corynebacterium raythi* on orchardgrass (p. 61).
- Control of mercury damage to wheat by several methods was reported by Roane et al. (p. 90); Roane also reported on the identification of 5 loci for leaf rust-

conditioning genes in barley (p. 90).

- Miller had several reports on nematodes injuring peanuts (p. 95-98). He found sting nematodes to be damaging only on fine sandy loam soils. Rootknot nematodes caused more damage because they were more widely distributed. Several nematicides were recommended for controlling peanut nematodes but hay from bromine-treated soils could not be used to feed dairy cows or other animals to be finished for slaughter.
- Henderson, LaPrade, and Spasoff described the breeding of disease-resistant tobacco varieties. Considerable progress was made in improving the quality of black-shank-resistant varieties (p.105-109).
- Troutman and LaPrade developed a procedure for selecting resistant plants and progenies for resistant to black shank. They used muffin pans and adapted them to a hydroponic, controlled temperature system (p.110-113).
- Groves reported that organic fungicides (captan, ferbam, and thiram) were superior to lime-sulfur and Bordeaux mixture and were less expensive for control of peach leaf curl (p.205- 206).
- Spasoff and Wingard reported on disease control for tomatoes. Their work involved field testing of varieties and lines and fungicidal dusts (p.219-220).
- Gruenhagen found that slow decline of boxwood was caused by a number of parasitic nematodes and that plants could be restored to health by applications of nematicides (p. 226-227).

Thus, the Research Report provided a compact summary of research progress for the two to four years prior to its publication.

Grover C. Smart, Jr. was appointed Assistant Plant Pathologist July 1, 1960 to work on nematode problems in the Holland area. Smart had been a student of Gerald Thorne at the University of Wisconsin. Thus, he was the first professionally trained plant nematologist on the staff.

Lawrence Miller was honored by being presented the J. Shelton Horsley Award of the Virginia Academy of Science. His research paper which earned him the award was entitled, "The influence of soil components on the survival and development of the sting nematode" (Va. J. Sci. 11:160). Temperature, pH, and soil moisture were not limiting factors; only soil texture was limiting. Groves was elected President of the Potomac Division and would preside over the 1961 meeting. For the parent Society he would continue as a member of the Advisory Committee on Collecting and Disseminating New Fungicide Data (Ibid. 50:243). Henderson was appointed to the editorial board of *Tobacco Science*. He would serve for four years, 1960-1963.

The Virginia State Horticultural Society held its 1960 annual meeting at the Hotel Roanoke in January. Both Groves and Hurt were on panels to discuss research with new materials [Va. Fruit 48 (2):129-134] and new approaches to spray programs [Ibid. 48 (2):135- 138]. Groves moderated the panel on new materials; initially, he described 6 criteria for establishing test sites in commercial orchards. He summarized the comparative usefulness of different fungicides on peaches and apples. In the discussion of the new approach, it was pointed out that the spray bulletin was extensively revised but most changes were for insect control. Most articles on diseases appeared in Howard Rollin's columns on fruit notes in volume 48.

An assortment of research publications appeared in various journals. Roane had a paper on the spread of stem rust from barberry bushes and the survival of races in the spreads. This was the result of 4 years of cooperative work with E. C. Stakman, W. Q. Loegering and D. M. Stewart (all of Univ. of Minnesota and the U.S.D.A. Rust Laboratory) and W. M. Watson (Barberry Eradication Supervisor for Virginia). In the paper, it was reported that many races of *Puccinia graminis* were established on wheat near barberry bushes and that virulence was not co-inherited with survivability. Some races with virulence toward several differential varieties were collected near barberry bushes but not further into the wheat field. Some races with relatively menial virulence multiplied rapidly in the field (Phytopathology 50:40-44).

Only Garren published an abstract (Ibid. 50:575). At the Southern Division meeting he reported that he could garner no evidence to support the concept that runner varieties of peanuts are more resistant to stem rot than bunch types.

In the *Plant Disease Reporter* (P.D.R.), Drake reported birdsfoot had been damaged by *Sclerotium rolfsii* at the Holland station. The association had not been noted previously (P.D.R. 44:115-116). Roane described the killing of winter oats in April following heavy snowfalls during February and March. The killing was caused by *Pseudomonas coronofaciens*, the halo blight bacterium. Resistant and susceptible varieties were clearly recognizable in yield trials at the Orange Station (P.D.R. 44:696). Responses of varieties to halo blight in yield trials were published in Va. Agri. Expt. Sta. Res. Rept. 45, 1960. Killing of winter oats by this bacterium had not been recorded previously. Curtis May and Ross W. Davidson (U.S.D.A.) found *Endothia parasitica* causing cankers on live oak in Williamsburg. Live oak had not been previously found to be a host of *E. parasitica* (P.D.R. 44:754).

In 1960, from the Extension Project Report for plant pathology, black root rot and nematodes caused considerable losses in tobacco; scab of wheat and barley was widespread and severe; the soybean cyst nematode was found in Southampton and Isle of Wight Cos. adjacent to the area it was originally found in Nansemond Co.; and milk was reported by North Carolina workers as useful in controlling tobacco mosaic virus.

Several Extension Service publications were issued in 1960. "Disease of Forage Crops" (Ext. Ser. Bul. 188, rev.) was completely revised. Sections on diseases common to legumes, and diseases of grasses were added. Soybean diseases were deleted. Four pages of color plates made the new edition a great improvement over the 1954 edition. Circular 635, "Control Diseases for Finer Tomatoes" was upgraded with new photographs, charts, and lists of pesticides. Fenne collaborated with B. Arorian, Horticulturist) to publish, "Black Root Rot of Strawberries" (Cir. 858). In general, it was devoted to strawberry culture because the cause of black root rot was not very well understood. The fire blight control circular was revised (Cir. 643) and mimeographed Nurserymen's Notebook sheets on cedar-apple rust and maple tar spot (MR-O-14, -O-15) were issued by Gruenhagen.

The Virginia Department of Agriculture and Immigration alerted farmers to treat soybeans harvested in 1959 for use as seed in 1960 with Arasan. The 1959 crop was severely weathered by hurricanes and was of poor quality. Seed treatment would be necessary if adequate stands were to be obtained (V.D.A.& I. Bul. 598:10). The Department also commented on the discovery of the soybean cyst nematode in Nansemond Co. in 1958. Miller had found a way to fumigate machinery cheaply and had been awarded $5000 to make further investigations on nematodes (V.D.A.& I. Bul. 601:3-4). Apparently, the method involved steam and compressed air but a description of it is yet to be found.

E. M. Matthews, Wybe Kroontje (Agronomist) and Henderson summarized their 3-year study on the "Effect of length of rotation on losses from black shank in flue-cured varieties" (Tob. Sci. 4:156-158). A 2-year rotation greatly reduced black shank in resistant varieties but had little effect on the incidence in susceptible varieties. A 3-year rotation virtually eliminated black shank in all varieties.

After several years of being a cooperator but being ignored in reports, Roane was recognized as a cooperator in, "1959 Virginia Corn Performance Tests" (V.A.E.S. Res. Rept. 35. 1969). Leaf blight ratings at three locations were included.

Henderson compiled, "Performance of Tobacco Varieties and Breeding Lines Tested in Virginia in 1958 and 1959" (V.A.E.S. Res. Rept. 37. 1960). M. J. Rogers, J. L. LaPrade (Chatham), Luben Spasoff (Blacksburg) and Frank McClaugherty (Glade Spring) were shown to be cooperators. Reactions to black shank were included for some tests.

T. J. Smith, P. T. Gish (Agronomists), and Williams summarized, "Varietal Tests of Sudangrass and Pearl Millet in Virginia, 1954-1959 (V.A.E.S. Res. Rept. 38. 1960). Leaf blight (caused by *Helminthosporium turcicum*) was the most damaging disease of Sudangrasses. No major disease occurred on pearl millets.

Tramel, Starling (Agronomists) and Roane published, "Results of Barley, Oats and Wheat Varietal Tests Conducted in Virginia in 1960" (V.A.E.S. Res. Rept. 45. 1960). Net and spot blotch became a problem in barley nurseries, halo blight damaged winter oats at all locations, leaf rust and powdery mildew caused damage to several wheat varieties.

W. H. Matheny of the Virginia Department of Agriculture reviewed the status of the soybean cyst nematode (Va. J. Sci. 11:161). From surveys it was revealed that the SCN occurred on 125 farms in Nansemond, Isle of Wight, and Southampton Cos. Rotations, pesticides, and resistant varieties could be used to contain the pest. Federal and State quarantines had been in effect since September 1, 1959, as a further measure of containment.

The faculty grew again in 1961. Samuel W. Bingham was appointed Associate Professor of Plant Physiology to work primarily on weed problems in turf and ornamentals. Cecil W. Lefevre was named Assistant Professor Plant Physiology to work on *Artemisia vulgaris*, an aggressive, allelopathic weed. John P. Sterrett was appointed Assistant Professor to work on weed and brush control in rights-of-way. Wyatt Osborne returned from Rutgers University where he had earned the Ph.D. degree in nematology. He would work on nematode and other types of diseases of field crops but chemical control would become his forte. With these gains, the Department also lost R. H. Hurt, long time fruit disease specialist at Charlottesville, who retired November 6.

Terry C. Davis, Jr. was third person to earn an M.S. degree in plant pathology in the 1949-1964 era. He was a Graduate Teaching Assistant from September 1959 to June 1961. His thesis was on, "Etiology and Symptomatology of Hemlock Twig Rust Caused by *Melampsora farlowii*". Gruenhagen was his advisor. Terry became Assistant Professor of Forest Pathology at Auburn University.

At the 1961 meeting of the Virginia State Horticultural Society, no member of the Department was on the program. On the cover of the May issue of *Virginia Fruit*, Groves was pictured and it was announced that he had a heart attack in February [Va. Fruit 49 (5):2]. There were some landmark events in 1961. G. M. Shear, Plant Physiologist in the Department, J. E. Moody and J. N. Jones, Agronomist and Agricultural Engineer (U.S.D.A.), respectively, read two papers that seemed to represent routine weed control work in corn. The papers "Corn production without tillage possible through use of herbicides" (Proc. Sou. Weed. Conf. 14:116-117) and "Growing corn without tillage" [Soil Sci. Amer. Proc. 25 (6):516-517] led to a revolution in corn production. As will be seen later it also elevated gray leaf spot of corn from a minor curiosity disease to a major problem disease.

Roane and T. M. Starling, small grains breeder in the Agronomy Department, after 12 years of cooperative effort released their first varieties of oats and barley. 'James' barley was a leaf rust and powdery mildew resistant selection from a cross of Wong ? Bolivia made at the North Carolina Experiment Station. 'Roanoke', a winter oat, was selected from a complex cross with 'Arlington' as one parent. The cross was made by F. A. Coffman, oat breeder for the U.S.D.A. Arlington, which Roanoke replaced, was susceptible to the very destructive Victoria blight disease; Roanoke was resistant. Both James and Roanoke provided a several bushel yield advantage over other recommended varieties (Extension Leaflets 154, 155. 1962).

In the academic field, the Department presented a petition (dated November 1961) for permission to offer a Ph.D. program in the Department. Apparently the petition was favorably received and permission was granted before the end of the year. Work was begun to develop syllabi for new courses proposed in the petition. Again, M. G. Hale was the spark for this enterprise.

Genetics in Relation to Plant Pathology was taught as a 3-credit course for the first time. Grace P. Li was the only student among seven in the course who was majoring in plant pathology. The report for the 1960 annual meeting of the American Phytopathological Society was published in January 1961 (Phytopathology 51:43-64). Groves was named chairman of the New Fungicide and Nematocide Data Committee and by virtue of this chairmanship was automatically a member of the Publications Committee (Ibid 51:44). Gordon Utter, outgoing Chairman of the Fungicide, etc., Committee, praised Groves for improvements in quality and manner of distribution of the committee's publication (Ibid. 51:57-58). At the March meeting of the Potomac Division, Groves was elected Councilor after serving as President for 1960-61.

A symposium on *Sclerotium rolfsii* was held at the Southern Division meeting February 1-6, 1960. Garren detailed the "Control of *Sclerotium rolfsii* through cultural practices". Since participation in the symposium was by invitation, it was an honor for Garren to be on the panel and to have the paper published in *Phytopathology* (Ibid. 51:120-124). He highlighted the deep covering and non-dirting procedures for row crops as illustrated by his experiments with peanuts.

M. G. Hale, Plant Physiologist in the Department, and Roane published a paper on, "The nutrition of *Helminthosporium carbonum* race 1 in relation to parasitism in corn" (Ibid. 51:235- 240). Parasitism could not be correlated with any substance extracted from susceptible or resistant plants or any nutritional requirements.

Drake found that *Rhizoctonia solani* caused crown rot of birdsfoot trefoil at Blacksburg (Pl. Dis. Reptr. 45:572-573). An aphid-transmitted virus similar to radish yellow virus was found to be causing problems for spinach growers in Virginia and other eastern states. (Ibid. 45:720- 721). Osborne found a cyst nematode parasitizing tobacco in Amelia Co. (Ibid. 45:812-813). The nematode was tentatively assigned to *Heterodera tabacum*. Grover Smart found peanut rust, *Puccinia arachidis*, in Southampton and Nansemond Cos. on October 6. This was the first record of the disease in Virginia (Ibid. 46:65). J. C. Wells of North Carolina State College also reported its occurrence in 12 counties of his state. He stated that rust does not overwinter in North Carolina and that it occasionally blows northward from South America and the West Indies (Ibid. 46:65). Thus, it was not expected to reappear in 1962.

Among the Experiment Station publications were, "Peanut Nematode Disease Control", by Miller and G. B. Duke, Agricultural Engineer, U.S.D.A., Holland (Va. Agri. Expt. Sta. Bul. 520) and, "Evaluation of Forage Crop Varieties in Virginia," by P. T. Gish, T. J. Smith (Agronomists), and A. S. Williams (Va. Agri. Expt. Sta. Bul. 528). Miller and Duke named as nematodes to be controlled, sting, northern rootknot, peanut rootknot, and smooth-headed lesion nematodes. Fumigants listed for nematode control were ethylene dibromide (EDB), dibromochloropropane (DBCP), dichloropropene-dichloropane (DD), and dichloropropenes (D). Materials could be applied overall in the fall, or in rows or overall in the spring. Applicantion equipment was carefully described and illustrated. Precautions were emphasized for handling the materials and feeding hay from treated soils. Treatments were shown to give profitable returns. Forage crops evaluated in Bulletin 528 were alfalfa, red clover, lespedeza, Sudangrass, Sudangrass-Johnsongrass hybrids, and pearl millet. Where data were obtained, reactions to diseases were given. Leaf blight caused by *Helminthosporium turcicum* was the only disease of consequence on the Sudangrasses. No literature was cited in either bulletin.

Henderson was still serving the tobacco workers. He was in his second year on the Editorial Board of *Tobacco Science*. Wingard continued as a member of the V.P.I. Resolutions Committee.

In "Results of Barley, Oat, and Wheat Varietal Tests Conducted in Virginia in 1961" (Va. Agri. Expt. Sta. Res. Rept. 60. 1961), Tramel Starling, and Roane found spot and net blotch to be very damaging to barley varieties in the Blacksburg test and that greenhouse seedling tests did not correlate well with field tests for barley powdery mildew. For oats, field reactions to soil-borne oat mosaic and halo were reported for the first time. Resistance and susceptibility were clearly evident. In wheat, seedling and field reactions to powdery mildew correlated well.

Director H. N. Young authorized the publication of a triennial research report under the title "Agricultural Progress" (Va. Agri. Expt. Sta. Res. Rept. 57. 1961). The report was prepared by the editorial staff of the Experiment Station. Illustrations include the small grains head-row and yield-trial nurseries, damage of oats by the halo blight bacterium at Orange (*Pseudomonas coronafaciens*), root damage to alfalfa (*Phytophthora cryptogeae*), fumigation of vehicles for soybean cyst nematode control, effects of black root rot on tobacco, manipulation of *Phytophthora parasitica* var. *Nicotiana* in the laboratory (pp.11-15), post-harvest rot control in peaches, rootknot resistant tomato, and nematode control by fumigation of holly roots (pp.34-

37). Most of the research accomplishments have been recorded previously in this text. Chemical control of dollarspot in bentgrass was described. Actidione-Thiram, Dyrene, Kromad, and Ortho fungicides controlled dollarspot in 1960 and 1961 tests.

At the Virginia Academy of Science annual meeting, Grover Smart described the , culture of the soybean cyst nematode" (Va. J. Sci. 12:153). In a 90% sand, 10% kaolin clay mixture, soybeans supported populations of the SCN free of weeds and organic residues.

In Extension, Fenne published two new circulars and contributed to revision of two others. "Black Root Rot", of tobacco (Ext. Cir. 894) was precipitated by the occurrence of severe damage in 1958 and 1960 attributed to *Thielaviopsis basicola*. In control measures, Fenne recommend a soil pH of 5.4 to 5.6, fumigation of seed beds with methyl bromide, a three or four year rotation which emphasized cereal and grass crops between tobacco crops, and growing resistant varieties which he did not name. In, "Oak Wilt" (Ext. Cir. 621), he described the manner of transmission of the fungus, *Endoconidiophora fagacearum*, its distribution in Virginia and control measures. The disease was described as a dire threat to oaks but anxiety over the consequences of the disease has subsided.

The Extension staff in Plant Pathology issued, "Controlling Sting and Northern Rootknot Nematodes of Peanuts" (Ext. Ser. Cir. 879). Fumigants applied over-all (broadcast) would control sting nematodes for three years but northern rootknot for only one. Therefore, annual row treatment was recommend for rootknot control. Various rotations were suggested to ameliorate the severity of nematode damage.

Three departments contributed to the revision of, "Managing Your Tobacco Plant Bed" (Ext. Ser. Cir. 437, rev.). Use of streptomycin for control of wildfire and blackfire and fumigation of soil with methyl bromide were the latest innovations. Fenne also issued three mimeographed leaflets aimed at control of diseases in gardens. At the Truck Station, K. H. McDonald described Fusarium and Rhizoctonia root rots of beans [Veg. Growers News 15(12):4].

In 1962, the faculty was again enlarged. Claude Fordyce, Jr., was appointed Assistant Professor of Plant Pathology on July 1 after earning the Ph.D. degree at Purdue University. He would work on diseases of ornamental crops, especially woody plants.

John J. Albert was appointed Instructor of Plant Pathology at Winchester as of April 1. His appointment was necessitated by Groves' need to have an understudy after having experienced a heart attack in early 1961. Albert had earned an M.S. degree at the University of Delaware and had worked one year toward a Ph.D. degree at Pennsylvania.

Charles Drake made a lateral move from Plant Pathologist, U.S.D.A., A.R.S. to Associate Professor of Plant Pathology as a replacement for R. H. Hurt. Drake, however, would be located at Blacksburg, not Charlottesville. His appointment, like Albert's was effective April 1. (No April fools, they!). Eventually Drake became Albert's advisor for Ph.D studies. Albert was pictured on the cover of the May issue of *Virginia Fruit* [50 (5): cover, 2]. The Experiment Station was applauded by the State Horticultural Society for having acted promptly to Groves' needs. Drake was pictured on the cover of the August issue and there was a biographical summary of his career on p. 18 [Va. Fruit 50 (8): cover, 18].

On July 1, J. L. Troutman of the Chatham Bright Tobacco Disease Research Station was promoted to Associate Plant Pathologist. Troutman had been the primary investigator in the development of a laboratory indexing procedure for identification and selection of black shank resistant tobacco germplasm.

Grace Li completed her M.S. Degree in June. Her thesis was entitled, "Cross Protection of Rust Fungi on Barley". She was advised by Roane. Grace became a Senior Research Mycologist at the Upjohn Drug Company in Kalamazoo, Michigan.

Donald H. Kludy, as a student of Gruenhagen, completed an M. S. degree program in September. His thesis was entitled, "Effects of Root-Knot Nematodes on Growth of Three Species of Woody Ornamental Plants". Kludy at first became a Nursery Inspector and later State Entomologist for the Virginia Department of Agriculture. He served as a Graduate Research Assistant while at V.P.I.

The 1961 annual meeting of the American Phytopathological Society was held at Biloxi, Mississippi December 10-13. Several members from V.P.I. participated. Getting from Blacksburg to Biloxi was a nerve-wracking experience. We left Blacksburg on the morning of December 9; a freezing rain had glazed the highways in several places. A tractor-trailer rig had slid into the ditch and overturned near Marion; one had jack-knifed near Rogersville, Tennessee. Its tandem rear wheels had rolled several hundred feet into oncoming traffic. Nearby a truck load of hogs had overturned and caught fire killing its squealing load. At Marysville, on a narrow bridge, two cars had crashed head-on killing the several occupants in both cars. When we arrived at Chattanooga for an over-night stop, all five of us, Gruenhagen, Pristou, Troutman, Osborne and I, had some stiff drinks to quell our frayed nerves. At the restaurant, somebody ordered rabbit pot-pie. It should have been very tasty except the bones had been crushed and dispersed throughout the serving. It was concluded that the poor rabbit must have been picked up from the highway after being struck by a car. The ride to Biloxi was much more soothing than that to Chattanooga.

Papers were presented at the Biloxi meeting by Drake and Roane. Drake described the control of Stemphylium leaf spot (*Stemphylium loti*) on birdsfoot trefoil with Dyrene. He could achieve an one-ton/acre increase in forage yield with 6 lb/acre of Dyrene at 7-day intervals. The effect on animals fed treated hay was not noted. Details of this were published later in the year (Pl. Dis. Reptr. 46:509-512). Drake also gave a paper on the host-parasite relations of *S. loti* in leaves and stems (Phytopathology 52:8). Roane reported on the genetics of reaction to *Puccinia hordei* in barley; he identified, 4 or possibly 5 loci in the race differentiating cultivars. There was considerable duplication of loci among the 9 cultivars (Ibid. 52:26).

Only Groves served the Society; he served as Councilor for the Potomac Division in 1962 and as a member of the Committee on New Fungicide and Nematocide Data (Ibid 52:463-464); he was chairman of the committee in 1961. In his report to the Council, Groves showed a continuing increase in sales and profits from the publication "Results of Fungicide-Nematocide Tests". He suggested that his health had become tenuous and he should be relieved of the chairmanship (Ibid. 52:476-477).

About 9 months later, the 1962 meeting was held in Corvallis, Oregon, August 26-29. Miller, in collaboration with M. B. Harrison and A. F. Schindler, described the, "Horsenettle and Osborne's cyst nematodes – two undescribed nematodes occurring in Virginia" (Ibid. 52:743). Difference between the two nematodes are slight; neither was given a Latin name.

The Potomac Division met April 24-25 in Morgantown, West Virginia. Garren presented two papers. In the first, "Reaction of five peanut varieties to cultural control of stem rot", he reported that 'NC 2' and 'NC 4X' showed less infection than 'Va, Bunch 46-2', 'Ga. 119-20', and 'Va. 56R', but there were no differences in yield of nuts. In, "Use of specific pesticides in determining the probable cause of peanut pod rot", Garren had tested fungicides specifically toxic to *Pythium* spp. and *Rhizoctonia* spp. From tests with 15 materials, he concluded a *Pythium* sp. caused pod rot (Ibid. 52:1218). At the same meeting Smart reported on, "Distribution of cysts of *Heterodera glycines* in soil at different depths" (Ibid. 52:1221). He found cysts to a depth of 3 ft. while soybean roots extended to 5 ft. Although the majority of cysts were found 3 to 6 in. below the surface, he seemed to imply that eradication of the nematode would be very difficult.

Roane published the first of 3 papers on, "Inheritance of reaction to *Puccinia hordei* in barley" (Ibid 52:1288-1295). The data supported the paper presented at Biloxi; gene symbols were not assigned. Of significance was Roane's departure from classifying reaction types 0-2 as resistant and 3-4 as susceptible. Instead, 0-3 and 4 were the major classes, called non-4:4. This led to precision in identifying genes, a precision that was lost when the scheme for identifying physiologic races (0-2:3-4) was employed.

M. G. Hale, and Plant Physiologist, Roane, and M. R. C. Huang, Plant Physiology Graduate Student, published on the, "Effects of growth regulators on size and number of leaf spots, and on 0_2 uptake and extension growth of coleoptile sections of corn inbred lines K41 and K44" (Ibid. 52:185-191). Some growth regulators increased the size and number of spots caused by *Helminthosporium carbonum*. These same growth regulators caused an increase of 0_2 uptake and coleoptile extension.

There were very few Experiment Station publications in 1962. The 1961 corn performance tests were summarized by Ed Shulkcum and C. F. Genter, Agronomists, with Roane furnishing leaf blight data (Va. Agri. Expt. Sta. Res. Rept. 62). It was noted that Virginia-bred hybrids were invariably scored lower (= better) than the test average for leaf blight in the Blacksburg and Holland tests. At Blacksburg, *Helminthosporium turcicum* caused the blight but at Holland it was mostly *H. maydis*. Although stalks were scored for stalk rot, the scores were not reported; the number of lodged and broken stalks was considered to be more useful information. Although the statements above hold generally true for the 1962 tests, gray leaf spot (GLS caused by *Cercospora zeae-maydis*) caused severe damage to the plants in the Glade Spring test (Ibid. 68:27. 1963). GLS had been noted frequently in our Blacksburg tests and breeding nurseries, this was the first occasion it had caused general damage. The scores averaged 3.6 on a scale of 0-5.0. Only two entries were scored less than 3.0. It was apparent that there was little resistance to GLS among a diverse group of 39 entries. GLS would become a serious problem as no-till corn production became commonplace.

Starling, Tramel (Agronomists) and Roane published "Results of Small Grain Varietal Tests Conducted in Virginia in 1962" (Ibid. 66). From the Petersburg test (p.11) we learned that only 'Hudson' barley seemed immune from scald (*Rhynchosporium secalis*); that several oat varieties (p.18) were resistant to the soil-borne mosaic virus and barley yellow dwarf virus (which we called red leaf); and that resistance to powdery mildew and leaf rust was absent in most Virginia-bred wheat entries (p.27). It was obvious that new sources of resistance were needed.

Troutman and LaPrade published their results on the, "Effect of pH on the Black Shank Disease of Tobacco" (Va. Agri. Expt. Sta. Tech. Bul. 158. 1962). They found that at pH 4.0 even susceptible 'Va. Gold' survived well in laboratory tests when inoculated with *Phytophthora parsitica* var. *nicotianae*. In the field at pH 4.2 less than 10% of susceptible 'Va. 12' plants were killed. In the field, all susceptible plants died in limed plots as did some resistant plants. These results led to more careful management of soil pH in infested soils.

At the annual meeting of the Virginia State Horticultural Society (Roanoke, January 29- 31) Groves participated in a panel discussion on, "A critical look at orchard pest control". He made, "Comments on the disease control performance of the Virginia spray program and a look at future promise" [Va. Fruit 50 (3):137-139]. Fruit disease control was said to be at its highest level. Dodine furnished the best scab control ever obtained. Phaltan provides the best ever late season fruit rot control. New products were being tested but Groves declined to name them. No other publications on plant diseases appeared in *Virginia Fruit* for 1962.

At the 1962 meeting of the Virginia Academy of Science in May, Miller was Vice-Chairman of the Section of Agricultural Science. He was elected Chairman for 1962-63. Betty J. Gray, Miller's assistant, and Miller described the "Gross morphology of the Virginia 1 population of sting nematode" (Va. J. Sci. 13:212-213). They provided evidence that Va. 1 was a new species but did not name it.

Grover Smart and his assistant Barbara A. Wright, described the, "Survival of the cysts of *Heterodera glycines* adhering to stored sweetpotato, peanut, and peanut hay" (Ibid. 13:219-220). Cysts survived for 12 months through all storage conditions on each substrate.

K. H. MacDonald of the Eastern Shore substation published several items in the 1962 *Vegetable Growers News* (VGN). He described bean pod mottle of snapbeans [VGN 16 (1):3-4], design of experiments to determine the effectiveness of chemicals used against plant diseases [VGN 16 (7):2], fungicides for controlling seed piece rot on Irish potato [VGN 16 (8):2-3], and several foliage and fruit diseases of tomato [16 (11):2].

Brown stem rot of soybean (*Cephalosporium gregatum*) was found in Virginia for the first time. J. P. Ross (U.S.D.A. Raleigh, N.C.) and T. J. Smith (V.P.I. Agronomist) found the disease in experimental plantings in Richmond and Chesterfield Cos. during October 1962 (Pl. Dis. Reptr. 47:329). Soon thereafter it was found to be widespread in eastern Virginia.

Gruenhagen and Fordyce found a false holly plant (*Osmanthus ilicifolius*) infected by *Verticillium albo-atrum*. This plant represented a new host for *V. albo-atrum* in

Virginia and probably for the United States (Ibid. 47:688).

In 1961 and 1962, the potato virus Y caused severe damage to varieties and lines of tobacco homozygous for resistance to root-knot. These varieties invariably developed a systemic necrosis. Plants which were susceptible to root-knot developed a mild mottle (Ibid. 47:187-189). Susceptibility to systemic necrosis was shown to be a recessive trait.

Troutman, Henderson, and LaPrade described a procedure for, "Indexing tobacco for black shank resistance" (Tobacco Sci. 6:109-111). They modified muffin tins and cake pans to create a mini-hydroponic system. Roots penetrated through screened openings into a nutrient solution to which inoculum of *Phytophthora parasitica* var. *nicotianum* could be added. Susceptible plants died within 14 days of inoculation. Results from this procedure correlated well with field results. The method was functional on a year-round basis and saved much field space and time in identifying resistant breeding lines and varieties.

Henderson continued as a member of the editorial board of *Tobacco Science*.

Rachel Carson published a book under the ominous title "Silent Spring". This book would create all kinds of problems for manufacturers and users of pesticides but its impact would also be to create a more wholesome life for the world's biota. Insecticides, especially DDT were the chief target. As G. K. Parris put it, "---- Emphasis on fungicide research started to drop in '57-58 and continued to the present (1978) "low". Emphasis on breeding for diseases resistance started to rise from a "low" in '57 to its present, and still climbing position" (A Chronology of Plant Pathology. Published by the Author. Mississippi State. 1979.). Carson's book assured that these activities would continue on their respective trends.

Thomas O. Evrard joined the faculty in 1963 as Instructor in Plant Physiology and Graduate Student in Weed Science. Stanislaw Sadowski came from Poland on a one-year post- doctoral program in Turf Pathology. He was tutored by Williams. Dr. Wingard, having the longest tenure on the entire faculty, served as greeter on behalf of the faculty at T. Marshall Hahn's inauguration as President of V.P.I. on April 4. Hahn had been functioning as President for a year and had already made many changes.

K. H. MacDonald resigned from the staff of the Truck Station at Painter and Robert E. Baldwin was appointed Assistant Plant Pathologist to replace him.

The first major activity in 1963 was the meeting of the Virginia State Horticultural Society (Roanoke, January 28-30) where John Albert made his first presentation to the Society. He spoke on, "Suppressing apple scab lesions" [Va. Fruit 51(3):36-42]. He emphasized the action of Cyprex (dodine) in preventing scab. Most of the action was in preventing spore germination. Groves followed Albert with, "Minimizing fire blight losses" [Ibid. 51 (3):42-50). He stressed winter pruning, aphid control, application of streptomycin during the blossom period, reduction of nitrogen in fertilizers followed by addition of urea in sprays, and elimination of water sprouts during the growing season. Later, Groves discussed "Factors which affect program performance" [Ibid 51 (3):107-109]. According to Groves, weather if wet favored most diseases, but if dry favored powdery mildew and insects. Varieties vary wildly in their susceptibility to disease. The degree of pruning affects especially the severity of summer rots. Fertilizer practices, especially the management of nitrogen affects disease severity. Timing and thoroughness of spray application is the most important variable. As can be seen from the foregoing, several variables cannot be controlled but those which can should be within feasible limits.

Charles Drake made his first presentation as a fruit pathologist in, "A beginner's view of the Virginia fruit protection program" [Ibid 51(3):101-104]. He reviewed the history of plant protection, its successes and failures, in the Virginia fruit industry. He pointed out that virus diseases had not been fully assessed and that they represented an unknown in apple production. In the report for the 1962 annual meeting of the American Phytopathological Society, Groves was shown to be continuing as the Councilor for the Potomac Division (Phytopathology 53:2) but his tenure ended upon election of J. G. Moseman at the March 1963 meeting of the Potomac Division (Ibid. 53:745). Groves, however, would continue as a member of the New Fungicide and Nematocide Data Committee (Ibid. 53:3). The committee report had been prepared by Groves before he retired as chairman (Ibid. 53:15).

Garren presented two papers at the 1963 meeting of the Potomac Division of A.P.S. He provided evidence that a *Pythuim* sp. caused peanut pod rot in 1961 and *Rhizoctonia* sp. caused rot in 1962 (Ibid 53:746. In the second paper he reported variation in susceptibility to *Sclerotium rolfsii* among peanut varieties; 'N.C. 2' was the least susceptible. Infection and yield were inversely correlated for all varieties tested. Garren did not use the word "resistance". Smart studied the survivability of soybean cyst nematodes passed through swine. Some encysted larvae survived but were unable to reproduce on soybean (Ibid. 53:889-890). Smart presented this information at the August 1963 meeting of A.P.S.

The only Experiment Station publications in 1963 were Research Reports. Williams was co-author with P. T. Gish and T. J. Smith, Agronomists, of "Results of Sudangrass and Pearl Millet Performance Tests in Virginia" (Va. Agri. Expt. Sta. Res. Rept. 70). Leaf blight caused by *Helminthosporium turcicum* on Sudangrass was the only disease observed. Starling and Roane compiled the, "Results of Small Grain Varietal Tests Conducted in Virginia in 1963" (Ibid. 74). 'Roanoke' oats and 'James' barley, products of the Virginia breeding program, were recommended for the first time. Differential reactions to powdery mildew of wheat were observed at Orange and Charlotte C.H.

C. F. Genter (Agronomist, Corn Breeder) published the, "Performance of Experimental Corn Hybrids in Virginia, 1962" (Va. Agri. Expt. Sta. Res. Rept. 69). Leaf blight scores from Blacksburg were furnished by Roane. On a scale of 0-5, the highest score was 4.0 with a mean of 3.1. Grain yield and leaf blight scores were reasonably well negatively correlated but an r value was not calculated. Hybrids of Virginia-bred inbred lines had greater resistance to leaf blight than other hybrids. The results of the 1963 corn tests had ratings for leaf blight only at Emory (Glade Spring); unlike 1962 when scores were for gray leaf spot, scores in 1963 were for *H. turcicum*. Some variation was noted (Ibid. 82. 1964).

The Director again authorized a summary of research for the period July 1, 1961 to June 30, 1963, under the title "Agricultural Progress" (Ibid. 75). Several reports of interest to pathologists were included:

- p. 9 - The small grains breeders (T. M. Starling) and plant pathologist (Roane) were said to be studying the inheritance of resistance to barley leaf rust, powdery mildew, and scald. The results with leaf rust have been noted. Forty varieties with resistance to powdery mildew were studied; four varieties had two genes. Most varieties studied for scald resistance had one gene.

- p. 13. - An attempt to predict the severity of black shank in a growing season based upon the severity of weather in the preceding season was being carried out at Chatham. (Wills).
- p. 14. - Several articles on nematode control included the stem nematode on alfalfa, various nematodes on peanut, survival of and resistance to the soybean cyst nematode, and soil fumigation to control peanut and soybean nematodes.

A number of miscellaneous journal publications appeared in 1963:

John Albert published "Effectiveness of fungicides against apple scab conidia under greenhouse conditions (Fungicide-Nematocide Rept. 19:26).

Drake published on, "Host-parasite relations of Stemphylium leaf spot and stem canker of birdsfoot trefoil (*Lotus corniculatus*)" (Phytopathology 53:1094-1099); and on, "Peach brown rot control" (Fungicide-Nematocide Tests 19:50).

Garren and W. K. Bailey (U.S.D.A.) described, "Comparative responses of a Virginia runner and a Virginia bunch peanut to cultural control of stem rot" (Agron. J. 55:290-293). J. M. Good (U.S.D.A. Tifton, Ga.), J. N. Sasser (Raleigh, N.C.), and Miller provided, "A suggested guide for reporting experiments on nematocidal chemicals" (Pl. Dis. Reptr. 47:159- 163). Their lament was that a lack of uniformity prevailed in nematocide reports. Essential information, especially about edaphic factors, was frequently lacking. They made suggestions for correcting the situation.

Henderson and Troutman reported the occurrence of "A severe virus disease of tobacco in Montgomery County, Virginia" (Ibid. 47:187-189). This was reviewed earlier as a 1962 phenomenon.

Williams observed the twist disease on orchardgrass for the first time in Virginia during the late May - early June 1963 period of anthesis (Ibid. 48:119). It had been reported on wheat by Fenne in 1959. The fungus, *Dilophospora alopecuri*, is reported to be associated with the wheat gall nematode, *Anguina tritici*, but no such association could be established in orchardgrass.

In 1963, corn and Johnsongrass in Fluvanna Co. were observed by Roane to be infected with a disease later identified as maize dwarf mosaic (Ibid. 49:665-667). Appearance of this disease caused a shift in the corn breeding program.

Wills reported that the black shank fungus could be spread during overhead irrigation of tobacco fields from farm ponds. *Phytophthora parasitica* var. *nicotianae* could be isolated from leaves and stems high up on infected plants from a field in Charlotte Co., 1963; lower parts were healthy. The outbreak correlated with irrigation of the field. Plants of both 'Hicks', susceptible, and 'Coker 319', resistance, were infected. Although contaminated irrigation water had been postulated to be the source of inoculum, Wills' report is the first to provide such evidence (Ibid. 48:35-36).

Fenne re-issued two Extension Service publications in 1963. "Tobacco Diseases in Virginia" (Va. Agri. Ext. Ser. Bul. 152) and, "What You Should Know About Plant

Diseases" (Ibid. Bul. 261), were slightly revised. Osborne prepared an Extension Circular titled, "Control Nematodes in Tobacco for Better Quality and Higher Profits" and with Pristou prepared, "Control Nematodes in Peanuts for Extra Profits".

At the May 1963 of the Virginia Academy of Science, Miller served as Chairman of the Agricultural Section. P. L. Duke and Miller reported on, "Buckwheat, *Fagopyrum esculentum*, a new host of the knotweed cyst nematode, *Heterodera weissi* (Va. J. Sci. 14:164). B. J. Gray (Miller's Technician) and Miller made "A comparison of the gross morphology of three populations of the sting nematode" (Ibid. 14:165). This work led them to believe they had found a geographical variant of an undescribed species. Smart in his report on, "Peanut rust in Virginia" (Ibid. 14:176), postulated how the October 1961 occurrence of rust resulted from hurricane- borne spores from tropical America. In a second paper, "Physiological races of *Ditylenchus destructor*, the potato rot nematode...."(Ibid.14:176), Smart discussed the effects of P and K on oviposition and length of life cycle (Ibid.14:177).

Henderson completed his final year on the editorial board of *Tobacco Science* but continued as a member of the Tobacco Council. Wingard remained as a member of the College Resolutions Committee.

A significant event took place in the Department of Plant Pathology and Physiology during September 30 - October 4, 1963. The cooperative State Experiment Station Service of the U.S.D.A. had ceased the annual "inspection" of Experiment Station projects. Inspection had become an unwieldy farce. During the 5 days in September and October The Department underwent its first "Comprehensive Review". A committee of eminent plant pathologists and physiologists from several state universities and the U.S.D.A. served as reviewers. J. C. Walker (Univ. of Wisconsin), C. J. Nusbaum (N.C. State Univ.), and J. F. Fulkerson (U.S.D.A., C.S.R.S.) were the pathologists on the panel. The document prepared for the comprehensive review has been a fertile source of information to the writer of this history but of more importance is the recommendations of the panel. The following points were made:

- There should be greater expertise in the Department in the areas of virology, mycology, bacteriology and forest pathology.
- Projects should be rewritten such that there would be more specific objectivity and increased emphasis on basic research.
- Miller's expertise in nematology and Will's expertise in mycology would be more useful if they could contribute to the instruction program at Blacksburg.
- There should be increased extension effort in fruit pathology to relieve research workers from extension type work.
- Publication of findings is lagging. Effort should be expended to up-date and publish results.

At the Truck Station, MacDonald wrote about "The use of fungicides for control of seed piece rot of Irish potatoes", [Veg. Growers News 17 (8):3-4] in which he recommended dusting seed pieces if 'Pungo' and 'Irish Cobbler' with captan or zineb. MacDonald also described, "Some diseases found on snap beans on the Eastern Shore" [Ibid. 18 (2):14]. Included were ashy stem blight, Fusarium and Rhizoctonia root rot. This was MacDonald's last publication from work at the Truck Station.

G. B. Ohekar (Grad. Student, Horticulture), P. H. Massey, Jr. (Horticulturist, V.P.I.) and A. S. Williams described, "Histological investigations of resistant and susceptible varieties of tomato to rootknot nematodes (*Meloidogyne* spp.) [Ibid. 18(11):3-4]. This was somewhat unusual for V.G.N. which rarely contained papers on basic aspects of plant pathology. Nugent summarized, "Vegetable diseases in 1963" [Ibid. 18(6):1-2]. He explained why late blight of potatoes and downy mildew of cucurbits did not occur; it was too dry, and because it was dry, powdery mildew was prevalent. Despite the dryness, gray leaf spot of tomato was damaging throughout the truck crop area. Nugent also published on, "Snapbean diseases" [Ibid. 18(9):3]. He described and gave control measures for 8 diseases: Two bacterial blights, powdery mildew, rust, root rots, Southern blight, Sclerotinia wilt, and the virus diseases bean mosaic and bean pod mottle. Nugent and Baldwin also publish a bulletin, "Disease (control?) Recommendations for Truck Crops in Eastern Virginia".

An era ended in 1964; Samuel A. Wingard retired October 31, ending 47 years of association with V.P.I. He was appointed Assistant Plant Pathologist in 1917, he became Head of the Department in 1928, was reduced to Head of the Section of Plant Pathology and Botany in the Department of Biology in 1935, and was restored to Head of the Department of Plant Pathology and Physiology in 1947. When Wingard retired, R. G. Henderson was appointed Acting Department Head until a new permanent Head could be installed.

W. H. Wills was promoted to Associate Professor on July 1, 1964, and Smart resigned May 29.

Coyt T. Wilson, originally a plant pathologist but in recent years an assistant director of the Experiment Station at Auburn University, was appointed Associate Director of the Virginia Agricultural Experiment Station on July 1, 1964. Even though like Miller and Roane, he had earned a Ph.D. degree in plant pathology at the University of Minnesota, he never participated in the affairs of our Department.

Aside from administrative changes, a number of technical publications were issued. In January, J. L. LaPrade, J. G. Petty (Research Technician), and W. H. Wills (all of the Chatham Tobacco Disease Research Station), published on the, "Use of Plastic Film in Production of Tobacco Seedlings" (Va. Agri. Expt. Sta. Tech. Bul. 167). They compared cheese cloth, 4-mil clear plastic, and a combination of these. The combination gave best results by shortening the time between seeding and transplanting from 9 weeks to 6 weeks. Diseases were not a factor.

The remainder of Experiment Station publications for 1964 were in the Research Report series. In "Results of Sudangrass and Pearl Millet Performance Tests in Virginia, 1961-1963" (Va. Agri. Expt. Stat. Res. Rept. 77) Gish, Smith, and Williams followed the same format as in previous reports. The comments on diseases appear to be reprinted from those reports. LaPrade and J. G. Petty, Research Technician at Chatham, described the, "Evaluation of Flue-Cured Tobacco Breeding Material, 1963" (Ibid. 86). They selected for black shank resistance in the field and further screened material by the "muffin pan" method, testing for the black root rot resistance, reaction to potato virus Y as an indicator for root knot reaction, and tobacco mosaic virus.

Varieties and lines emerging from tests conducted by LaPrade and Petty were advanced to field tests. J. W. Crews (Tobacco Breeder) M. J. Rogers (Agronomist), LaPrade, Troutman, and Henderson summarized such work in "Performance of Flu-Cured Tobacco Varieties and Breeding Lines Tested in Virginia in 1963" (Ibid. 87).

Disease reactions were recorded for black shank (field and laboratory), black root rot, and Fusarium and Granville wilts. Breeding for multiple disease resistance was a major function of tobacco improvement.

Henderson, R. D. Sears (Agronomist, Charlotte C.H.) released "Va. 331, a Fire-Cured Variety with Black Shank Resistance" " (Ibid 90). Va. 331 was the first fire-cured variety to have black shank resistance. It was a cross of 'Walkers Broad Leaf' and 'Vesta 55' and it was derived from a single F_4 plant. Resistance was from Vesta 55; leaf quality was very similar to Walkers Broad Leaf.

LaPrade, J. W. Crews, and M. J. Rogers released "Va. 115, A New Flue-Cured Variety with Black Shank Resistance" (Ibid. 96) which originated from the cross Hicks X Coker 139. Va. 115 was highly resistant to black shank in Virginia and moderately resistant to black shank in North Carolina. It was agronomically similar to the Hicks parent.

In "Results of Small Grain Varietal Tests conducted in Virginia in 1964" (Ibid. 91), Starling and Roane reported field reaction to powdery mildew on oats, barley, wheat, and rye; leaf rust reactions on barley and wheat; and stem rust reactions on wheat. Resistance was observed in all crops and in all diseases except mildew on rye and stem rust on wheat. Greenhouse seedling reactions correlated well with field reactions.

Efforts to breed wheat resistant to stem rust had ceased because the disease was no longer a problem. Wheat production in Virginia had shifted to the Coastal Plain and Piedmont where no barberries existed to provide primary inoculum. When stem rust appeared on rare occasions in eastern Virginia wheat fields, it was so sparse that it caused no loss.

P. T. Gish, T. J. Smith (Agronomists) and Williams summarized, "Results of Sudangrass and Pearl Millet Performance Tests in Virginia, 1962-1964" (Ibid. 97). Comments about diseases were as in Research Report 77; disease scores were provided. Only one Sudangrass variety had consistently high disease *Helminthosporium turcicum*.

During the 1964 corn growing season, drought prevented the appearance of foliage diseases and no leaf blight data were reported (E. Shulkcum and C. F. Genter. 1965. Corn Performance Tests in Virginia in 1964. Ibid. 95).

The Director of the Experiment Station, H. N. Young, authorized the publication of a biennial summary of research under the title "Agricultural Progress, July 1, 1963 to June 30, 1965" (Research Rept. 102). Among reports related to plant pathology were:

- p. 9 - Maize dwarf mosaic was found in 13 Cos. Transmission studies indicated that corn, sorghum, sundangrasses, and Johnsongrass were the primary hosts and that the virus (MDMV) could be freely transmitted by sap and aphids among these species. MDMV appeared to be a strain of sugarcane mosaic verus.
- p. 11 - Peanut stunt was found in 1964 and was very severe in some fields.
- p. 13 - Resistance to the soybean cyst nematode was found in soybean line P.I. 90763.
- p. 14 - Workers at Chatham reported that cutting seedling roots and dipping

damaged plants into suspensions of *Pseudomonas solanacearum* greatly improved selection of tobacco for Granville wilt resistance. They also found the resistance of excised leaf tissue and resistance to root infection by the tobacco black shank fungus were highly correlated. There was a report of progress in breeding burley tobacco for resistance to black shank and wildfire. The Osborne's cyst nematode in Amelia could be controlled by soil fumigation with DD. Resistance had been found and F1 plants were being tested.

- p. 16 - Fungicides were tested and several were found useful for dollar spot control on golf greens and *Helminthosporium vagans* of bluegrass.
- p. 38 - The horsenettle cyst nematode was found to be destructive to eggplant in greenhouse tests; no field damage had been observed.
- p. 50 - Features for distinguishing the horsenettle and Osborne's cyst nematodes had been found.

Most of the synopses cited above were taken from project report summaries. Some were also topics of technical publications and papers read at meetings.

There were several journal publications issued by the faculty in 1964. Surprisingly, plant pathologists did not participate in the annual meeting of the Virginia State Horticultural Society nor did they contribute any articles to *Virginia Fruit* in 1964.

Wills and Troutman described, "Electrotaxis of *Phytophthora parasitica* zoospores and its possible role in infection of tobacco by the fungus" (Phytopathology 54:225-228). Zoospores were always attracted to the negative pole. The authors stated that roots produced weak electric fields and that they must be strongest just behind the root cap and that attachment of the spores by their flagellae to root surfaces is effected by electrostatic forces.

Wills and J. H. Crews (Agronomist) described the, "Expression of black shank resistance in leaves of flue-cured tobacco" (Ibid. 54: 1356-1358). Lesion extension in leaf strips dipped in a spore suspension for 7 days provided data that correlated well with the whole plant method results. Thus, the relative resistance of plants growing in the field could be determined without having to observe its survivability in infested soil.

Garren continued to explore the control of "Inoculum potential and differences among peanuts in susceptibility to *Sclerotium rolfsii*" (Ibid. 54:279-281). In four regimens of plant debris obtained by deep covering-nondirting, surface mulching-nondirting, deep covering- nondirting, and surface mulching-dirting, stem rot became progressively severer and yields correspondingly smaller. He classified 'NC 2' as resistant, 'Va. Bunch 46-2' as intermediate, 'Spanish' as susceptible, and 'Valencia' as highly susceptible.

Claude Fordyce with Ralph Green (Purdue Univ.) published a portion of his Ph.D. dissertation work in, "Mechanism of variation in *Verticillium albo-atrum*", (Ibid.. 54:795-798).

At the A.P.S. Potomac Division meetings held March 5-6, R. E. Baldwin of the Painter station on Eastern Shore, presented a summary of work done at West Virginia University on, "Nematodes associated with red clover growing on favorable and unfavorable sites" (Ibid. 54:746). No significant correlations were found.

Roane and Starling (V.P.I. Agronomist) presented a paper at the annual meeting of A.P.S. titled, "Gene loci conditioning reaction to leaf rust in barley" (Ibid. 54:904). The gene in 'Weider' previously labeled Pa_1 was found to allelic with the A locus. The gene in 'Estate' (Pa_2) was not allelic with any of the loci in the leaf-rust-differentiating varieties (A,B,C,D,X).

Williams presented a paper on, "Comparisons of Virginia isolates of *Corynebacterium* from orchardgrass with *Corynebacterium raythayi* and *C. tritici* from the American Type Culture Collection" (Ibid. 54:912). The Virginia isolates were more closely related to *C. tritici* than to *C. raythayi*.

In a paper given by Wills, the "Effect of defoliation of tobacco on expression of resistance to *Phytophthora parasitica* var. *nicotianae*" (Ibid. 54:912), it was reported that defoliation reduced the resistance of a resistant variety. There was evidence that resistant varieties release a factor into the liquid growing medium that could be taken up by susceptible plants resulting in an increase of their resistance. Defoliation interfered with this process.

Robert Pristou was a member of the A.P.S. Extension Committee for 1964 (Ibid. 54:3).

The faculty published several papers in the *Plant Disease Reporter*. Drake reported on, "The relationship of white grubs, facultative fungi, and bacteria on the decline of birdsfoot trefoil"(Pl. Dis. Reptr. 48:406-408). The insects were the primary causes of damage. Garren reported on progress in reducing pod rot (Ibid. 48:344-348; 349-352). Grover Smart of the Holland station published two papers on variation and host range of the soybean cyst nematode (Ibid. 48:388-390; 542-543). Species of Caryophyllaceae and Scrophulariaceae were found to be hosts.

Wills described the, "Autumn weather in relation to subsequent occurrence of tobacco black shank in Virginia" (Ibid. 48:32-34). 'Vesta 5', a moderately resistant variety, was more damaged by black shank following a warm wet October accompanied by a late freeze than when a cool dry October accompanied by an early freeze preceded a growing season. The observations were made over a 9-year period on the same land where tobacco was grown continuously.

Williams described the, "Twist disease of orchardgrass in Virginia" (Ibid 48:119). It was the first report of *Dilophospora alopecuri* on orchardgrass in the eastern United States. J. W. Crews, Wills, and LaPrade published, "Black shank disease reactions of six flue- cured varieties and the hybrids among them" (Tob. Sci. 8:128-132) in which from muffin pan tests they described reactions of two susceptible varieties, 'Hicks' and 'Virginia Gold'; four resistant varieties 'McNair 10', 'NC 95', 'Vesta 5', and 'Coker 187'. Resistance had been derived from 'Fla. 301'. Within groups no differences in reaction were observed but in F_1 hybrids, differences were observed. Hicks crosses were more resistant than Va. Gold crosses. Vesta 5 transmitted the highest degree of dominance and the F_1 of Coker 187 had greatest resistance. Genetics of F_1 is not very useful but the authors charted an interesting analysis.

In a paper, "Indexing tobacco for black root rot resistance" (Tob. Sci. 8:21-23), Troutman described a technique used to select plants resistant to *Thielaviopsis basicola*. It was essentially a modification of the muffin tin procedure for indexing tobacco plants for reaction to the black shank fungus (Tob. Sci. 6:107-109).

At the May 1964 meeting of the Virginia Academy of Science, two non-pathologists, M. W. Alexander (Asst. Agronomist) and G. M. Boush (Asst. Entomologist) of the Holland station reported on, "Differential reaction of certain peanut lines to Botrytis blight" (Va. J. Sci. 15:248- 249). In 1963, 38 peanut introduction lines were evaluated for reaction to Botrytis blight. Only one line P.I. 269-041, was scored as significantly better than the others. It was a Virginia type plant which could provide a source of resistance should a breeding program become necessary. Miller, P. L. Duke, and Betty Gray reported on two species of *Rumex* as new hosts of the knotweed nematode (Ibid. 15:260), and Smart reported that soybean in fumigated, infested soils yielded 46% more than those in unfumigated, soils infested with the soybean cyst nematode (Ibid. 15:265).

Three diseases new to Virginia were observed or confirmed during 1964, but reported at later dates. Gruenhagen reported the occurrence of *Endothia parasitica* on live oak in May at Fort Monroe (Pl. Dis. Reptr. 49:269). It had been found at Colonial Williamsburg in 1960 by May and Davidson of the U.S.D.A. (Ibid. 44:754). Roane and Troutman reported the presence of maize dwarf mosaic in 15 counties primarily on farms near the James and Roanoke-Staunton Rivers. The virus could be transmitted to corn, johnsongrass, teosinte, pearl millet, sorghum and Sudangrass. Numerous other cereals and grasses were insusceptible (Ibid. 49:665-667). In 1966, Miller and Troutman described a, "Stunt disease of peanuts in Virginia", which Miller had found in Southampton and Sussex Cos. in 1964. (Ibid. 50:139-143), as noted in the biennial summary "Agricultural Progress" (Va. Agri. Expt. Sta. Res. Rept. 102, 1965). Peanut stunt was found to be an aphid-borne virus disease new to the United States. Where it occurred in Virginia, it caused up to 50% loss of marketable peanuts.

Extension publications became more difficult to locate after 1961. However, a number of pages were prepared by Gruenhagen for the Nurserymen's Notebook on diseases of ornamentals and techniques for disease control. In 1964, titles published were:

- Rose blackspot and mildew, MR-0-9 (Rev.).
- Useful conversion factors, MR-0-16 (Rev.).
- Dogwood spot anthracnose, MR-0-30.
- Hollyhock rust, MR-0-31.
- Toxicity of certain fungicides and soil fumigants, MR-0-32.
- Criss-cross dilution method, MR-0-33.

Pathologists at the Truck Station apparently published only in the *Vegetable Grower's News* although some bulletins for growers may have been prepared. Nugent wrote about "Disease control in fall grown cucumbers" [Veg. Growers News 19 (1):1, 4]. 'Palmetto' and 'Santee' were named as resistant to downy mildew and 'Ashley' was resistant to both downy and powdery mildew. For angular leaf spot and anthracnose, disease-free seed, crop rotation and spraying with folpet were recommended. Nugent also described two diseases troublesome during harvesting and marketing sweet potatoes; namely, black rot and soft rot [V.G.N. 19 (2):2]. E. A. Borchers, Plant Breeder, described, "Controlled testing for disease resistance" [V.G.N. 18 (9):4] in which he explained how soil and air temperature, soil moisture, and humidity were controlled to facilitate reactions to tomato Fusarium wilt and spinach downy mildew fungi. Borchers also described, Chesapeake hybrid, a new F_1 spinach hybrid [V.C.N. 19 (3):1, 4]. This variety was resistant to spinach blight caused by the cucumber mosaic virus and downy mildew caused by *Peronospora effusa*.

Since this concluded a review of individual accomplishments during S. A. Wingard's tenure and with his retirement on October 31, it might be appropriate to review the growth of the Department of Plant Pathology and Physiology during his second tenure as Department Head. In September 1949, when the Department was formed, there were five professors (Wingard, Fenne, Groves, Henderson and Shear), five associate professors (Hurt, Jenkins, LaPrade, Miller and Roane) and one assistant professor (Spasoff). In October 1964, there 28 faculty members. New professors were Chappell, Garren (USDA, adjunct professor), and Gruenhagen; six new associate professors (Drake, Hale, Kates, Osborne, Pristou, Troutman, and Williams); seven new assistant professors (Bingham, Fordyce, LeFevre, Rud, Smart, and Sterrett); and two instructors (Albert and Evrard). Jenkins had died but all others were still present; no one had resigned. Extension faculty had been increased from one full time equivalent (FTE) to five, four of whom were pathologists and one was in weed work. Initially there was one FTE in teaching and this assignment remained constant. The remainder of new faculty were in research. Nine were classified as plant physiologists 19 as plant pathologists. Eight plant pathologists were at field stations in 1964, up from two in 1949. The new pathologists extended areas of specialization into nematology, virology, forage crops, ornamentals. Work on peanut, tobacco and tree fruit diseases was expanded. Significant strides were made in control of peanut, tobacco, and alfalfa nematodes, breeding disease-resistant tobacco and grain crops, evaluating organic fungicides in orchards, and developing new procedures for evaluating disease resistance in tobacco. A Tobacco Disease Research Station was established in 1949 under the direction of W. A. Jenkins, and later after Jenkin's death, was staffed by three faculty members. Protection of crops was given high priority but some basic research was conducted.

The physical facilities at Blacksburg were poorer in 1949 than at the field stations. Little was done to upgrade laboratories, offices, and class rooms in Price Hall but greenhouses facilities were upgraded and the campus expanded, better field plot land became available perforce. Our old plot land just north of the upper duck pond had been taken to facilitate building West Campus Drive, the golf course, and a parking lot.

It is hard to say how much growth was attributable to Wingards' efforts and how much was inevitably caused by agricultural prosperity of the era. When Wingard was interviewed by a local paper in 1964, he recounted his most important achievements as: Cooperating in the introduction of seed treatment to peanut farmers; encouraging, participating in, and supporting projects for breeding disease-resistant crop varieties; supporting a vigorous fruit disease control program; participating in, and supporting the development of an outstanding vegetation control program; and providing leadership and support to extension, teaching, and research projects pertinent to a modern department in a land-grant university. He derived personal satisfaction from his bean work for which he was once called a modern "Jack" as in "Jack and the Bean Stalk". Wingard's effectiveness was difficult to evaluate; he worked quietly with administrators and they respected his counsel. Whatever the case, Sam Wingard captained a fruitful period of calm progress. His era was superceded by one of disconcerting upheaval characterized by sharply delimited and altered priorities. Happiness and calm, reflective contemplation over ones objectives would soon disappear.

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A History of Plant Pathology in Virginia: The Couch Era (1965-1974)

Houston B. Couch was named Professor of Plant Pathology and Head of the Department of Plant Pathology and Physiology soon after S. A. Wingard retired on October 31, 1964. However, since he did not move to Blacksburg until January 9, 1965, R. G. Henderson served as Acting Department Head for the interim. Couch at the time of his appointment was Associate Professor of Plant Pathology, specializing in turfgrass pathology at Pennsylvania State University. He had published several articles in *Phytopathology* and a book entitled Diseases of Turfgrasses.

As of January 1965, there were 28 faculty level persons or positions in the Department, 20 of whom were plant pathologists; eight of these were located at field stations. There were nine Professors (W. E. Chappell, S. B. Fenne, K. H. Garren, A. B. Groves, R. H. Gruenhagen, R. G. Henderson, L. I. Miller, G. M. Shear, and of course Couch); ten Associate Professors (C. R. Drake, M. G. Hale, A. H. Kates, J. L. LaPrade, W. W. Osborne, R. Pristou, C. W. Roane, J. L. Troutman, A. S. Williams, and W. H. Wills); six Assistant Professors (S. W. Bingham, C. Fordyce, Jr., C. W. LeFevre, O. E. Rud, L. Spasoff, and J. Sterrett); and two Instructors (J. J. Albert and T. O. Evrard). G. C. Smart of the Holland Station had resigned in May 1964; his position was to be filled in 1965. Nine of the faculty were plant physiologists (Bingham, Chappell, Evrard, Hale, Kates, LeFevre, Rud, Shear, and Sterrett).

In 1965, seven plant pathologists were located at three field stations. Miller and Garren (a U.S.D.A. pathologist) were located at the Tidewater Research Station at Holland in Nansemond Co., now the city of Suffolk; both worked on peanut diseases. LaPrade, Troutman, and Wills were at the Tobacco Disease Research Laboratory at Chatham, Pittsylvania Co. Albert and Groves were at the Winchester (Fruit) Research Laboratory. In addition to those at field stations, Henderson and Spasoff worked with tobacco, and Drake worked on fruit diseases; thus, five pathologists had tobacco projects, three had fruit projects and two were assigned to peanut diseases. At the Virginia Truck Experiment Station, T. J. Nugent worked in vegetable pathology at Norfolk (actually in Princess Anne Co. which became Virginia Beach) and R. E. Baldwin worked at Painter, a substation of the Norfolk Station in Accomack Co. No doubt the V.P.I. professionals named above were devoted to the most valuable cash crops in Virginia but the total value of grain crops, handled by Roane, and forage crops, handled by Williams, exceeded the value of tobacco, peanuts, and fruits but did not command as much attention because they were grown primarily for on-farm use. Two pathologists, Gruenhagen and Fordyce, were assigned to study ornamental plants.

Henderson, Roane, and Williams conducted classroom chores, which in a way diluted the effort devoted to crop pathology. The teaching program will be described later.

A Plant Disease Clinic had been organized by Fenne; since due to multiple sclerosis he had been restricted to the campus, Gruenhagen was hired as extension project leader. Osborne and Pristou handled the off-campus field crop extension work; namely, demonstrations, meetings, etc.

Soon after Couch arrived, he began implementing suggestions made by members of the 1963 Comprehensive Review Panel for the Department; in addition, he imposed the mandates of the administrators who had hired him and, of course, he implemented some of his own ideas. The faculty was not privy to the Review Panel written suggestions and administrative mandates; consequently, they perceived that Couch himself originated all changes. Changes in research assignments and office space impacted the faculty almost immediately. Each researcher was required to reduce his federal projects from two or several to one. For example, the two projects on corn and small grains were combined into one on cereals and genetics. Projects had to be revised by a certain time, regardless of field commitments such as planting schedules, crop and disease development. It seemed to the faculty that getting research results was not as important to Couch as getting papework in order. Thus, there was considerable friction between Couch and the faculty from the onset that persisted for some time. For faculty who had been accustomed to calm contemplation, Couch personified a pressure-cooker style under which several faculty found it difficult to operate. Some sought employment elsewhere, some took extended leaves of absence, and some simply retired; others persevered, trying to accommodate Couch while devoting attention to research and teaching, albeit somewhat distracted. The faculty dubbed the period "A.C.", after Couch, and before 1965 as "B.C.", before Couch. In fairness to Couch, many changes were needed and when made resulted in a stronger Department. Couch had been appointed as a "hatchet man". Anyone else who might have been named Head of the Department would have had to perform similarly. The only difference would have been in personality. The Couch years coincided with a rapid expansion in plant pathology at a national level. Jobs were plentiful, graduate students abounded, and grant funding was lucrative. In essence, it was a golden age of plant pathology. The golden age was a significant era in Virginia; it is hoped that it will be appropriately described.

STAFF

Since there were several staff changes during the Couch era, it might be well at this point to list the plant pathology faculty and show their status during those nine years.

Professors (in 1965 or at time of appointment):

- H. B. Couch, Dept. Head, Jan. 1, 1965-June 30, 1974.
- S. B. Fenne, retired June 1967.
- K. H. Garren, U.S.D.A. Holland = Suffolk.
- R. H. Gruenhagen, transferred to Chemical Pesticides, Oct. 1, 1966.
- A. B. Groves, Winchester, died Jan. 26, 1966.
- R. G. Henderson, retired Aug. 31, 1973.
- L. I. Miller, Holland, transferred to Blacksburg July 1, 1969.
- D. M. Porter, assigned to Holland, Aug. 1, 1966 by U.S.D.A.

Associate Professors (in 1965 or date of appointment or promotion in Couch era):

- C. R. Drake.

- R. C. Lambe, appointed April 1, 1967.
- J. L. LaPrade, Chatham, retired Sept. 30, 1970.
- W. W. Osborne, promoted to Professor, July 1, 1968.
- R. Pristou.
- C. W. Roane, promoted to Professor July 1, 1968.
- J. L. Troutman, Chatham, resigned Dec. 31, 1967.
- A. S. Williams, resigned Aug. 31, 1968.
- W. H. Wills, promoted to Professor July 1, 1969.

Assistant Professors (in 1965 or date of promotion in Couch era):

- C. Fordyce, resigned May 31, 1967.
- J. A. Fox, appointed July 1965.
- G. J. Griffin, appointed Aug. 1, 1967, promoted to Associate Professor July 1, 1970.
- K. D. Hickey, appointed Assistant Professor at Winchester Nov. 1, 1966.
- L. D. Moore, appointed Assistant Professor April 1, 1965, promoted to Associate Professor July 1, 1970.
- J. M. Skelly, appointed Assistant Professor Jan. 1988, promoted to Associate Professor July 1, 1972.
- L. Spasoff, retired Mar. 1, 1974.
- R. J. Stipes, appointed Assistant Professor Nov. 13, 1967, promoted to Associate Professor July 1, 1974.
- Sue A. Tolin, appointed Assistant Professor Sept. 15, 1966, promoted to Associate Professor July 1, 1971.

Instructors

- J. J. Albert, appointed in 1962, resigned fall 1966.

INSTRUCTION

Instruction in the Department had changed drastically during the Wingard era. From the outset, the Department was a service Department at the undergraduate level. The introductory Plant Pathology course met the curricular needs of Agronomy and Horticulture majors; Forest Pathology provided a course for Forestry, Wildlife, and Conservation majors. There was no undergraduate curriculum in the Department. In 1953, the Department was authorized to offer a program leading to an M.S. degree and in 1961, a Ph.D. program was authorized. Courses having approved syllabi as of January 1965 were (Pl.P.P.):

- 303 Plant Pathology - 3H, 6L, 5C, III.
- 304 Forest Pathology - 3H, 3L, 4C, III.
- 401 Principles of Plant Disease Control - 3H, 3C, II.
- 501 Diseases of Field Crops - 3H, 3L, 4C, I, even yrs.
- 506 Genetics in Relation to Plant Pathology - 3H, 3C, I, odd yrs.
- 508 Plant Parasitic Nematodes - 1H, 6L, 3C, I, even yrs.
- 511, 521 Seminar - 1H, 1C, I, II.
- 599 Research and Thesis.
- 600 Directed Study.

The Catalogue, published in December 1964 for the academic year 1965-1966 indicated that only one new item was added:

- 799 Research and Dissertation.

However, syllabi were approved for new courses that could be presented in 1965-1966 after the catalogue was published:

- 502 Diseases of Fruits and Vegetables - 1H, 6L, 3C.
- 507 Principles of Plant Disease Control - 3H, 3C, II (a revision of 401).
- 509 Plant Virology - 2H, 3L, 3C, I, odd yrs.
- 5011 Diseases of Ornamental Plants - 2H, 3L, 3C, II, even yrs.
- 601 Physiology of Parasitism of Plants - 3H, 3C.
- 602 Epiphytology - 3H, 3C.

A course, Methods of Research in Plant Pathology, was proposed but rejected by the University Graduate Committee. All of the above courses were proposed in the 1961 Petition to offer a Ph.D. degree in the Department of Plant Pathology and Physiology. There were several courses in Plant Physiology and Weed Science that were also included in the Petition, some of which Plant Pathology majors found quite pertinent. The faculty was in place to offer all courses; thus, the Department was ready to enter the instructional phase of the Couch era.

There were several changes in faculty during 1965-1969, leading to changes in teaching assignments and consequent changes in catalogue listings. In 1965, Couch relieved Williams of teaching Plant Pathology (303) and assumed that assignment himself. Williams would teach the Laboratory sections and the courses he had originated; namely, Plant Parasitic Nematodes (508) and Plant Virology (509). Although Williams had reluctantly taken over Plant Pathology in the mid-fifties, he had grown to enjoy it, and reluctantly relinquished it to Couch. He taught Plant Parasitic Nematodes (508) once in fall of 1964 and Plant Virology (509) once in fall of 1965. Before he could teach 508 again, J. A. Fox, a trained plant nematologist, was hired and assigned all teaching in nematology. Before Williams could teach 509 again, Sue A. Tolin, a trained virologist, was hired and assigned all teaching in plant virology. Williams had now been eliminated from control of both courses he had originated and from Plant Pathology. His contributions to instruction were reduced to advisor of graduate students and presentation of some Plant Pathology lectures. Claude Fordyce was made instructor for Plant Pathology Laboratory for 1965 and 1966. This assignment changed in 1967, when Fordyce resigned and W. H. Wills who had been transferred from Chatham to Blacksburg was assigned responsibility for Plant Pathology Laboratory. Williams was instructor of only two periods of Plant Pathology in 1968. This turned out to be Williams' last contribution to the instruction program.

Clinical Plant Pathology (512, 522) was created in lieu of the failure of Methods of Research in Plant Pathology to be approved by the University Graduate Committee. In the first quarter, methods were emphasized; in the second quarter, diagnosis of diseases and identification of causal agents were emphasized. It was a smoke-screen to present a methods course. In the 1968-69 catalogue, it was listed as:

- 512, 522 - Clinical Plant Pathology. 3L, 1C, IV, V.

It was reivsed in the 1971-72 catalogue to:

- 512, 522 - Clinical Plant Pathology I, IV; 6L, 2C, I; 6L, 2C, IV.

Later, it was shifted to quarters II, III.

Forest Pathology underwent several changes between 1950 and 1974. Henderson organized the course for presentation in spring of 1950. In those days, forestry students were required to take one quarter of Pl.P.P. 303, Plant Pathology, and Pl.P.P. 304, Forest Pathology for a total of 7 credits. Later in the 1950's, at the behest of the forestry faculty, the requirement to take Plant Pathology was dropped and Forest Pathology was changed from 2H, 3L, 3C, to 3H, 3L, 4C. In 1968, Pl.P.P. 306, Plant Pathology Laboratory was initiated as a distinct course; Pl.P.P. 303 was renumbered Pl.P.P. 305 as a 3-hour lecture course only. J. M. Skelly, trained in forest pathology, was appointed Assistant Professor in January 1968 and he was assigned to teach Forest Pathology as a 1-credit (3L) course. Students majoring in Agronomy or Horticulture took Pl.P.P. 305 and 306; those majoring in Forestry took Pl.P.P. 305 and the renumbered course 307, Forest Pathology. Thus, Henderson, a tobacco pathologist, who had taught Forest Pathology for 18 years, was freed from it. Henderson coordinated Clinical Plant Pathology from 1966 to 1971.

Several other new courses were installed during the Couch era. Couch himself introduced Principles of Plant Disease Development in 1966 (Pl.P.P. 609). In 1968, he turned it over to R. J. Stipes, newly hired Assistant Professor. This course was to be primarily for advanced Ph.D. students; it was to review the infection process, symptom development, host responses, pathogen reproduction, and propagule dispersal. Attention was given to writing for publication and to one's behavior as a professional. Students were forced to review their entire education in plant pathology. In fact, the course was an excellent preparation for students soon to undergo their oral preliminary or final examinations.

Diseases of Ornamental Plants (Pl.P.P. 5011) was to be initiated in 1967; however, the intended instructor, Claude Fordyce, resigned to take a position in the U.S. Department of Agriculture. The course was listed in the 1967-1968 Graduate Catalogue but apparently was never taught.

J. A. Fox, plant nematologist, was a philosophical sort. He prepared a course entitled Concepts in Nematology (Pl.P.P. 5010) which would give him a stage to discuss his ideas in nematode taxonomy, host-nematode interactions, and a history of plant nematology. Apparently, at least during the Couch era, there were never enough students registered to warrant presenting the course.

Physiology of Pathogenesis (Pl.P.P. 608) was first offered in winter of 1969; L. D. Moore, newly hired Assistant Professor, was the instructor. Much attention was devoted to biochemical processes involved in disease development.

By the end of the 1960's, much thought was being given to providing inducements to undergraduate students to elect a second course in plant pathology. The course Diseases of Crop Plants (Pl.P.P. 404) was proposed and first presented in 1970; C. R. Drake was the instructor. The course was intended for both undergraduate and graduate students but it did not attract many undergraduates.

In 1971, there were discussions in the Department as to how the number of graduate students could be increased and how students could be specifically trained to fill non-research, non-academic positions. A graduate program in plant protection was conceived in which insects, phytopathogens, weeds and their control would be emphasized. C. R. Drake was named Coordinator. In lieu of a research thesis, a course entitled Project and Report, Pl.P.P. 590, was established. Students took more course work than those in an M.S. thesis program. Their report was to be an extensive review of literature on some specific topic and a simple demonstration of some host- pest interaction or efficacy of a pesticide. Ironically, some reports, but not all, were superior to some M.S. theses.

The non-thesis program served its purpose well; graduate student numbers increased, classes were fuller, more degrees were granted, and the students found employment. Several continued in Ph.D. programs in the Department or elsewhere. The initiation of the non-thesis M.S. program lead to installation of a new course available for both graduate and undergraduate credit.

The consequences of smog in metropolitan areas and the industrial out-pouring of sulfur-laden smoke, unexplained death or stunting of forest trees, created interest by researchers in developing projects to investigate the effects of air pollution on vegetation. Skelly began studying air pollution effects on Virginia forests and in 1972, with L. D. Moore, initiated the course Air Pollution Damage to Vegetation, Pl.P.P. 405 (2H, 3L, 3C, III). It was a required course in the M.S. non-thesis program. This became a popular course. *Phytopathology News* featured it as a cover story [P.N. 7(2):1. Feb. 1973]. The flying classroom was shown, a Queen Air Beechcraft twin engined airplane, in which students were flown aloft to observe inversion layers and plumes from power plants. There were 9 students in 1972, 30 in 1973. Enrollment grew over a period of several years. The flying classroom soon was outgrown and had to be abandoned.

Two other courses were initiated to complete the M.S. non-thesis program. Concepts and Principles in Pesticide Application, 2H, 3L, 3C, III, (Pl.P.P. 5120), was first offered in spring of 1973. It addressed physical properties, formulation, and use of pesticides; types, use, and calibration of application equipment; and safety. Another course was offered under two titles there was a problem getting the syllabus approved. Offered first in spring 1973 as Plant Pathogenic Agents (temporary no. Pl.P.P. 598), it could not be repeated under that name. It was renamed Phytopathogens (again 598) and offered in the fall of 1973. Later it was permanently titled and numbered Plant Pathogenic Agents, 3L, 3H, 4C, I, Pl.P.P. 5130.

When Couch stepped down as Department Head in 1974, the following plant pathology courses were listed in the catalogue. Note that they have been renumbered in a University wide system:

3010 Plant Pathology.
3020 Plant Pathology Laboratory.
3030 Forest Pathology.
4010 Air Pollution Damage to Plants.
4040 Diseases of Crop Plants.
4050 Phytopathogens.
4060 Principles of Pesticide Application.
4311 Integrated Plant Pest Management I.
4312 Integrated Plant Pest Management II.
4680 Virology.
4960 Field Study.
5090 Genetics of Host-Parasite Interactions.
5111 Seminar.
5120 Concepts and Practices of Pesticide Application.
5130 Plant Pathogenic Agents.
5150 Diseases of Field Crops.
5170 Epidemiology of Plant Diseases.
5221 Clinical Plant Pathology I.
5222 Clinical Plant Pathology II.
5311 Pest Management Systems I.
5312 Pest Management Systems II.
5900 Project and Report.

4970 Independent Study.
4980 Special Study.
4990 Undergraduate Research.
5020 Principles of Plant Disease Control.
5030 Plant Parasitic Nematodes.
5040 Plant Virology.
5970 Independent Study.
5980 Special Study.
5990 Research and Thesis.
6020 Principles of Plant Disease Development.
6040 Physiology of Pathogenesis.
7990 Research and Dissertation.

RESEARCH AND EXTENSION

The Couch era coincided with the beginning of the "publish or perish" era practiced by universities nation wide. As a consequence, papers were published on research before the research was ripe for publication. Thus, there were many preliminary, fragmented reports in an effort to amass publication titles. There was also an increased dependence on granting agencies for funds and a corresponding reduction of funds from federal and state governments. Successful renewal of grants often was determined by the ability of researchers to show progress via publication. This caused a burgeoning of journals filled with unnecessary redundancy and this in turn taxed libraries to find a means to store the outpouring.

To record the progress of plant pathology during the Couch era would be an impossible task if it were done entirely chronologically; also, it would be a hodgepodge wherein the logic of the research would be difficult to follow. Therefore, the research is presented under commodities and to a lesser degree under categories of pathogens.

Fruit pathology was the oldest activity in the Department, extending back to the appointment of W. B. Alwood as Vice-Director of the Agricultural Experiment Station in 1888. The first article relating to plant pathology was an article appearing in *The Southern Planter* magazine in which Alwood described equipment available and how to maintain and utilize equipment for applying pesticides. Alwood wrote several articles and bulletins on fruit diseases between 1889 and 1904. Activity in fruit research became so intense and specialized that a fruit research laboratory was established at Winchester in 1922 and a fruit pathologist, F. J. Schneiderhan, was appointed and assigned there that year. Schneiderhan, thus, became the first field station pathologist in the Experiment Station. Fruit pathology has remained an important and continuous departmental activity since 1888.

FRUIT

During the Couch era fruit pathologists were A. B. Groves, C. R. Drake, K. D. Hickey, and J. J. Albert. Groves had been at Winchester since September 1929; his career ended abruptly on January 26, 1966 when he died of a second heart attack. After Groves' first heart attack in 1962, John J. Albert had been appointed Instructor in 1962 to assist him with orchard work. When K. D. Hickey was appointed Assistant Professor to succeed Groves, Albert resigned to pursue a Ph.D. degree at V.P.I. & S.U. At Blacksburg, Drake was essentially a replacement for R. H. Hurt who had retired from the Piedmont Fruit Laboratory at Charlottesville, resulting in closing of the laboratory.

Toward the end of his career, Groves was working on the interregional project IR-2, which was organized to isolate and maintain virus-free tree fruit propagating stock. In an article, "Apple viruses, a newly recognized disease problem" (Va. Fruit 53:113-116, 1965), Groves outlined his research on apple virus diseases. Through January

1966, he reported that he had found only one virus-free tree, a Golden Delicious. Thus, the effect of viruses on horticultural performance of apple varieties could not be evaluated and was unknown. Apple viruses are spread through propagating practices and probably through root grafting. Groves anticipated that virus-free stock would become available but not soon (Va. Fruit 53:113-116). The foregoing statements attest to the basic research underway at Winchester in the twilight of Groves life. They also pointed out that pesticide testing need not be the only function of a fruit disease laboratory.

Kenneth D. Hickey replaced Groves in late 1966, but did not move to Winchester until early 1967. Since Hickey was transferring from the Pennsylvania fruit laboratory at Arendtsville and he had cooperated with Groves on a number of projects and programs in the Cumberland-Shenandoah Fruit Workers conferences, he was well prepared to replace Groves and continue his projects. He immediately became Groves replacement on IR-2.

Hickey's research can be tracked very well from the papers he presented at annual meetings of the Virginia State Horticultural Society. He kept growers appraised of new fungicides and application methods. Results from several tests with fungicides and individual diseases were summarized in the American Phytopathological Society annual publication, *Fungicide and Nematicide Tests*, for which he served as either editor or business manager during the Couch era (Fungicide. Nemat. Tests vols. 23-30, 1967-1974). Generally, he would publish a technical summary and follow this up by less technical oral presentations at annual meetings of the Cumberland-Shenandoah Fruit Workers Conference and Virginia State Horticultural Society. In 1969, Hickey promoted the use of concentrated sprays applied with airblast sprayers (Va. Fruit 57:81- 84, 1969). Savings resulted from the reduction of spray volume, spray machine costs, and labor.

Apple powdery mildew was a topic of intensive research by Hickey. Many new products were tested but only a few were adequate. Dikar 80W was first recommended during these studies. Triamirol and Benlate appeared promising in later studies and were recommended as soon as they were properly labelled (Va. Fruit 59:85-90, 1971).

The various chemical usages can be traced through the recommendations issued in Extension Service Bulletin 131 (up to 1968 and renumbered 219 in 1969). Hickey contributed extensively to these publications.

Hickey advised one graduate student, D. A. Smith, through an M.S. thesis project. Smith's thesis was titled "Fungicidal control and related studies on black root rot of apple (*Malus pumila* Mill.) caused by *Xylaria mali* Fromme (1973). Smith also worked at Winchester on the apple powdery mildew problem; Hickey and Smith read a paper on movement of benomyl and thiabendazole in apple seedlings as determined by bioassays and mildew occurrence (Va. J. Sci. 24:113, 1973).

Charles R. Drake became a State employee in 1962 after having worked as a U.S.D.A. employee in Blacksburg from 1956 to 1962. Drake was named Associate Professor of Plant Pathology in the Agricultural Experiment Station; in 1966, he became Associate Professor and Extension Specialists in fruit pathology.

Since there were no orchards near the V.P.I. and S.U. campus, Drake in 1965 established an experimental-demonstration planting of apple, pear, peach, and nectarine trees. With this small orchard and through cooperation with orchardists in Carroll, Patrick, Albemarle, and Nelson counties, Drake studied disease problems in the western Piedmont and southwestern Virginia. Most of these studies led to the publication of numerous 1-4 page leaflets in the Extension Service Plant Disease Control Notes, Control Series. In most of these, a single disease was described and illustrated, and recommended control practices were outlined. Once published, they were revised almost annually in the Couch era.

Drake prepared or coordinated the preparation of three Extension Publications, 35, 374, and 4745 having the outside and inside (4 pages) adorned with color illustrations of diseases. He prepared "Fire Blight of Apple and Pear and is Control in Virginia" (Extension Publ. 35, 1968); a colored diagram of the disease cycle was featured. The second in this series, "Apple Diseases and Their Control in Virginia" (Ext. Publ. 374, 1970) prepared in a similar format was authored by Hickey, G. M. Shear and coordinated by Drake. Four disease cycles were diagrammed. The final one, "Diseases of Stone Fruits and Their Control in Virginia" (Ext. Publ. 475, 1972) was prepared by Drake abone. These three publications were beautifully illustrated and executed; they represent the acme of perfection in Extension plant pathology.

Drake revised "Diseases of Grapes and Their Control in Virginia" (Ext. Publ. 32, 1974). It is also excellent but with black and white photographs.

Apparently, Drake was well-trained in plant histology. He developed a histology laboratory for the Department (long since dismantled) and studied the pathological progress of several diseases. He had a special interest in *Botryosphaeria ribis*, cause of a stem canker and fruit rot of apple, and he reported on several occasions about the justification, and pathological histology and control of *B. ribis* (Fungicide Nemat. Test Results 22:35-36, 1966; 23:29, 1967; 24:6, 6-7, 1968; 26:7-9, 19, 1971; Phytopathology 56:876, 891, 1966; 57:645, 1967; 58:884, 1968; 60:1014, 1970; 61:883, 1971; Va. J. Sci. 19:165, 1968).

Drake's contributions to disease control in orchards may be tracked through reports published in *Fungicide and Nematicide Test Result* and in *Proceedings of the Cumberland-Shenandoah Fruit Workers Conference*, 1965-1975. The essences of these reports were incorporated into the Extension Service Control Series and the annual Virginia Spray Service Bulletin 131/219.

An outbreak of peach powdery mildew occurred in 1968 in Patrick and Nelson Cos. Two species of powdery mildew fungi occurred on peach but since only the oidial stage was found Drake did not determine whether it was *Sphaerotheca pannosa* or *Podosphaera oxyacanthae* (Pl. Dis. Reptr. 54:686-688, 1970). Most likely it was the latter which is now (1998) report as occurring in the range of the host (Farr et al. P. 477). It was not found again until 1973 when it occurred in Albemarle Co. and in 1974 in Nelson and Patrick Cos. again (Va. Fruit 63:89, 1975).

With fruit pathology anchored by Hickey at Winchester and Drake at Blacksburg, fruit growers felt that their disease problems would be capably managed, and so it was through the Couch era.

TOBACCO

Research on tobacco diseases probably involved more people and more man- hours than diseases of any other commodity. Before the Couch era, much effort had been devoted to tobacco ringspot, tobacco mosaic, black shank, blue mold, Granville wilt, wildfire, angular leaf spot, and several nematode diseases. Breeding for pathogen resistance had become the most time-consuming phase of research. Blue mold and nematodes required testing fungicides and nematicides and techniques for their application. From 1965 through 1974, significant progress resulted in the release of several new tobacco varieties and new preventatives for blue mold and nematodes.

From 1929 to 1973, Robert G. Henderson worked steadfastly to improve tobacco, tobacco production, and the lot of tobacco growers. He worked with farmers on their land, with agronomists, other plant pathologists in Virginia and in all tobacco-producing states to facilitate interchange of information and germplasm. Thus, under his leadership through the Couch era, important results accrued.

Henderson was located at Blacksburg but he cooperated with plant pathologists W. H. Wills, J. L. Troutman, and J. L. LaPrade at Chatham agronomists E. M. Matthews also at Chatham, J. W. Crews and later T. R. Terrill at Blacksburg, and R. D. Sears at Charlotte Court House. Henderson emphasized flue-cured and burley tobacco but he also worked on sun-cured tobacco problems. Later, L. D. Moore joined the research; he investigated the physiology of tobacco diseases, especially the pectolytic enzymes involved.

Henderson and his associates released a number of tobacco varieties in the 1965-1974 period. In the following list the reactions to diseases and the cooperating breeders are included:

- <u>Sears Special</u> - fire-cured - Henderson and Spasoff
- <u>Virginia 310</u> - fire-cured - Henderson and Spasoff (VPI Res. Div. Bul. 131. 1968). Va. 310 is resistant to black shank, tolerant of black root rot.
- <u>Virginia 509</u> - burley, Henderson, Spasoff, M. O. Neas, F. S. McClaugherty, L. A. Link (VPI Res. Div. Bul. 130. 1968). Resistant to black shank, wildfire, black root rot.
- <u>Virginia 309</u> - fire-cured, Henderson (VPI & SU Res. Div. Bul. 69. 1972). Resistant to black shank, tolerant of black root rot.
- <u>Virginia 407</u> - sun-cured, Henderson (VPI & SU Res. Div. Bul. 71. 1972). Resistant to black root rot.
- <u>Virginia 770</u> - flue-cured, LaPrade, Terrill, Henderson (VPI & SU Res. Div. Bul. 77. 1973). Resistant to black shank, root knot, black root rot, tobacco mosaic, Fusarium wilt and Granville wilt.
- <u>Virginia 115</u> - flue-cured, LaPrade, Crews, Rogers (Va. Agri. Expt. Sta. Res. Rept. 96. 1964; Crop Sci. 6:98). Resistant to black shank, Granville wilt, Fusarium wilt.
- <u>Virginia 080</u> - flue-cured, LaPrade, Terrill, Henderson, Rogers (Va. Agri. Expt. Sta. Rept. 77. 1973). Resistant to black shank Granville wilt, Fusarium wilt, root knot, black root rot, and mosaic.
- <u>Virginia 3160</u> - flue-cured breeding line, registered in Crop Sci. as GP9.

From the list above, it can be seen that Virginia's tobacco pathologists were quite active in tobacco breeding. The benefits to growers were immeasurable. It had been demonstrated that most of the diseases they targeted could be controlled only by growing resistant cultivars. Most of the greenhouse-laboratory techniques for classifying plants and populations for disease reactions had been developed in Virginia. One notable achievement was the discovery that the PVY virus produced vein-banding on plants susceptible to root knot incited by *Meloidogyne incognita* but produced vein necrosis on plants resistant to root knot. By inoculating with PVY, populations could be classified homozygous resistant or susceptible to root knot and heterozygous. Developing this procedure was a major accomplishment in tobacco breeding (LaPrade & Henderson. 1968. Tob. Sci. 12:158-160).

Troutman and LaPrade reported on the effect of pH on black shank; high pH favored it, low pH suppressed it. Moore and Wills established that increased calcium in a hydroponic growing medium and not merely a high pH was directly correlated with increased severity of black shank (Phytopathology 59:346-351, 1969; Tob. Sci. 16:168, 1972). Although the effect of pH has been clearly elaborated, management of pH and calcium receive little emphasis.

Through extension demonstration plots Wyatt Osborne greatly aided tobacco growers by showing how much crop loss was caused by nematodes; he showed they could be suppressed by application of soil fumigants. He made up-to-date recommendations for nematode control in a variety of Extension Service publications. He realized that a cyst nematode causing damage to tobacco in Amelia County was an undescribed species. It became known as the Osborne's cyst nematode although Osborne did not describe it; Miller and Betty Gray (Technician at Holland) described it as *Heterodera solanacearum* (Nematologica 18:404-413. 1972). Later, it was renamed *Globodera solanacearum* and it is commonly called the Virginia tobacco cyst nematode.

In this zeal to create an awareness of the magnitude of nematode damage to plants, Osborne developed a systematic nematode assay program. This, coupled with his field nematode clinics led to the construction of a mobile disease control laboratory. The vehicle was a van dubbed "the Worm Wagon". The self-contained unit was equipped with electricity, water, a centrifuge, and microscopes. It was used primarily at field days in the tobacco, peanut, and soybean production areas. Osborne was a convincing, effective Extensioneer. He could have canned and sold nematodes.

Wills had been hired to study the ecology of *Phytophthora parasitica*. This work was continued into the late 1960's. The effect of pH had been demonstrated so Wills joined with Moore to determine the precise roles of pH-modifying ions in the black shank disease. They found that increased calcium levels and not merely higher pH levels were directly correlated with increased black shank severity. This same effect on another soil Phycomycete, *Pythium myriotylum* could not be demonstrated (Plant Dis. Reptr. 51:641-644. 1967; Phytopathology 59:346-351. 1969; Tob. Sci. 16:168. 1972).

Research workers from Virginia contributed extensively to interstate, even international cooperation, through the Tobacco Workers Conference. Wingard and Henderson were prime movers in the organization of this group. Henderson was General Chairman of the Conference in 1965; Member of the Advisory Committee on Variety Releases, 1965-66; Chairman of the Flue-cured Tobacco Quality Committee, 1965-70; Member of the Editorial Board for *Tobacco Science*, 1965-66; Member of the Resistance Evaluation Committee, 1966-69; and Member of the Tobacco Disease Loss Committee, 1972. In 1970, *Tobacco Science*, vol. 14 was dedicated to Henderson.

Others who served on committees of the Tobacco Workers Conference were Osborne who was Chairman of the Disease Council, 1969; Chairman of the Disease Council Subcommittee on Nematode Control, 1970; and Member of the Disease Loss Committee, 1972; LaPrade who was on the Regional Tobacco Disease Evaluation Committee, 1968-69; Spasoff who served on the Committee on Tobacco Diseases, 1965; and who was the recipient of the Conference Research Award in 1965; Troutman who served as Chairman of the Tobacco Disease Council, 1967; Wills who participated in the Conference programs through 1967; Tolin who was a member of Tobacco Disease Council, 1973.

In 1967, the Disease Laboratory at Chatham was closed. Wills was transferred to Blacksburg to investigate root diseases of ornamental crops; Troutman resigned and LaPrade continued his breeding project until he retired in 1970. In 1974, all remaining Chatham personnel were transferred to a new location at Blackstone. The Charlotte C.H. station was also closed in 1974; no faculty members were at Charlotte C.H. but tobacco seed-bed and field experiments were still in progress under the direction of Blacksburg personnel. The opening of the Southern Piedmont Research Station at Blackstone was dawn of a new era in tobacco disease research. Henderson, LaPrade, and Spasoff retired during the Couch era; Troutman resigned; and Wills was transferred into ornamental crop work. A new generation would pick up tobacco work in the Foy era.

PEANUT

Peanut disease research began at Holland in 1938 when Miller began studying methods to control peanut leaf spot. He served in the U.S. Marine Corps during World War II and returned to the Station afterward. In 1946, he took an educational leave to study for a Ph.D. degree. He returned in 1949 and remained there until he was transferred to Blacksburg in 1969. Garren was assigned by the U.S.D.A. to Holland in 1955. Miller became an expert nematologist at Holland; Garren emphasized control of stem rot and pod rot.

Prior to the Couch era, Miller discovered a new virus disease of peanut in September 1964. Troutman worked diligently with Miller and others to characterize and control this new disease and its viral pathogen which they called peanut stunt and peanut stunt virus (Plant Dis. Reptr. 50:139-143, 1966; Phytopathology 56:587, 904, 1966). The virus was found to be non-persistently aphid-borne, mechanically transmissible, seed-borne, reactive to a homologous antigen but not to that of squash, pea enation, southern bean, and cucumber mosaic viruses. The virus was never photographed by Troutman with an electron microscope; eventually it was found by others to be an icosahedron of the cucumovirus group. Troutman and T. W. Culp (U.S.D.A. at Holland) found that seed transmission occurred only in seeds that passed through an 18/64 inch screen. Larger seeds were found to be virus-free. Thus, a mechanical means of obtaining virus-free seed from infected, symptomless plants was available to growers (Pl. Dis. Reptr. 52:522-523, 1968).

In 1970, *Cylindrocladium crotalariae* was discovered by Garren et al. on peanut plants in Nansemond County. It caused a disease called black rot (Pl. Dis. Reptr. 55:419-421, 1971). Work ensued to seek varietal resistance as it seemed that it would become very destructive (J. Am. Peanut Res. & Edu. Assoc. 4:14-17, 1972). The organism infected soybeans; this created a problem for growers in the peanut-producing counties as soybeans and peanuts were rotated through the same fields.

Remote (aerial) sensing was investigated in an attempt to estimate disease losses rapidly. N. L. Powell, Garren, G. J. Griffin and D. M. Porter, who had been appointed to a U.S.D.A. position in 1966, cooperated and were able to solicit the support of the National Aeronautics and Space Administration, Wallops Island, Va., for the flights and infrared photography (Peanut Sci. 3:21-24, 25-29, 1976). Although the work revealed new infestations and field patterns of diseased plants, it was discontinued as a routine survey procedure because of the expense.

In 1971, Porter and M. K. Beute found an outbreak of peanut blight incited by *Sclerotinia minor* now *S. sclerotiorum*, the first occurrence on peanut in the United States (J. Am. Peanut Res. & Educ. Assoc. 5:199, 1973; Phytopathology 64:263-264, 1974). Later, Powell, Porter, and Pettry demonstrated that aerial infrared photography as described above could be used to detect Sclerotinia blight and assess losses caused by it (Peanut Sci. 3:21-24, 1976). In experiments conducted in 1973 and 1974 Porter and Beute obtained excellent control of the blight with DCNA, PCNB, and benomyl (Pl. Dis. Reptr. 59:697-701, 1975).

Porter, from the outset of his appointment to the Holland station, tested new fungicides for control of Cercospora leaf spot. At first, benomyl was efficaceous (Pl. Dis. Reptr. 54:955-958, 1970), but later other products were introduced. Complications developed when it was discovered that captafol or chlorothalonil, although excellent for leaf spot control, resulted in more destruction by Sclerotnia blight (Pl. Dis. Reptr. 61:995-998, 1977).

Porter cooperated with Garren, and F. S. Wright on studies of proliferation of *Aspergillus flavus* and consequent production of aflatoxin in peanut (Phytopathology 61:1194-1197, 1971). It was determined that to minimize aflatoxin accumulation, pods must be harvested promptly and dried quickly to 9% water content (Proc. Am. Phytopath. Soc. 3:253, 1976).

Garren was a great believer in isolation and culture of fungi as a diagnostic technique. In the early 1960's, he had obtained evidence from tests with soil fungicides that a Phycomycete was involved in peanut pod rot. After thousands of isolations, inoculations and re-isolations, he devised a selective medium that yielded *Pythium myriotylum* from partially rotted pods. He reported these results in 1966 (Phytopath. Zeitschrift 55:359-367) and verified them in further studies (Pl. Dis. Reptr. 54:840-843, 1970).

Both Garren and Porter were active in the American Peanut Research and Education Association. Garren served as president in 1974. Porter as president in 1986. Miller received the Golden Peanut Research Award from the National Peanut Council in 1965; Garren received it in 1974.

CEREALS

Corn - In the Couch era, maize dwarf mosaic and gray leaf spot received emphasis from the corn pathologist, C. W. Roane, the virologist, S. A. Tolin, and the corn breeder, C. F. Genter.

Maize dwarf mosaic (MDM) was identified in 1964; it had been observed but not identified in 1963 and farmers along the James River declared that it had appeared in 1962. Since it was invariably associated with the presence of johnsongrass, it was found to be widespread in Virginia (Plant Dis. Reptr. 49:665-667, 1965). Troutman assisted Roane in early studies on the host range of the virus (MDMV). When Tolin was hired in 1966, she took an interest in MDMV, and the work underway was greatly refined (Plant Dis. Reptr. 53:307-310, 1969). Roane and Genter, starting in 1966 began a project to breed corn resistant to MDMV. Several hybrids were found to resist the stunting phase of MDM but none were found that would not mottle to some degree. Hybrids that mottled and therefore were regarded as susceptible to MDMV would produce respectable crops; these were recommended to growers. In this respect, Virginia was more successful than states that made recommendations based on freedom from symptoms.

Roane, Genter, and Tolin conducted some experiments from 1970 to 1973 by artificially inoculating corn with a johnsongrass isolate of MDMV. Although it was known that several entries in the test would stunt severely, produce nubbins and bright yellow and red leaves in the presence of johnsongrass, the artificially inoculated corn only mottled and was just a few inches shorter than healthy corn. Yield of grain was only slightly reduced (Crop Sci. 13:531-535, 1973). It was concluded that in association with johnsongrass, severe symptoms in maize were caused by an agent other than MDMV. Shortly thereafter, workers in Mississippi and Ohio demonstrated that symptoms in natural infections were produced by two viruses, an aphid-borne, sap-transmissible, flexuous rod that caused mottling (MDMV) and a leafhopper-borne, isometric particle. The latter was designated the maize chlorotic dwarf virus; it was responsible for the dwarfing and sterility (Phytopathology 63:127-133, 1973). Obviously MDMV is a misnomer as it causes no dwarfing.

R. K. Jones, working with Tolin, studied purification of MDMV for his dissertation. Unlike other rod-shaped viruses, MDMV underwent severe degradation during purification. Field-grown maize produced higher titres of MDMV and maintained the virus at a high level longer than did greenhouse-grown maize (Phytopathology 62:640- 644, 812-816, 1972).

Gray leaf spot (GLS) caused by *Cercospora zeae-maydis* began intensifying in 1971; by 1973 it was causing heavy losses to corn growers, mostly west of the Blue Ridge Mountains. As the no-tillage method of corn production became more widespread, so did GLS. No-tillage allowed crop residues to remain on the surface where viable inoculum could generate spores soon after a new planting of corn emerged. By plowing under corn crop residue, GLS could be effectively controlled. In the Couch era, resistant hybrids were sought, but by the end of the era, little progress had been made (Plant Dis. Reptr. 58:456-459, 1974). MDMV had a predisposing effect on GLS.

Helminthosporium maydis race T, so designated because it was highly virulent and very destructive on all maize lines and hybrids carrying the Texas male sterility factor, appeared in Virginia in August 1970. No effort was made to study this disease because nearly every other eastern state initiated a crash program to bring it under control. Although these programs compiled a considerable fund of knowledge about the disease, the commercial corn breeders reverted to hand detasseling and greatly suppressed it in 1971; in 1972 they virtually eliminated it. This disease is often cited as one where genetic uniformity in the host species is liable to make it vulnerable to disease (Annu. Rev. Phytopathology 11:463-486, 1973; 12:167-179, 1974). Roane in the 1973 article, elaborated on the implications of genetic homo- and heterogenicity (Ibid 11:471-472, 475-476).

Barley - Although equal emphasis had been given to breeding wheat and barley varieties, progress was more rapid with barley. 'James' had been released in 1961; 'Hanover' was released in 1968; 'Rapidan' was released in 1970 (Crop Sci. 6:303, 1966; 10:456, 1970; 13:769-770, 1973). Hanover and Rapidan were similar; they provided resistance to scald, powdery mildew, and leaf rust; stiffer and shorter straw and higher grain yields than did previous varieties; but unfortunately, they were very susceptible to net blotch and they brought it to the forefront.

Inheritance of reaction to *Rhynchosporium secalis* and *Puccinia hordei* were studied intensively in the Couch era. The genes conditioning reaction to leaf rust were labelled Pa1-Pa5 (Phytopathology 57:66-68). The standard leaf rust race-differentiating varieties were found to have <u>Pa</u> genes duplicated thus their efficiency was impaired. A new group of differential varieties based on monogenic resistance was proposed. This suggestion was based on the assumption that Flor's gene-for-gene hypothesis was applicable to *Hordeum-Puccinia hordei* genetics (1971 Barley Newsletter 15:23-28, 1972). Eventually such a system would be adopted.

There were studies to identify leaf-rust conditioning genes in several cultivars useful to breeders. 'Franger' carried <u>Pa4</u>, 'Cebada Capa' <u>Pa5</u> (Phytopathology 60:788- 790, 1970); 'Kwan' and others were listed by Roane in a book chapter on barley (Breeding Plants for Disease Resistance, Concepts and Applications, R. R. Nelson, ed., Penn. State Univ. Press. 1973).

Inheritance of reaction to *R. secalis* was investigated primarily by T. M. Starling (Agronomy Dept.) and his student K.-R. Chi (Proc. 2nd Internat. Barley Genet. Symp. 513:519, 1970). Many cultivars were studied all but one, C. I. 8618, had genes previously recognized.

Roane contributed a book chapter on barley (cited above) in which the genetics of disease reactions, sources of resistance, and methods of breeding were summarized for leaf rust scald, powdery mildew, brown loose smut, barley yellow dwarf virus, covered smut, spot, and net blotch.

In 1970, permits to manufacture mercury seed treatment chemicals in the United States were cancelled. In 1972, all labels for such mercury products were cancelled. This action removed from the market the only chemicals known to be effective for controlling cereal smuts and barley stripe. In part, the Food and Drug Administration (F.D.A.) was moved by three events to take this action:

1. A farmer in Alamagordo, N.M., fed his hogs mercury-treated grain, mercury accumulated in the hogs, they were slaughtered and fed to his family causing mercury-poisoning to his children. The television networks gave the incident national publicity.
2. A shipment of mercury-treated wheat intended for sowing arrived in a mid-eastern country and many of the bags were stolen, the grain was used for bread, and many people died of mercury poisoning.
3. Treated grain was transported in bulk from treatment plants to farmers in northern states and Canada. Spillage occurred along the roadways and the toxic grain was consumed by birds, among them pheasants. Birds died and mercury traveled up the food chain in raptors and other scavengers. People consuming

poisoned birds became ill.

Most seed treatment mercury compounds were methyl mercuries for which there was no antidote. Armed with these facts and under pressure from environmentalist and health organizations, the F.D.A. clamped down on all agricultural mercury products. Mercury products already distributed after the ban could be used. The impact of this ban most seriously affected the seed grain industry. There was a need to find replacements for mercury. Von Schmeling and Kulka announced the systemic activity of 1,4-oxathiin (= carboxin) derivatives as being especially efficacious toward Basidiomycetes, namely rusts, smuts, and *Rhizoctonia* (Science 152:659, 1966). For smut control, one of these products, Vitavax, quickly replaced mercury. However, none of the oxathiins controlled seedling diseases nor barley stripe. D. M. Kline (U.S.D.A. at N.C. Ag. Expt. Sta.) and Roane experimented with other chemicals and combinations with carboxin. Cycloheximide + thiram, carboxin + thiram were the most effective materials (Kline & Roane, Plant Dis. Reptr. 56:183-185, 1972). Thiram + carboxin became the standard treatment for barley in the Virginia certified seed business. No other studies were conducted with seed-treatment chemicals during the Couch era.

Ascochyta graminea was found on barley at scattered locations; it did not appear to be a threat to the crop as it colonized only senescent leaves in early spring (C. W. Roane and M. K. Roane, Plant Dis. Reptr. 58:455, 1974).

Wheat - Most of the effort in wheat pathology from 1964 to 1974 was toward breeding disease-resistant varieties. However, *Ascochyta sorghi* was detected on wheat in 1973 (Plant Dis. Reptr. 58:455-456, 1974). Agropyron mosaic virus and wheat streak mosaic virus found at Blacksburg and Orange by Tolin and Roane were of no economic importance (Plant Dis. Reptr. 53:751-752, 1969). The discovery in 1973 that wheat spindle streak mosaic virus (WSSMV) rather than wheat soil-borne mosaic (WSBMV) is the predominant mosaic-inducing virus present in Eastern Virginia caused a reconsideration of previous claims and helped to explain an inconsistency observed in the mid-fifties. Since this situation was described only in a newsletter (Ann. Wheat Newsl. 30:166-167, 1984), it is repeated here.

In 1951, the wheat cultivars Atlas 50 and Atlas 66, released by the North Carolina Agricultural Experiment Station, were widely planted in Virginia and neighboring states. In the spring of 1952, wheat soil-borne mosaic (WSBM) was observed in seven eastern Virginia counties where Atlas wheats were being produced. In 1953, WSBM was observed in 5 additional counties. In cooperative experiments with the U.S. Department of Agriculture, and the North Carolina and Virginia Agricultural Experiment Stations, plantings of several hundred cultivars were made at Statesville, N.C. in 1951 and in 1952 and China Grove, N.C. and near Lyells, Westmoreland County, Va., on the W. D. Edwards farm in 1952. As mosaic developed in 1953, a number of cultivars were severely mottled in both North Carolina and Virginia, some were severely mottled in both North Carolina and Virginia, some were severely mottled in Virginia and not at all in North Carolina. We attributed the different responses to occurrence of difference virus strains of WSBMV in North Carolina and Virginia (Plant Dis. Reptr. 38:14-18, 19-24, 1954). 'Atlas' wheats were replaced with more resistant cultivars and WSBM was not observed for a number of years.

In 1970, Slykhuis described the wheat spindle streak mosaic (WSSMV) and *Polymyxa graminis* was later shown to be the transmitting agent for this virus (Phytopathology

60:319-331, 1970). In 1973, several cultivars of wheat displayed mosaic symptoms in plots at the Warsaw, Virginia Station. Symptoms were severe in 'Arthur', 'Arthur 71', 'Abe' and some numbered lines. 'Oasis', 'Blueboy', and 'Blueboy II' were non-symptomatic. We presumed the disease to be WSBM but were suspicious because Arthur, Arthur 71, and Abe had been described as resistant to WSBMV. Sue Tolin examined the specimens provided with an electron microscope and found virus particles characteristic of WSSMV. No particles of WSBMV were found. Since then, wherever a soil-borne wheat mosaic has been encountered in Virginia, only WSSMV particles have been associated with the symptoms. Collections were obtained from several locations where WSBM had occurred in Atlas wheats had only WSSMV type particles. If in the 1952-3 experiments, WSBMV occurred in N.C., but WSSMV occurred in Va., as appears to be the case, the reasons for different responses to viruses in the two states is apparent. Two different viruses, WSBMV and WSSMV, rather than two strains of WSBMV occurred at the two locations.

The advent of new discoveries, new technologies including the availability of an electron microscope, and a person (Tolin) capable integrating these factors, made it possible for an enigma to be unscrambled.

Oats - The project for breeding disease-resistant oats had been abandoned by the beginning of the Couch era. Oats were no longer an economic factor in Virginia agriculture. Work on oats was reduced to testing available varieties for adaptability to Virginia conditions and cooperating with the U.S.D.A. by growing the hardiness tests. The breeding work culminated in the release of 'Windsor' winter oat in 1971.

In 1960, late winter snows kept some of our nurseries covered until April 10 during which the halo blight bacterium (*Pseudomonas coronafaciens*) caused an unusual type of damage to winter oats which breeders were prone to write off as winter-killing (Plant Dis. Reptr. 44:69, 1960). Roane found that 'Dubois', 'Mid-south', and 'Victorgrain 48-93' were resistant and several other varieties were susceptible. C. P. Cheng chose to study the inheritance of reaction to the halo blight bacterium for his Ph.D. dissertation project (Phytopathology 58:1402-1405, 1968). He found the varieties Dubois and Victorgrain 48-93 to be monogenic resistant but that their genes were closely linked (1.8 ± 1.04 C.O. units). The genes were labelled <u>Pc2</u> and <u>Pc3</u>.

SOYBEANS

There had been no continuous work with soybean diseases in Virginia until the soybean cyst nematode was found in 1958. Grover Smart was soon hired at Holland to work on the disease and its pathogen, *Heterodera glycines*. However, Smart resigned before the Couch era began and Miller began to take an interest in the soybean cyst nematode. Most of his work addressed variability in the nematode, its host range and interfertility of various species of cyst nematodes. He published several papers on the subject throughout the Couch era. He repeatedly demonstrated their interspecific and intergeneric compatibility and proposed that species within each genus may have had a common ancestor but by geographic isolation they have become relatively host specific and morphologically distinct. Miller did not forsake the practical aspect of soybean cyst nematode work. He described in news releases and extension notes satisfactory methods of disinfesting machinery and moving marketable peanuts from infested farms to intra- and interstate markets without risk of disseminating the nematode. This eased the problem that had developed among farmers, pathologists, and enforcement agents when a quarantine was imposed upon farms having an infestation.

In 1965, Roane was asked by Couch to cooperate with T. J. Smith of the Agronomy Department in breeding disease-resistant soybean cultivars. Smith and H. M. Camper of the Warsaw station had bred 'York' and 'Essex', both high-yielding, high quality soybeans. They had emphasized ridding Virginia soybeans of purple stain and streaking or bleeding hilum and they had succeeded so well that Virginia soybeans had become coveted in the market. Smith knew that viruses, purple stain and brown stem rot were diseases to be dealt with and he though a pathologist could wave a magic wand and eliminate the problem. He also thought bacterial pustule was a threat. Into this arena, Roane was thrust with great anticipation.

Roane made surveys of soybean fields and found viruses to be very prevalent near forage legume fields, and in the peanut producing counties. Brown stem rot was commonly encountered, mostly north of the York River. Late in the season, stems everywhere became decorated with anthracnose and pod and stem blight fungi. With Tolin's help, soybean mosaic (SMV), peanut mottle (PMV), and bean pod mottle (BPMV) viruses were identified as most common (Proc. Amer. Phytopathol. Soc. 2:129, 1975). Field symptoms thought to be induced by tobacco ringspot virus were found to be induced by BPMV. As Tolin and Roane, through surveys supported by funds from the Virginia Soybean Commission, clarified the virus situation, numerous varieties were inoculated, the effects of each virus were observed. It became clear that viruses could not be identified from field symptoms. It also became clear that any virus, not just SMV, could cause seed streaking or bleeding hilum. York was found to be resistant and Essex susceptible to SMV and PMV. Lee was resistant to peanut stunt virus (Proc. Amer. Phytopathol. Soc. 1:36-37, 1974). Smith was shown the tests wherein four cultivars were inoculated with four viruses. Essex was obviously severely damaged by all viruses. When Smith saw the test, he commented "You're ruining my Essex". Thereafter, Roane could get no further cooperation from him. It became obvious that he only wanted a pathologist to look over his shoulder; he wanted no one tampering with his soybean breeding program. Little real progress was made in breeding disease- resistant soybeans until Smith retired and Glenn Buss replaced him.

Attempts to establish a nursery for evaluating soybean reactions to brown stem rot failed. The fungus, *Cephalosporium gregatum*, was easy to isolate but difficult to propagate. Furthermore, soil inoculations failed. It was concluded that naturally infested sites would be more useful than artificially inoculated sites. Since no useful sources of resistance were known, brown stem rot work ceased in favor of virus work.

FOREST AND SHADE TREES

Not much attention was devoted to diseases of forest and shade trees by the V.P.I. faculty before the arrival of R. J. Stipes in 1967 and J. M. Skelly in 1968. Workers in the U.S.D.A. had studied chestnut blight but came up empty; the chestnuts died. Federal and State Department of Agriculture workers had some success at controlling Dutch elm disease in Virginia, and there had been a project to eradicate the telial host of white pine blister rust in several western counties. Oak wilt had been found and there were efforts to contain it. Records on the latter two problems are unavailable. Numerous diseases had been noted in the U.S.D.A. Agricultural Handbook 165, Index of Plant Diseases in the United States, as occurring in Virginia but there had been no research on them. Gruenhagen had reported a canker of live oak from the Newport News area in 1964, caused by *Endothia parasitica* (Pl. Dis. Reptr. 49:269, 1965). Thus, there was a fruitful field in forest and shade tree pathology awaiting to be tapped.

Stipes was appointed in 1967 to 65% research, 25% extension, and 10% teaching. He would devote non-teaching time to shade and ornamental tree diseases. His first efforts were to search for systemic chemical controls for Dutch elm disease (DED) and mimosa (*Albizzia*) wilt. The work was continued throughout the Couch era. Primary methods explored were soil and bole injection of various chemicals. Benomyl, captan, and thiabendazole were most effective. P. M. Phipps conducted research for an M.S. thesis on mimosa wilt (*Fusarium*). Results of this research are scattered through a number of abstracts, conference proceedings, and short articles (Va. J. Sci. 20:99, 100, 1969; 21:103, 1970; 22:107, 108, 1971; 23:122, 1972; 25:52, 1974; Phipps. M. S. Thesis. V.P.I.-S.U., 1972).

In 1970, a canker disease caused by *Endothia gyrosa*, was discovered on pin oak in Hampton. This launched Stipes into an extensive study of *E. gyrosa* and other diseases attributed to *Endothia* in Virginia (Plant Dis. Reptr. 55:467-469, 1971; Va. J. Sci. 22:86, 1971; 24:136, 1973; 25:74, 1974; 26:65, 1975). Martha K. Roane became involved in the work; she took particular interest in the taxonomy of *Endothia* spp. (Mycologia 66:1042-1047, 1974). As a result, she was appointed Adjunct Professor of Plant Pathology in 1975. John R. Elkins, a Professor of Chemistry at Concord College was interested in the comparative chemistry of *Castanea* spp., thinking perhaps there was some product in resistant Chinese chestnut that was lacking in American chestnut. He too became an Adjunct Professor of Plant Pathology. Stipes furnished the impetus, much of the money, and the laboratory for intensive study of chestnut blight and *Endothia* spp. At the end of the Couch era, *Endothia* and chestnut blight research was still gaining momentum.

Fomes annosus was a research topic for several State Foresters at the Virginia Division of Forestry during the Couch era. Involved were C. L. Morris, D. H. Fazier, and J. D. Artman. When J. M. Skelly was appointed in 1968 to a three-way position in research, extension, teaching he, too, became involved in *F. annosus* research. Morris and Frazier had devised a scheme for site hazard rating in loblolly pine plantations (Plant Dis. Reptr. 50:510-511, 1966). These workers were interested in preventing stump-top colonization after thinning to prevent build-up of *F. annosus* inoculum which would be a hazard to remaining trees. They investigated the efficacy of borax and urea for preventing stump colonization and found them to be equally efficacious (Plant Dis. Reptr. 53:108-110, 1969).

Artman and W. J. Stambaugh were cognizant of the British discovery that *Peniophora gigantea*, a sap-rotting fungus, could be used as a biological control for *F. annosus*. Applications of spore suspension sprays would have the same labor costs as chemical sprays and, therefore, would not become a practice. Artman and Stambaugh conceived the method by which *Peniophora* spores could be applied in chain-saw chain oil as the trees were being felled. Their experiments with loblolly pine yielded a high success rate. They did not address the problem of making oil inoculum commercially available (Plant Dis. Reptr. 54:799-802, 1970). Later, Artman and E. L. Sharp applied the same technique to white pine but because of excessive resin production on the stumps, *Peniophora* inoculations were not very successful (Plant

Dis. Reptr. 55:834- 836, 1971).

Artman continued experiments initiated in loblolly pine and reported that field tests were not as successful as first reported (Plant Dis. Reptr. 56:66-68, 1972). They attributed failure in part to the high viscosity of SAE 30 oil. In tests with SAE 10 oil, a higher degree of success was obtained. Artman attributed this to a heavier deposition of oil inoculum during felling (Plant Dis. Reptr. 56:958-960, 1972). Apparently, there are no further reports on this work during the Couch era. Artman reported on the occurrence of a canker on white pine caused by *Fusarium lateritium* (Plant Dis. Reptr. 57:182-184, 1973), and on breeding loblolly pine for resistance to *F. annosus* (Plant Dis. Reptr. 58:409-411, 1974). Meanwhile, J. M. Skelly was generating funds to explore insect transmission of *F. annosus*, an area in which he had become proficient while studying oak wilt for a dissertation at Pennsylvania State University [Phytopathology News 5(6):7, 1971; 6(2):7, 1972)].

Both Skelly and Stipes prepared a number of Extension publications on tree diseases. Skelly published on needle cast and sooty molds of conifers; oak wilt, decline, and cankers; eastern gall, fusiform, blister, and needle rusts of pine; mistletoe; pine pitch canker; Fomes root and butt rot of pine; winter drying; Nectria canker; chestnut blight; little leaf of short leaf pine; shoestring rot; leaf diseases, decays, and discolorations of hardwoods. Stipes prepared leaflets on Mimosa wilt, Verticillium wilt, cankers and galls, Dutch elm disease, foliar diseases, Endothia canker of live oak, wetwood, and chemical injuries. R. C. Lambe, working with ornamental plants, prepared leaftlets on juniper twig blight, dogwood spot anthracnose, dogwood Septoria leaf spot, and hemlock twig rust. Most of these Extension publications went through one or more revisions.

Skelly reported finding western gall rust, caused by *Endocronartum harknessii*, in Christmas tree plantations on Scots pine in Bedford, Nelson, Buckingham, and Roanoke Cos. The discovery was made in 1971 but the rust was not identified until it sporulated in 1975. It is an autoecious rust that was apparently brought into Virginia on nursery stock (Plant Dis. Reptr. 60:222-223, 1976). The rust must not be very destructive. Its discovery was but a ripple on the pond.

Stipes and T. C. Davis, Assistant Professor of Forestry at Auburn University and former graduate student who had earned an M.S. degree in the Department and who had studied hemlock rust for his thesis project, prepared a list of 101 landscape tree diseases observed in Virginia, 1968-1970 (Plant Dis. Reptr. 56:108-111, 1972). Thirty- seven diseases were previously unreported. In June 1971, Davis also collaborated with Stipes and Skelly to organize and host the Southwide Forest Disease Workshop at V.P.I. & S.U. Davis presided over the Workshop (Phytopathology News 5(9):1, 1971).

Skelly was the leader and advisor of a number of students who studied forest tree problems and who initiated studies of problems in Christmas tree plantations. They emphasized the effects of edaphic factors (S. A. Alexander), the use of fertilizer to alleviate air pollution damage to white pine (J. B. Will), role of insect vectors for *Fomes annosus* (W. E. Himes). However, it will be seen that Skelly became most interested in diagnosing air pollution damage to forest trees and seeking ways to alleviate the damage.

VEGETABLES

Traditionally, vegetable pathology has been in the province of the Virginia Truck Experiment Station at Virginia Beach and Painter although some tomato and bean work was done at Blacksburg. In the Couch era, Robert Pristou was assigned to Extension vegetable pathology at Blacksburg, T. J. Nugent was the pathologist at Virginia Beach, and R. E. Baldwin was located at Painter. The latter two had the responsibility for research in vegetable pathology. In 1967, Nugent became Associate Director of the Truck Station. The truck cropping industry in the Norfolk-Portsmouth area was declining; the burden of vegetable research had shifted to Eastern Shore. Ornamental plants were becoming the principle subject at the Virginia Beach station.

The principle publication outlet for Truck Station professionals was the *Vegetable Growers News* (VGN). Baldwin authored or co-authored 49 articles in VGN from 1965 to 1974. In the same period, he published 26 items in the American Phytopathology Society *Fungicide and Nematicide Test Results* (FNTR). Items in the publications were on similar subjects; those in VGN for growers, those in FNTR for professionals. The topics of Baldwin's publications pretty well describe the truck crop grower's problems in eastern Virginia; namely, cucumber anthracnose, scab, powdery and downy mildew, and Cercospora leaf spot; strawberry fruit rot and leaf scorch; tomato early and late blight, gray leaf sot, and anthracnose; potato early and late blight, and seed piece decay; sweet potato soft rot; snap bean rust; and root knot nematodes on cucumbers, snap beans, tomatoes and sweet potatoes. He published repeatedly on these subjects, thus providing growers information on the latest products and procedures. Data were sometime collected at both Painter and Virginia Beach by Baldwin and Nugent.

There were gardeners and truck croppers outside of Tidewater who were not specifically served by the Truck Station. Pristou served these growers by visiting problem farms with County Extension Agents. He also prepared several leaflets in the Control Series on vegetable diseases. These included bacterial spot of pepper, cucurbit diseases, early blight and blossom-end rot of tomato and root and stem rot of beans. Sadly, our cabbage industry in Southwest Virginia was not specifically treated in publications but cabbage diseases were treated in the bulky annual, general publication, "Virginia Plant Disease Guide", to which both Pristou and Baldwin contributed.

Much of the vegetable Extension pathology was handled by responses to specimens sent to the Plant Clinic. Pristou was in charge of the Clinic and he managed vegetable pathology through personal contacts and letters. However, during the Couch era, vegetable pathology was not a major topic for Blacksburg faculty.

ORNAMENTAL AND NURSERY PLANTS

In 1965, R. H. Gruenhagen was the Extension Project Leader in the Department and Claude Fordyce, Jr. was assigned to research and teaching; both worked in the pathology of ornamental plants. Gruenhagen did not leave a very impressive paper trail in the Couch era before he transferred out of the Department to the Chemical Pesticides Unit on October 1, 1966. He was an interesting, amusing speaker and lady's garden organizations enjoyed his presentations. In this respect, he represented the Department well and, therefore, was good for the Department. Fordyce published very little on ornamental plants but contributed greatly to the establishment of a gnotobiology laboratory in the Department. He resigned on May

31, 1967 to join the U.S.D.A. at Beltsville.

Robert C. Lambe was appointed Associate Professor and Extension Project Leader on April 1, 1967, presumably to replace Gruenhagen. Lambe proved to be very industrious and soon prepared a group of illustrated publications for the Florist and Nursery Notebook much in the style that Gruenhagen had initiated earlier. Later revisions of these were issued in Plant Disease Control Notes. Since this was the principle contribution of the Department to flower garden and nursery crop pathology, they are listed here. All are in the Virginia Cooperative Extension Service Control Series; the series number is given at the beginning of each:

49. Chrysanthemum Septoria Leaf Spot.
85. Black Spot of Roses.
86. Powdery Mildew of Roses.
87. Gladiolus Corn Rots.
88. Fire Blight of Ornamentals.
89. Scab of Apple and Pyracantha.
90. Phytophthora Root and Crown Rot.
91. Hemlock Twig Rust.
99. Camelia Flower Blight.
100. Fire or Botrytis Blight of Tulip.
107. Dogwood Septoria Blight.
108. Chrysanthemum Rust.
109. Dogwood Spot Anthracnose.
111. Hollyhock Rust.
116. Ovulinia Blight of Azalea.
118. Juniper Twig Blight.
119. Azalea Leaf and Flower Gall.
120. Peony Botrytis Blight.
128. Rust of Ornamentals.

Each of the above was issued in 1969 and revised for reissue in 1970, 1971, 1972, and 1973. Later, lambe and Drake added MR-34, Powdery Mildew of Ornamentals, and Lambe, R. E. Baldwin (Eastern Shore Station), and R. S. Lindstrom (Horticulturist) added MR-37, Propagating and Growing Disease Free Plants.

Lambe conducted experiments to control powdery mildew on crape myrtle, drooping Leucothoe and rose; he found Benomyl to be the best product [Fungicide and Nematicide Test Results, A.P.S. 25:101-103, 1969 (four items); 26:113, 115, 1970]. He conducted many such experiments but apparently only incorporated the results into the Control Series publications.

When Wills moved from Chatham to Blacksburg in June 1967, he was assigned in part to work on diseases of woody ornamental plants. Boxwood became his principle subject. Boxwood decline flared up in the late 1950's and was still causing concern into the 1970's. Wills took an interest in the disease because a *Phytophthora* had been isolated from some boxwood plants and he had worked with *Phytophthora* at Chatham. George Montgomery decided that an investigation of boxwood decline would be a suitable dissertation subject. The American Boxwood Society and the Westmoreland Davis Memorial Foundation provided financial support for the resarch. Davis had been a governor of Virginia early in the 1900's and was owner of the *Southern Planter*. Boxwood is a valuable plant on many old Virginia estates, around historical buildings, and in some parks such as Colonial Williamsburg. To caretakers, the loss of a single decades-, even centuries-old plant would be a catastrophe. Thus, there seemed to be ample incentive to find a cause and prevention of boxwood decline. The most complete summaries of the situation appear in Montgomery's dissertation [The Etiology of Root Rot and Decline of English Boxwood (*Buxus sempervirens* cv. *suffruticosa* L.), VPI & SU, 1975], and a paper by Lambe and Wills (Decline of English boxwood in Virginia (Pl. Dis. Reptr. 59:105-108, 1975). They rejected *Phytophthora* spp. as causing decline but implicated *Paecilomyces buxi* and *Fusarium oxysporum*. No control measures were devised but study of the disease would be continued into the Foy era and beyond.

AIR POLLUTION

For people who lived in Blacksburg, pure, bracing mountain air had been tauted as characteristic of the area. Yet, one only had to look westward after 1940, to see that on quiet days, a haze hung heavily over the New River Valley. The Radford Army Ammunition Plant (RAAP) had begun production in 1941 and its emissions vastly beclouded the valley. However, most of the residents looked upon air pollution or smog as a problem of metropolitan areas. Tobacco farmers had to contend with a phenomenon known as weather fleck which was attributed primarily to ozone. However, there was a growing awareness that air pollutants were damaging our biota and probably ourselves. Skelly and Moore developed a special interest in the potential for damage from the emissions of the RAAP on local biota, especially forest trees. The RAAP was conveniently located to provide a natural study arena. With the assistance of graduate L. L. Stone, the RAAP was identified as an isolated source of oxides of nitrogen and sulfur. They correlated growth in conifers with periods of maximum production at RAAP and described symptoms of NO_x and SO_2 damage to white pine and yellow poplar (Phytopathology 60:1314, 1970; 63:805, 806, 1973; 64:773-778, 1974; Plant Dis. Reptr. 56:3-6, 1972). Growth data were obtained on trees progressively remote from the source of pollutants, from climatic data, and from production data at RAAP. Increment borings showing width of annual growth rings revealed a high inverse correlation with RAAP production (Phytopathology 64:773-778, 1974). These results led Skelly and his associates to seek funding to construct open- top, filtered-air chambers wherein air could be freed of pollutants and ambient or controlled amounts of pollutants could be introduced, and greenhouse chambers in which temperature, humidity, edaphic factors could be controlled and their effects isolated and measured. This, in effect, made our Department one of the most advanced centers in the East for research on air pollution damage to plants. The work was continued into the 1980's. Moore made studies of the RAAP emissions on tobacco and reported oxides of N induced leaf flecking and abscission, and generally stunted growth (Phytopathology 63:804, 1973).

The joint efforts by Moore and Skelly and the developing interest world-wide in air pollution and its control led to the creation of the course on "Air Pollution Damage to Plants" (PlPP 405), first-offered in 1972. Armed with preliminary data and awareness of air pollution problems, Skelly and Moore were able to obtain lucrative grants to continue and expand air pollution research.

NEMATOLOGY

Couch gave particular attention to developing nematology. When he became Department Head, Williams was teaching the course in nematology and investigating nematode problems in forage legumes and turfgrasses. Miller at Holland was investigating nematodes in peanuts and in crops rotated with peanuts and W. W. Osborne, the only truly trained nematologist, was the Extension nematology specialist, especially for tobacco and peanuts. J. A. Fox was hired in 1965 as a truly trained nematologist. It was not clear why four nematologists were needed unless Couch did not regard Miller and Williams as nematologists.

Williams' interest in nematodes originated when he inherited forage pathology from R. G. Henderson during the late 1950's. The alfalfa stem nematode had been a subject of their research. When the grass nematode, *Hypsoperine graminis* was found in 'Tifgreen' Bermuda grass putting greens in eastern Virginia in 1964, Williams shifted his nematode research to this species (Plant Dis. Reptr. 52:162-163, 1968; Nematologia 13:155-156, 1968). Later this nematode was classified as *Meloidogyne graminis*. Under Williams' guidance, C. W. Laughlin began a Ph.D. research project on the biology of *H. graminis* (VPI & SU Ph.D. dissertation, 1968). About the time Laughlin completed his work, A. J. Webber began his Ph.D. program under the guidance of Williams and opted to study factors affecting sex determination in *Meloidogyne graminis*. Williams resigned in late August 1968 to take a position in Kentucky and Webber continued his program under the guidance of Fox. It was a loss to the Department when Williams departed. He had a number of good ideas that he had begun to implement; those that he had not implanted in Webber's dissertation proposal, and it is unknown what they were, probably never bore fruit. Williams potential became apparent when he was later appointed Head of the Department of Horticulture (!) at the University of Kentucky.

Miller's work at Holland was centered around the soybean cyst nematode (*Heterodera glycines* = SCN), peanut root knot nematodes (especially *Meloidogyne arenaria*), and a group of cyst nematodes affecting tobacco production (Osborne's cyst, horsenettle cyst, and tobacco cyst). Miller co-authored papers with P. L. Duke, Nancy T. Whitfield, and his extra-ordinarily talented technician, Betty J. Gray, a high school graduate whom he had trained and who had participated in the advanced nematology course given at North Carolina State University. As leader of the group, Miller studied the host range and pathogenic specialization of isolates of the SCN. In addition to soybean, pathogenic specialization was observed for several leguminous species and the host range was extended to three *Penstemon* species and spinach (Va. J. Sci. 16:314, 1965; 17:245, 246, 1966; 18:143, 1967; 20:99, 1969; 25:51, 1974; Phytopathology 55:1068, 1965; 56:585, 1966; 59:1558, 1969.

Other cyst nematodes had been detected in Virginia; Miller's investigations on the SCN stirred his interest in those species and in resolving their uncertain taxonomic relationships. This led to descriptions of the horsenettle cyst nematode as *H. virginiae* (Nematologia 14:535-543, 1968), and the Osborne's cyst nematode as *H. solanacearum* (Ibid 18:404-413, 1972). Betty Gray made the critical measurements and drawings for these publications. Through host range studies and critical measurements, Miller and Gray were able to distinguish these species from *H. tabacum* and each other. (Currently, all three are classified as subspecies of *H. tabacum*). Miller and Harrison (Cornell Univ.) studied the host range of *H. tabacum* and extended it by 45 species, mostly Solanaceae, including eggplant and sweet peppers. Distinct differences for the host ranges of *H. tabacum*, *H. virginiae*, and *H. rostochiensis* were evident (Plant Dis. Reptr. 53:949-951, 1969). In an effort to find resistance among tobacco species, cultivars, and lines to *H. tabacum* and *H.*

virginiae, Miller and Duke examined numerous such materials but they reported those which supported reproduction but not those apparently resistant (Va. J. Sci. 20:99, 1969; 21:102, 1970). Miller's work was disrupted by his relocation from Holland to Blacksburg on May 1, 1969, after which his co-authors became J. A. Fox and L. Spasoff and his interests shifted to *H. solanacearum* and its relationship with the potato nematode, *H. rostochiensis*. Meanwhile, Halima Baalaway under the guidance of Fox completed an M.S. thesis on "Resistance in *Nicotiana* species to Osborne's cyst nematode" (1969). Her studies encompassed known resistant species and cultivars and some of their F_1 hybrids. She reported there were different mechanisms of resistance among the different species.

Miller was also involved to a lesser extent in the pathology of *Meloidogyne arenaria*, the peanut root knot nematode. He reported that these nematodes were not disseminated in peanut hay and fruit (Va. J. Sci. 22:84, 1971), and that some isolates could reproduce on two of 18 corn inbred lines (Ibid 24:110, 1973). No hybrid varieties were tested but there was some indication from field sampling that *M. arenaria* could reproduce on corn (Ibid 23:100, 1972).

Although Miller was well established in nematological circles at the beginning of the Couch era (1965), Fox had yet to establish his identity. Most of his publications during the era were as co-author with his student advisees, especially A. J. Webber. Themes were sex determination and factors influencing it in *Meloidogyne graminis* (J. Nematol. 1:212-215, 1969; 3:332-333, 1971; J. Parasitology 56:105, 1970; Nematologia 13:143-144, 1967; Phytopathology 60:1319, 1970; 62:673, 1972; 63:801, 1973); resistance to and inheritance of resistance to cyst nematodes in soybean and tobacco (Phytopathology 59:1555, 1969; 62:673, 776, 1972; J. Nematol. 3:329-330, 395-398, 1971; 4:224, 225, 1972). As might be deduced from the pagination, most of these were abstracts of papers presented at professional society meetings.

Fox collaborated on an interesting publication with Spasoff and Miller. Spasoff had been seeking a quick method for indexing the reaction of tobacco to the OCN (*H. solanacearum*). He described his preliminary results at the 22nd Tobacco Workers Conference in 1968. In 1971, Spasoff, Fox, and Miller described a procedure whereby the resistant reaction to *Pseudomonas tabaci* (wildfire bacterium) was perfectly correlated with the resistant reaction to OCN. It was much easier to test for reaction to wildfire than to OCN; therefore, populations could be screened for resistance to both organisms using only one (J. Nematol. 3:329-330, 1971).

Osborne contributed numerous Extension Service publications on tobacco, peanut, cotton, soybean, vegetables, fruits, and nursery plants. He also summarized the results of various nematicide tests in the American Phytopathology Society annual publication "Fungicide and Nematicide Test Results". Several popular articles were published in "Virginia-Carolina Peanut News", "The Flue-Cured Tobacco Farmer" and "Virginia Nurserymens Assocation News". In essence, Osborne performed an excellent service to growers with nematode problems. He made one national contribution to academics; namely, an exercise for the "Recovery of nematodes from soil by the centrifugation-flotation method", published in the Sourcebook of Laboratory Exercises in Plant Pathology' (W. H. Freeman & Co. 1967).

Miller was gaining international fame among nematologists during the Couch era.

Alan R. Stone of the Rothamstead Experimental Station chose to be a visiting professor in the Department June-December 1973 because of Miller's stature and intimate knowledge of cyst and root knot nematodes. In August 1973, Miller made a collecting trip to Mexico to find cyst nematodes parasitizing solanaceous plants. Specimens obtained would benefit both Stone and Miller and lead to a better understanding of the origin and taxonomic relationships among cyst and root knot nematodes. As will be seen in the Foy (1974-1980) and Hooper (1980-1984) eras, Miller became more renowned.

In addition, to the dissertations by Laughlin and Webber and the thesis by Baalawy mentioned previously, Barbara Muse prepared a dissertation on, "A study of the pathogenic relationship of two populations of *Ditylenchus dipsaci* on Wando pea" (1968), which she had started with Williams as her adviser but completed under L. D. Moore. Salim B. Hanounik completed one on, "Population dynamics and effects of *Meloidogyne incognita* on tobacco plants" (1974) under the guidance of Osborne. Hanounik's project was the first to utilize gnotobiotic conditions for the study of a nematode disease. He reported that under these conditions, nicotine movement into leaves was reduced by nematodes in a susceptible cultivar but was unaffected in a resistant cultivar. D. E. Weber under the advice of Williams, conducted a thesis study of, "Population behavior of three parasitic nematodes on selected Gramineae and an analysis of the centrifugation-flotation extraction technique" (1967). He fould that different concentrations of sugar were differentially efficient for separating *Helicotylenthus* and *Criconomoides* spp. but not *Hoplolaimus* sp. from soil. He also found that recovery was more efficient from 150 cc than from 600 cc for *Criconomoides*; recovery from the two quantities was not affected for the other two species. Oddly, this thesis may have had more impact on nematology than the dissertations.

VIROLOGY

Viruses, like nematodes, are not crop or commodity specific; thus, some studies with viruses may have been mentioned in preceding sections. The following discussion is offered to show how virology gained momentum as discipline during the Couch era.

Prior to 1965, Troutman had monitored tobacco viruses, and had cooperated with Miller on identifying peanut stunt virus and with Roane on manipulating maize dwarf mosaic virus. Of course he had cooperated with several tobacco workers on control of tobacco viruses. Couch foresaw the need to have a modern virology laboratory and a person competent to acquire and use the modern instruments and procedures essential to research in virology. He therefore hired Sue A. Tolin as Assistant Professor, effective September 15, 1966.

The first major effort by Tolin was to obtain a grant from the Virginia Agricultural Foundation with which she could purchase a hood, laboratory furniture, density gradient fractionator, a cold room, and other lesser items, all vital to virology. Coincidentally, in early 1967, a new building on Glade Road was readied for occupancy; the virology laboratory was housed there; a greenhouse was attached. An electron microscope was available whereby shapes and dimensions of virus particles could be ascertained. None of this equipment had been available to Troutman or Williams. Once the laboratory was equipped, the course Plant Virology (PlPP 5040) changed sharply. Students were introduced to modern equipment and methods. A graduate program with emphasis on virology was now available. Tolin emphasized laboratory aspects of virus identification; Troutman emphasized field aspects; Williams retreated to nematology, and forage and turfgrass pathology.

There was heavy emphasis by Troutman and Tolin on peanut stunt virus (PSV), which Miller and Troutman had first recognized in 1964 (Pl. Dis. Reptr. 50:139-143, 1966). In their 1966 publication, Miller and Troutman described symptoms and transmission of PSV. Troutman also gave a paper on thermal death point, infectivity duration of expressed sap, dilution end-point, purification, and serology. He distinguished PSV from viruses causing squash mosaic, pea enation mosaic, southern bean mosaic, and cucumber mosaic (Phytopathology 56:904, 1966). Tolin refined the purification process and with electron photomicrography found the PSV particle to be an icosahedron measuring 25 mµ (Ibid. 59:1560, 1969). Troutman resigned in December 1966, to take a position with the Arizona Experiment Station at Yuma, but before he departed, he completed experiments with W. K. Bailey and C. A. Thomas (U.S.D.A.) that revealed transmission of PSV through peanut seeds. They reported that transmission occurred only in seeds passing through an 18/64-inch screen. Seeds too large to pass through the screen bore no viruses. Thus, they found a mechanical means of providing PSV-free seeds (Ibid 57:1280-1281, 1967). Troutman also published two papers with T. W. Culp (U.S.D.A. at Holland) in which they reported that the yield of sound, mature kernels was reduced from 1500 to 300 lb/ac as the incidence of stunt increased from 25 to 100% (Pl. Dis. Reptr. 51:856-860, 1967).

Troutman and Culp also examined several hundred peanut varieties, introductions, and breeding lines for reaction to PSV. None was immune, but several showed less severe symptoms than others (Ibid 52:914-918, 1968). In this connection Couch decreed that all plant pathology graduate students would go to Holland and assist in artificially inoculating the plants. This did not set well with advisers and students but Tolin and Troutman had done a good selling job, Couch was adamant, and the students went.

Tolin continued working with PSV. In 1969, she reported on refinements in the purification process (Ibid 59:1560, 1969). The occurrence of white clover fields near peanut fields where PSV was prevalent had been reported in North and South Carolina, in 1967 and 1968, respectively, and by W. H. Matheny and D. H. Kludy of the Virginia Department of Agriculture at Richmond (Pl. Dis. Reptr. 51:169-170, 1967). In 1970, Tolin, O. W. Isakson (a graduate student in Entomology) and Troutman described the association of white clover with PSV and experiments on transmitting it with the cowpea aphid. They recommended isolation of peanuts from white clover (Pl. Dis. Reptr. 54:935-938, 1970).

John Groelk, with Tolin as his advisor, presented an M.S. thesis in 1970 in which he made serological comparisons among PSV, CMV, tomato aspermy virus (TAV), and chrysanthemum virus L (CV-L). He concluded the CMV and CV-L were unrelated but that CMV and TAV were related. All had been shown to be related to PSV; thus, Groelk concluded that PSV was most likely the hypothetical parent strain of the CMV group. In 1973, additional research reported by S. Boatman (Hollins College, Organic Chemist), J. M. Kaper (U.S.D.A. Virologist), and Tolin had the conclusion that PSV is a strain of CMV (Phytopathology 63:801, 1963). This was the last PSV study reported in the Couch era.

When Tolin arrived in 1966, Roane was involved with C. F. Genter in field work to control maize dwarf mosaic. However, Couch had requested that Roane work with T. J. Smith (Soybean Breeder, Agronomy Department) on breeding disease-resistant soybean varieties (see the section, Soybean). In the summer of 1966, Roane had collected a number of soybean plants displaying symptoms of viral infection but he lacked the knowledge for identifying them. When Tolin examined them, she savored the challenge and therefrom a fruitful soybean virology research team was born. During the Couch era, Roane and Tolin surveyed Virginia for virus-infected soybeans. Surveys, purchase of laboratory, field, and greenhouse supplies were supported by grants from the Virginia Soybean Commission. Soybean mosaic, peanut stunt, and peanut mottle viruses were the most prevalent; PMV and PSV were very damaging in the peanut-producing counties; SMV was scattered throughout the State. Bean pod mottle occurred in soybean near red and crimson clover fields (Proc. Amer. Phytopathol. Soc. 1:36-37, 114, 1874; 2:129, 1975). After recognizing the affects of viruses on soybean and finding that a number of cultivars were apparently immune from SMV, PMV, and PSV but not from BPMV and tobacco ringspot the stage was set for extensive studies on the genetics of reaction to these viruses. Such studies would be made in the years after the Couch era.

As previously stated, when Tolin arrived, Roane and C. F. Genter, corn breeder had field work underway to provide farmers with maize dwarf mosaic virus (MDMV)-resistant corn varieties. Although some progress had been made the expertise of a virologist located at Blacksburg promised greater, more rapid success. Fortunately, Tolin became interested in MDMV and soon provided techniques for rapidly inoculating field and greenhouse plants. The team assembled a tractor mounted apparatus for inoculating field corn. The apparatus was built from a two-row tobacco planter. A gasoline-powered air compressor mounted on the planter supplied air to two artists' air brushes. Operators were seated astride corn rows and could be lowered or raised with the tractor's hydraulic system. From the lower position operators moving at a very low speed could inoculate plants at the 1- to 6-leaf stages. Thousands of plants could be inoculated in a half day. The team's first objective was to locate inbred lines and hybrids resistant to MDMV. Many were resistant under artificial inoculation that severely stunted reddened and yellowed in natural conditions. Therefore, a concerted effort was made to study the effects of MDMV. Nine inbred lines that had displayed a wide range of reactions under natural conditions on the farm of C. W. Wood at Virginia, Nelson Co. were selected to create a diallel series of hybrids. In Wingina, lines Oh07B, T8, and Pa884P were resistant; Pa91, Oh43, and VaLE8 were susceptible; and CI21E, H84, and Va36 were intermediate. Under conditions of artificial inoculation, in the absence of johnsongrass, no yellowing, reddening or severe stunting occurred as it did near johsongrass. Lines and hybrids that were severely damaged at Wingina only mottled and were slightly to moderately less productive at Blacksburg their uninoculated counterparts. The team concluded that, "In association with johnsongrass, severe symptoms in maize are caused by an agent other than MDMV" (Crop Sci. 13:531-535, 1973). About the time this work was concluded, others began reporting that a second, leaf hopper-borne isometric virus was associated with the yellowing, reddening, and severe stunting (Phytopathology 62:748; Pl. Dis. Reptr. 56:652-656, 1972). The second virus was named maize chlorotic dwarf virus (MCDV); it was more damaging than aphid-borne MDMV but, fortunately, not as efficiently transmitted. In Virginia, we had relied on natural infection to find and recommend resistant hybrids to our growers. We also depended on yielding ability more than symptom expression because some hybrids that mottled were superior yielders. Apparently, they were moderately susceptible to MDMV but immune from MCDV.

This chapter on corn virology cannot end without paying tribute to Cliff Wood on whose farm much of the corn virus work was done. Wood was an excellent observer. We taught him about the disease cycle, including transmission and overwintering. When we told him the virus needed johnsongrass rhizomes to over-winter, he figured out a way to break the cycle. He grew sudangrass-sorghum hybrids (SSH) for greenchop feed for his dairy herd. He noticed that after a vigorous growth of SSH, johnsongrass had failed to produce new rhizomes. New growth the following spring came from seeds. He tested Eptam® for controlling emergence of johnsongrass seedlings; it worked. He found that a crop of soybeans treated with Treflan® ahead of corn worked well as did barley whose stubble was plowed down ahead of corn. Double- cropping soybeans after barley was especially effective. These methods were described to farmers who had excellent bottom land farms but had given up because of johnsongrass and corn viruses. Eventually, corn once again became a profitable crop in Virginia's johnsongrass-infested fields.

Roane and Tolin expanded the host range of MDMV through numerous inoculation experiments and from collections of naturally infected specimens. Several hosts were perennial but only johnsongrass was deemed epidemiologically significant as the overwintering source of MDMV (Pl. Dis. Reptr. 53:307-310, 1969).

Wheat soil-borne mosaic virus (WSBMV) had been described as the cause of a widespread virus disease in Virginia. Tolin decided to examine the virus particles with the electron microscope. Roane collected samples of mottled wheat from several fields in eastern Virginia. Tolin found long flexuous rods characteristic of wheat spindle streak mosaic virus (WSSMV) but could find no short stiff rods characteristic of WSBMV. As described in the section on cereals/wheat, this explained an inconsistency that had been observed in the '50's (Pl. Dis. Reptr. 53:751-752, 1969).

A major accomplishment in breeding tobacco for root knot resistance was the discovery by Henderson and Troutman that a strain of potato virus Y (PVY) produced a vein necrosis on lines and varieties resistant to root knot and vein banding on those susceptible to root knot (Tob. Sci. XII:158-160, 1968). Tolin and others studied this strain of PVY and found it to have the basic characteristics of other PVY strains; the relationship with root knot reactions was apparently unique to the Virginia strain (Pl. Dis. Reptr. 57:200-204, 1973). In this case a virus was used to enhance progress in breeding for resistance to another pathogen.

Into the Foy era, there would be emphasis on viruses of peanut, soybean, maize, and tobacco would be emphasized.

TURFGRASS DISEASES

When H. B. Couch became Head of the Department of Plant Pathology and Physiology in January 1965, he was already well-known for his resarch on turfgrass diseases and for his ability as a teacher. He had published a book, "Diseases of Turfgrasses" (1962); at the time, the only book on the topic. Naturally, he wished to continue research in that area. The only significant work on turfgrass diseases in Virginia had been done by A. S. Williams. He had conducted fungicide tests on dollar spot and brown patch but no major research reports came from that work. His expertise seemed to lie in extension type presentations to the annual Virginia

Turfgrass Conferences and to Nurserymen's Short Courses. Williams had also become somewhat of an authority on nematode diseases of turfgrass, having discovered *Hypsoperine graminis*, now designated *Meloidogyne graminis*, on putting greens in Virginia Beach in 1964 (see the section on Nematology). Both the fungus and nematode research had evolved from his research on forage grass fungi and the alfalfa stem nematode. Since Couch planned to continue as a turfgrass pathologist, there developed a conflict of interest between Couch and Williams which contributed to Williams' resignation in 1968.

Couch established a comprehensive program for study of turfgrass diseases in Virginia. Emphasis was on disease recognition and control. One student, R. R. Muse, studied turfgrass pathology but his dissertation was more a study of enzymes (Pectolytic and cellulolytic enzymes associated with *Helminthosporium sativum*-blighted common and Merion Kentucky bluegrasses, 1968). Beyond assessing the value of various fungicides on various diseases and species of grasses, Couch produced no publications of fundamental importance while he was Department Head. A revised edition of "Diseases of Turfgrasses" was published in 1973.

Couch's forte in turfgrass pathology lay in his ability to describe the principles and practices of pathology, and to describe disease phenomena in an entertaining fashion. This put him in demand as a speaker for various turfgrass and golf course maintenance groups all over North America.

In 1965, there was a dearth of literature for Extension work in turfgrass pathology. Couch and Williams prepared two publications: Diseases of Turfgrasses (Va. Coop. Ext. Ser. Leaflet 209, 1967); and Chemical control of turfgrass diseases (In Guide for Chemical Control of Turfgrass Diseases and Turfgrass Weeds, Va. Coop. Ext. Ser. Cir. 1034, 1967). Beginning in 1969, Couch published fourteen publications addressing individual diseases; these are in the Control Series, in the following list the publication number precedes the title:

57. Lawn Diseases: Fairy rings.
58. Lawn Diseases: Red spot of bentgrasses.
59. Lawn Diseases: Stripe smut.
60. Lawn Diseases: Melting-out of Kentucky bluegrass.
61. Lawn Diseases: Slime molds.
74. Lawn Diseases: *Helminthosporium* blight (netblotch) of fescues.
112. Lawn Diseases: *Helminthosporium* leaf spot.
113. Lawn Diseases: Powdery mildew.
114. Lawn Diseases: Pythium blight (cottony blight).
115. Lawn Diseases: Fusarium patch (pink snow mold).
131. Lawn Diseases: Fusarium blight.
132. Lawn Diseases: Sclerotinia dollar spot.
133. Lawn Diseases: Rhizoctonia brown patch.
134. Lawn Diseases: Rusts.

Thereafter, various authors joined with Couch to publish annually the "Guide for Chemical Control of Turfgrass Diseases" in the Control Series. These publications represent a very significant contribution by Couch to turfgrass pathology in Virginia.

Couch was able to induce the International Turfgrass Society to hold its 1973 conference at V.P.I. & S.U. Twenty-one pathologists participated in the meeting.

When Couch retired from the Department Headship, he continued his turfgrass research and later published a third book on turfgrass pathology.

GNOTOBIOLOGY AND SOIL ECOLOGY

When Couch became Head of Plant Pathology and Physiology, he wanted to establish a gnotobiology laboratory. I am frank to say I didn't know the meaning of gnotobiology, however, I soon learned that it was a form of axenic culture involving one or few organisms. It was a very useful system for studying host-parasite interactions. Our laboratory initially contained 8 large isolation chambers and several other small chambers. Artificial lighting and temperature controls were also installed. Maynard Hale (Plant Physiologist) and Claude Fordyce were the supervisors and principle researchers. The chambers were used to study root exudations and, in plant pathology, mycotrophy in loblolly pine, interactions of *Penicillium* spp. with marigold and broomrape with tomato.

Fordyce and Hale described the equipment and experiments in progress or planned in a paper read to the Virginia Academy of Science (Va. J. Sci. 17:242, 1966). Because of the widespread publicity given the laboratory, the Department attracted and hosted two conferences on the Ecology of Root-Infecting Microorganisms in 1969 and 1971 [Phytopathology News 3(8):5, 1969; 5(11):3, 1971]. These meetings generated considerable favorable publicity for the Department. The research in gnotobiology also generated active cooperation between the major disciplines of the Department.

Burwell Wingfield conducted a dissertation research project on loblolly pine (Mycotrophy in loblolly pine: I. The role of *Pisolithus tinctorius* and *Rhizoctonia solani* in survival of seedlings. II. Mycorrhiza formation after fungicide treatment. V.P.I. & S.U. Ph.D. Diss. 1968). He was guided through the research initially by Fordyce and later by W. H. Wills. Wingfield, using isolator chambers, found that *P. tinctorius* provided some protection to seedlings from destruction by *R. solani* if a mycorrhiza was established before there was an encounter with *R. solani*. Wingfield obtained conflicting results in studies on the effects of fungicides. Some favored establishment of seedlings with or without mycorrhizae; some interfered with establishment of mycorrhizae. Wingfield suggested that better tree seedling stands could be obtained by mixing seeds with mycorrhizal fungi in a manner similar to that for applying of *Rhizobium* spp. to legume seeds.

K. M. Hameed used the same isolator chambers for his dissertation research (Influence of *Penicillium simplicissimum* (Oud.) Thom and *Penicillium citrinum* Thom on growth, chemical composition and root exudation of axenic marigold, V.P.I. & S.U. Ph.D. Diss., 1971). Hameed's dissertation contains several excellent photographs of the chambers. The two fungi he studied did not severely affect the growth of marigold plants nor were any major changes in root exudates apparent. In his, M.S. thesis research, Hameed had studied the effects of *P. lanosum* on marigold. He had reported significant increases of amino acids, carbohydrates, nitrogen and phosphorus in exudates from inoculated plants.

There were several attempts to initiate gnotobiologic projects with broomrape on tomato, black shank of tobacco, and nematodes on various plants but these efforts led nowhere in the Couch era. The plant physiologists were more successful and opportunistic in the gnotobiology laboratory than were the plant pathologists.

Studies on soil-inhabiting and root-infecting fungi were initiated by Gary J. Griffin as soon as he was hired in August 1967. K. H. Garren had been involved in such studies as they related to peanut diseases; Griffin added some new methodologies to this work. Ted Pass conducted dissertation research under the supervision of Griffin (Studies on the physiology of conidial germination by *Aspergillus flavus* Ph.D. Diss., V.P.I. & S.U., 1971) whereby he implemented several techniques suggested by Griffin to determine the edaphic and rhizospheric effects on *A. flavus* spores. Although responses of germinating spores to various edaphic factors were evaluated, there was little discussion relative to the development of *A. flavus* mold in peanut.

Griffin's research provided fundamental knowledge of the interactions of rhizospheric components with plant resistance, pathogen survival, pathogen propagation, and disease potential. It laid the foundation for manipulating and controling soil-borne pathogens.

MISCELLANEOUS ACTIVITIES

During the Couch era, faculty involvement in professional societies greatly increased. For plant pathologists, shifting from participation in the American Phytopathological Society Southern Division to the Potomac Division made it economically possible for most to participate in every annual meeting. The remotest meetings were held in Morgantown, West Virginia or Newark, Delaware; they were frequently held in the College Park and Beltsville, Maryland areas. On the other hand, Southern Division meetings were held as far away as Texas, and frequently in New Orleans. It was usually feasible to transport students to Potomac Division but not to Southern Division meetings. Despite this shift in participation, Osborne and Garren continued with the Southern Division, primarily because they dealt with the southern crops peanut and tobacco and with nematodes. During the Couch era, Couch and Miller served as Potomac Division presidents and councilmen.

Although not documented here, pathologists were also active in the Virginia Academy of Sciences, the Tobacco Workers Conference, the Cumberland-Shenandoah Fruit Workers Conference, Ecology of Root Diseases Conference, Virginia State Horticultural Society, Mycological Society of America, and American Peanut Research and Education Association. Activity in the American Phytopathological Society and Society of Nematology is detailed below:

American Phytopathological Society

- Houston B. Couch
  - Vice-President, Potomac Div., 1971-2.
  - President, Potomac Div., 1972-3.
  - Councilor for Potomac Div. To A.P.S. 1973-7.
  - *Committee service*:
    - Association of Plant Pathology Dept. Chm., 1969-73.
    - Steering Comm. Chm. 1969.
    - Exec. Comm. 1970-73, Chm. 72-3.
    - Local Arrangements Comm., Chm. 1972.
    - Program Comm. 1971.
    - Membership Comm. 1965-69.
    - Special Publications Comm. 1965, 1972-73.
- Charles R. Drake
  - Extension Committee, 1972.

    - Ad hoc Comm. to Study Formation of National Apple Disease Council.
- Kenneth H. Garren
    - Soil Microbiology Comm., 1963-5.
    - Comm. on Public Relations, 1972-4.
- Gary J. Griffin
    - Soil Microbiology Comm., 1972-4.
- Kenneth D. Hickey
    - Comm. on New Fungicides and Nematicides Data, 1964-74; Chm. 1968-70;
    - Business Manager 1971-4.
    - Extension Comm., 1965.
    - Editor, Results of Fungicide and Nematicide Tests, 1968-70.
    - Publications Comm., 1968-70.
    - Contributed Chapter to Ann. Rev. Phytopathol. With F. H. Lewis (A.R.P. 10:399- 428, 1972). First contribution to A.R.P. by V.P.I. & S.U. faculty. Robert C. Lambe
    - Extension Comm., 1970-2.
    - Program Comm., Potomac Div., 1969.
- Lawrence I. Miller
    - Vice-President, Potomac Div., 1967-8.
    - President, Potomac Div., 1968-9.
    - Councilor, for Potomac Div., 1969-72.
    - Publications Comm., 1968.
    - Building Fund Comm., 1970-3.
    - Nominating Comm., 1971.
    - Meeting Site Comm., 1971-4.
    - Nominating Comm., Potomac Div., 1971.
- Laurence D. Moore
    - Air Pollution Damage Comm., 1973-4.
    - Environmental Quality Comm., 1974-5.
    - Membership Comm., 1974.
    - Program Comm., Potomac Div., 1969.
    - Nominating Comm., Potomac Div., 1972.
- W. Wyatt Osborne
    - Comm. on Plant Dis. Losses, 1966-7.
    - Social & Local Arrangements, Sou. Div., 1973.
- Robert Pristou
    - Extension Comm., 1964-8.
- Curtis W. Roane
    - Plant Rust Advisory Comm. to ATTC., 1966-74.
    - Comm. on Host Resistance and Microbial Genetics, 1968-9.
    - Genetics Comm. 1970-72; Vice-Chm., 1970-71; Chm. 1971-2.
    - Membership Comm. 1970-2; Vice-Chm., 1972.
    - Program Comm., 1970-2.
    - Ad hoc Comm., Instructions to Authors, Phytopathology, 1971.
    - Environmental Quality Comm., 1971-5.
    - Compendium Comm. (Subcomm. of Publications Comm., 1974).
    - Associate Editor, Phytopathology, 1968-71.
    - Contributed chapter to Ann. Rev. Phytopathology, first solo author from V.P.I. &
    - S.U. (A.R.P. 11:463-486, 1973).
- John M. Skelly

- Phytopathology Classics Comm. 1970-4; Vice-Chm. 1972; Chm. 1972-5.
- Publications Comm., 1973-5.
- Environmental Quality Comm., 1973-5.
- Teaching Comm., 1971-5.
- Slide Salon, Chm., 1971-4.
- Special Illustrations Comm., 1971-5.
- Teaching Film Comm., Co-Chm., 1971.
- Program Comm., 1971-4.
- Program Comm., Potomac Div., 1973-4.
- Paper Session Chm., 1972.

- Roland J. Stipes
  - Teaching Comm., 1971-4.
  - Sub-Comm., Internat. Plant Pathology Glossary Revision, 1973-4.
  - Forest Pathology Comm., 1971-5; Chm. 1975.
  - Paper Session Chm., 1971.
- Sue A. Tolin
  - Ad hoc North Central Comm., CLF-2-Kernel Red Stripe of Corn, 1966.
  - Paper Session Chm., 1970, -72, -73.
  - Virology Comm., 1972-4.
  - Sub-Comm. on Extension Aids for Virus Identification, 1973.
  - Virus Advisory Comm. to ATCC, 1973-4.
  - 2nd ICPP, Colloq. Chm., 1973.
- Albert S. Williams
  - Comm. on Special Programs, 1967.
  - Program Comm., 1967-9; Chm., 1969.
  - Program Comm., Potomac Div., 1967-9.

Society of Nematology

- Joseph A. Fox
  - Honors and Awards Comm., 1970-1.
- Lawrence I. Miller
  - Member Executive Comm., 1968-9.
  - Paper Session Chm., 1971.
  - Associate Editor, Journal of Nematology, 1974-6.
- W. Wyatt Osborne
  - Paper Session Chm., 1966.
  - Public Relations Comm., 1967-70.

AWARDS AND HONORS

A number of plant pathologists and their students were honored for their achievements in research. It is also deemed an honor to be elected chairman or president of a scientific group or to be named an administrator at one's station. The following were recognized in these categories during the Couch era:

- 1965
  - L. I. Miller received the Golden Peanut Research of the National Peanut Council in April.
  - Luben Spasoff received the Tobacco Workers Conference Research Award in July.
  - R. G. Henderson served as General Chairman of the Tobacco Workers

Conference.
- 1966
  - C. W. Roane served as President of the V.P.I. & S.U. Chapter of the Society of the Sigma Xi, 1966-67.
- 1967
  - T. J. Nugent was named Assistant Director of the Virginia Truck Experiment Station.
- 1968
  - L. I. Miller, President of Potomac Division of the American Phytopathological Society.
- 1969
  - Loraine M. Unbehaun received the V.P.I. & S.U. Chapter of the Society of the Sigma Xi award for research excellence in a Ph.D. project.
- 1970
  - R. G. Henderson, volume 14 of *Tobacco Science* is dedicated to R.G.H.
  - A. J. Webber receives the V.P.I. & S.U. chapter of Phi Sigma award for excellence in research.
- 1971
  - C. W. Roane was elected chairman of the Southern Small Grains Workers Conference; he was the first plant pathologist to serve in this capacity.
- 1972
  - H. B. Couch was elected President of the Potomac Division of the American Phytopathological Society 1972-73. He had served as President of the Northeast Division in 1964, before coming to Blacksburg. He is the only person to serve as President of both divisions.
- 1973
  - J. M. Skelly received the Southern Forest Disease and Insect Council Award for excellence in research.
- 1974
  - K. H. Garren received the Golden Peanut Award of the National Peanut Council. Elected President of the American Peanut Research and Education Society, 1974-75.
  - W. W. Osborne received the Big E Award of the Southern Soybean Workers Council.
  - B. G. Joyner received the Potomac Division's 2nd annual Graduate Student Research Award.

REGIONAL PROJECTS

Being a member of a regional project committee contributed in a way to one's status as an achiever. It was somewhat of an honor because there could be only one representative on the committee from each state. Therefore, the nature of one's research and expertise was usually the governing factor for being appointed to a regional or inter-regional project. The following persons represented Virginia on regional projects:

- G. J. Griffin - S-90 - Southern Regional - Rhizosphere ecology as related to plant health and vigor ('72-'74).
- K. H. Garren - S-26 - Southern Regional - The relation of soil microorganisms to plant disease ('65-'74).
- A. B. Groves - IR-2 - Inter-Regional - Obtaining and preserving virus-free

deciduous tree fruit stocks ('65-'66; deceased '66).

- K. D. Hickey - IR-2 - replaced Groves ('67-'68, Chm. '69, '70-'74). - NE-14 - Northeastern Regional - Virus disease and their control in deciduous fruits (Chm. '69, '70-'74).
- R. C. Lambe - NC-43 - North Central Regional - Diseases of landscape plants ('72- '73).
- L. I. Miller - S-19 - Southern Regional - Factors influencing survival and pathogenicity of plant parasitic nematodes ('65-'70). - S-76 - Southern Regional - Nature and extent of variation in root-knot and cyst nematodes ('71, Chm. '72, '73-'74).
- J. M. Skelly - NE-69 - Northeastern Regional - Atmospheric influences on ecosystems and satellite sensing ('70-'74).
- R. J. Stipes - NE-25 - Northeastern Regional - Vascular wilt diseases of trees ('72-'74).
- S. A. Tolin - S-70 - Southern Regional - Detection, identification, transmission, and control of viruses and mycoplasma-like organisms causing diseases of corn ('68- '74).

Diseases first reported in Virginia, 1964-1974:

- Barley - Leaf spot caused by *Ascochyta graminea* was found at several locations in Augusta and Montgomery Cos. In 1965 and 1973, respectively (Pl. Dis. Reptr. 58:455-456, 1974). Roane.
- Corn - T-race of *Helminthosporium maydis* first observed in August 1970 (Pl. Dis. Reptr. 54:1104-1108).
- Corn - Gray leaf spot, *Cercospora zeae-maydis*, began intensifying in 1971 (Pl. Dis. Reptr. 58:456-459, 1974). Roane.
- Oak, pin - Canker cause by *Endothia gyrosa*, was found in Hampton (Pl. Dis. Reptr. 55:467-468, 1971). Stipes.
- Peanut - recognition of peanut mottle, peanut stunt and bean pod mottle viruses as pathogens of peanut and soybean (Proc. Amer. Phytopath. Soc. 2:129, 1975). Tolin & Roane.
- Peanut - *Pythium myriotylum* found to cause pod rot (Pl. Dis. Reptr. 51:601-605, 1967). Garren.
- Peanut - Blight, *Sclerotinia sclerotiorum*, first occurrence in U.S. 1971 (J. Am. Peanut Res. & Ed. Assoc. 5:199, 1973). Porter & Beute.
- Peanut - Pepper spot and leaf scorch, *Leptosphaerulina crassiasca*, first observed in Virginia in 1969 (Pl. Dis. Reptr. 55:530-532, 1971). Porter & Garren.
- Pine, Scots - In Christmas tree plantations, western gall rust, *Endocronartium harknessii*, was found in Bedford, Nelson, Buckingham, and Roanoke Cos., 1971 (Pl. Dis. Reptr. 60:222-223, 1976). Skelly.
- Pine, white - Canker caused by *Fusarium lateritium*, Charlottesville 9Pl. Dis. Reptr. 57:182-184, 1973). Artman.
- Pine, white - SO_2 and NO_x damage to recognized near the Radford Army Ammunition Plant (Pl. Dis. Reptr. 56:3-6, 1972). Skelly et al.
- Soybean - Peanut mottle, bean pod mottle, and soybean mosaic viruses found; PMV & BPMV for the first time in Va. (Proc. Amer. Phytopath. Soc. 2:129, 1975). Tolin & Roane.
- Soybean - *Cylindrocladium* root rot, *Cylindrocladium crotalariae* (teleomorph = *Calonectria crotalariae*, in peanut-producing Counties, 1970 (J. Am. Peanut Res.

& Educ. Assoc. 4:14-17, 1972). Garren.

- Wheat - Leaf spot, caused by *Ascochyta sorghi*, was found at Blacksburg, 1973 (Pl. Dis. Reptr. 58:455-456, 1974). Roane.
- Wheat - Wheat streak mosaic virus was found in wheat at Orange, April 1967, a first identification for Va. (Pl. Dis. Reptr. 53:751-752, 1969). Tolin & Roane.
- Wheat - Agropyron mosaic virus was collected at Blacksburg in 1967 and at Charlotte C.H. in 1968 (Pl. Dis. Reptr. 53:751-752, 1969). Tolin & Roane.
- Wheat - recognition in 1973 of wheat spindle streak mosaic as the predominant virus, rather than wheat soil-borne mosaic virus as previously thought in Coastal Plains Cos., especially Richmond and Westmoreland Cos. (Ann. Wheat Newsl. 30:166-167, 1984). Roane.
- Trees - Stipes and T. Davis compiled a list of 101 diseases of landscape trees found in Virginia; thirty-seven were not previously reported as of 1970. The list is too lengthy to include here; none were described as highly destructive (Pl. Dis. Reptr. 56:108-111, 1972).

EPILOGUE

Plant pathologists were involved in many projects, organizations, and events that contributed to advancement of the Department and enhancement of disease control. There are some noteworthy national and international discoveries and events that occurred during the Couch era which influenced plant pathology in Virginia. These are taken from the 1979 book, "A Chronology of Plant Pathology" by G. K. Parris who worked at the Virginia Truck Experiment Station during World War II:

- 1964 - The term "Green Revolution" was coined by Rockefeller Scientists. In
- 1970 - Norman E. Borlaug, a plant pathologist was awarded the Nobel Peace Prize for his role in the Green Revolution.
- 1966 - Vitavax and Plantvax, carboxin derviatives were introduced for control of rusts and smuts (Basidiomycetes).
- 1967 - Japanese workers discovered that some yellows type diseases thought to be caused by viruses were actually caused by mycoplasma-like organisms. Aster yellows is an MLO found in Virginia.
- 1968 - Van der Plank published the second of a series of books on epidemiology and host resistance. His books introduced several new concepts in epidemiology and disease resistance.
- 1969 - George Agrios published the first edition of "Plant Pathology", a book which has undergone three revisions and has been an all-time best selling textbook.
- 1972 - T. O. Diener discovered a viroid causing potato spindle tuber.
- 1973 - A rickettsia-like organism was found to cause the phony peach disease.
- 1973 - The American Phytopathological Society initiated the plant disease compendium series by publishing a "Compendium of Corn Diseases". This has been a very useful, sucessful activity.

The Couch era is appropriately named. Houston Couch forced numerous changes in departmental procedures and attitudes. Although many of his directives were somewhat difficult to accept, there was a remarkable increase in accomplishment and camaraderie. A few, able faculty were added; a new building, greenhouses, and laboratories were constructed; projects were more focused, and new curricula became available. Annual summaries of departmental activities in research, extension, and teaching were assembled. These greatly facilitated the preparation of this history of the Couch era. Unfortunately, these summaries were not extended beyond the era. Couch initiated a remodeling of Price Hall. He had ceilings lowered, modern lighting installed, ugly wainscoat removed, new laboratory tables and cabinets installed, offices renovated and new equipment purchased. The improvements to Price Hall greatly lifted the morale of the Department. He established a departmental library and saw to it that it was properly maintained. He established an annual alumni magazine, *The Physiopath*, which had it been continued after his era, would have been a boon to loyalty among our graduates. He established a secretarial and technician pool that were successful in some respects but failures in others. He promoted the non-thesis Plant Protection Curriculum for students at the M.S. level; a Plant Protection Newsletter, and the Control Series Extension publications. Annual picnics brought families together for fun frolic and good eats.

Our reputation began to rise among our peer institutions; we could hold our head high among the achievers of our profession. Much of what we were and what we had in 1974, we owed to Houston Couch.

C. W. Roane
February 1999

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A History of Plant Pathology in Virginia: The Foy Era (1974-1980)

Chester L. Foy was appointed Department Head for the Department of Plant Pathology and Physiology on July 1, 1974. He served in this capacity until August 30, 1980. There were sharp differences between Foy and his predecessor, Houston B. Couch, in their personalities and manners of administering departmental affairs. Couch was domineering, self-assured, and obsessed with real or conjured mandates to better the Department and display it prominently in University, professional, and commodity circles. He had mandated course and curriculum revisions, project consolidations around fundamental concepts rather than commodity needs, and committees to expedite the Department into his perceived mold. He had created secretarial and technician pools and named a head secretary and supervisory technician. He had created a central library for all publicly owned books; he had conceived the Physiopath, alumni magazine, and the Resume, an annual summary of faculty activities and publications; and he had implemented a refurbishing of classrooms, laboratories, hallways and even lavatories in Price Hall. Couch had been a motivator, activator, doer whose frequent new ideas kept the faculty agitated, but involved. He had hired several new pathologists and weed scientists and in doing so had installed new disciplines or expanded old ones in the Department.

Into this arena stepped Foy, who by comparison to Couch was unobtrusive, seemingly apologetic, and imperturbable but by any measure, very competent. Foy was born in Dukedom, Tennessee, July 8, 1928. He earned a B.S. degree in 1952, from the University of Tennessee, majoring in Agronomy and Soils: an M.S. from the University of Missouri in 1953, majoring in Chemical Weed Control of Field Crops; and the Ph. D from the University of California, Davis in 1958, majoring in Plant Physiology. At the time of his appointment at V.P.I. and S.U. in 1966, he was Associate Professor of Botany at Davis. He was appointed Associate Professor and in 1968, he was promoted to Professor. When he was appointed Head of the Department of Plant Pathology and Physiology, he was the first non-pathologist to assume that position.

At the beginning of the Foy Era, the Departmental faculty was comprised of eight professors, eleven associate professors, and three assistant professors. The faculty and their assignments in 1974 are enumerated below.

Professors:

> Samuel W. Bingham, Plant Physiologist, weed control on highways, golf courses, and turf.
> William E. Chappell, Plant Physiologist, weed and brush control, rights-of-way.
> Houston B. Couch, Plant Pathologist, turf pathology.
> Lawrence I. Miller, Plant Pathologist, peanut diseases, plant nematology.

Wyatt W. Osborne, Plant Pathologist, Extension tobacco diseases, field crop nematology.
Curtis W. Roane, Plant Pathologist, diseases of cereals, soybean, genetics of host-parasite interactions.
Wirt H. Wills, Plant Pathologist, fungal pathogens, ornamental plant diseases.

Associate Professors:

James S. Coartney, Plant Physiologist, Extension weed control in nurseries.
Charles R. Drake, Plant Pathologist, fruit crop diseases, coordinator of the plant protection program.
Gary J. Griffin, Plant Pathologist, soil microbiology, chestnut blight.
Maynard G. Hale, Plant Physiologist, instruction, gnotobiology, plant stress.
Kenneth D. Hickey, Plant Pathologist, fruit crop disease, Winchester Fruit Laboratory.
Allen H. Kates, Plant Physiologist, Extension weed control in field crops.
Robert C. Lambe, Plant Pathologist, Extension, ornamental plants, nursery crops.
Laurence, D. Moore, Plant Pathologist, physiology of diseases, tobacco, turf.
Robert Pristou, Plant Pathologist, Extension, clinical plant pathology, disease of field crops.
Roland J. Stipes, Plant Pathologist, diseases of landscape trees.
Sue A. Tolin, Plant Pathologist, virology, diseases of legumes, tobacco, corn.

Assistant Professors:

Joseph A. Fox, Plant Pathologist, nematology.
David M. Orcutt, Plant Physiologist, instruction, plant stress.
Orvin E. Rud, Plant Physiologist, weed control research and extension, Suffolk.

Research Associate:

Lance W. Kress, Plant Pathologist, air pollution, forest pathology.

In addition, there were two adjunct appointees and a pathologist of Painter

Kenneth H. Garren, Adjunct, Plant Pathologist, USDA-SEA/AR, Suffolk, peanut diseases.
David M. Porter, Adjunct, Plant Pathologist, USDA-SEA/AR, Suffolk, peanut diseases.
Robert E. Baldwin, was Plant Pathologist at the Va. Truck and Ornam. Res. and Ed. Ctr., Painter, vegetable pathology.

During the Foy Era there were promotions to Professor : Drake on July 1, 1976; Griffin on July 1, 1977; and Skelly July 1,1978. There were also several appointments and resignations:

New appointments:

John J. Reilly, 1975, Assistant Plant Pathologist, tobacco, Blackstone
J. A. Swader, 1975, Associate Plant Physiologist, weed control.
Samuel A. Alexander, 1976, Assistant Plant Pathologist, forest tree diseases.
Keith W. Yoder, 1976, Assistant Plant Pathologist, fruit disease, Winchester.
Ronald W. Tillman, 1977, Assistant Plant Pathologist, instruction, coordinator of IPM, plant protection programs.
James R. Martin, 1978, Assistant Plant Physiologist, Extension, IPM field programs at Warsaw.
Patrick M. Phipps, 1978, Assistant Plant Pathologist, Extension, and researcher, peanut diseases, Suffolk.
Dean A. Komm, 1979, Assistant Plant Pathologist, Extension, tobacco disease.
Kriton K. Hazios, 1979, Assistant Plant Physiologist, herbicidal action.
M. L. Link, 1976, Research Associate, vegetation management along rights-of-way.

Resignations:

Kenneth D. Hickey, 1976, for a position with Pennsylvania State University, Biglerville.
Wyatt W. Osborne, 1977, physical disability.
Joseph A. Fox, 1980, for a position in the Mississippi Extension Division.
J. S. Swader, 1980, for a position in California.

Person named Adjunct Professor:

Martha K. Roane, 1975, to work with Stipes and Griffin.
L. S. Dochinger, 1977, to work with Skelly.
John R. Elkins, 1978, to work with Stipes and Griffin on chestnut blight.

In the remaining text, only the work of plant pathologists will be discussed, unless, of course, others operated in some phase of the work. In the Foy Era, it was becoming more difficult to recognize major contributions or "break-throughs" as the pressure to publish or perish was manifested. Scientists began intensifying publication of minor contributions, publishing the same findings under different titles in two or more journals, and in essence publishing progress reports. This need to have many titles published yearly created a difficult problem for historians who have to assess the magnitude of one's contributions. It also created a major problem for libraries as this padding filled the shelves with volumes containing little substance. The days of waiting until a research project was completed or ripened before a publication was issued had passed. Journal publications dominated while Experiment Station bulletins virtually disappeared. Therefore, as a historian, I found it essential to report on commodities such as tobacco, cereals, fruit, etc. and disciplines such as virology, nematology, genetics, etc., rather than an annual output. I also became aware that progress slowed; history became more voluminous and assessment more uncertain.

Instruction

The plant pathology courses offered in the Department remained relatively stable during the Foy Era. There were some additions; the following list is taken from the 1980 University Catalog. All courses are designated PLPP:

2960 - Field Study - hr. and cr. arr.
3010 - Plant Pathology - 3 (3), II or V.
3020 - Plant Pathology Laboratory - 3 (1), II or V.
3030 - Forest Pathology - 3 (1), II.
4010 - Air Pollution Damage to Plants - 3 (3), I.
4040 - Diseases of Crop Plants - 7 (3), II.
4050 - Phytopathogens - 4 (4), I.
4060 - Principles of Pesticide Application - 5 (3), III.
4960 - Field Study - hr. and cr. arr.
4970 - Independent Study - hr. and cr. arr.
4980 - Special Study - hr. and cr. arr.
4990 - Undergraduate Research and Thesis - hr. and cr. arr.
5020 - Principles of Plant Disease Control - 3 (3), III.
5030 - Plant Parasitic Nematodes - 7 (3), II, alt. even yrs.
5040 - Plant Virology - 6 (4), I, alt. odd yrs.
5090 - Genetics of Host-Parasite Interactions - 3 (3), II, alt even yrs.
5111 - Seminar - 1 (1), III.
5120 - Concepts and Practices of Pesticide Application - 5 (3), III.
5130 - Plant Pathogenic Agents - 4 (4), I.
5150 - Diseases of Field Crops - 6 (4), I.
5170 - Epidemiology of Plant Disease - 6 (4), III.
5180 - Disease of Landscape Trees, Ornamentals and Turfgrasses - 4 (3), III; alt. even yrs.
5190 - Phytopathogenic Fungi - 6 (4), III.
5221 - Clinical Plant Pathology I - 6 (2), II.
5222 - Clinical Plant Pathology II - 6 (2), III.
5311 - Pest Management Systems I - 5 (3), II.
5312 - Pest Management Systems II - 9 (3), III.
5900 - Project and Report 1-3 (1-3) arr.
5970 - Independent Study - hr. and cr. arr.
5980 - Special Study - hr. and cr. arr.
5990 - Research and Thesis - hr. and cr. arr.
6020 - Principles of Plant Disease Development - 3 (3), I; alt. odd yrs.
6040 - Physiology of Pathogenesis - 6 (4), III; alt. even yrs.
7990 - Research and Dissertation - hr. and cr. arr.

Added to the courses above were those in plant physiology and weed science to make an impressive showing for the Department in the University catalog.

Two new graduate courses were added in the Foy Era, PLPP 5180 and 5190. The first, 5180, Diseases of Landscape Trees, Ornamentals and Turfgrasses had an impressive instructional staff, Stipes, Wills and Couch, (listed according to subject matter). It also had the longest course title. The second, Phytopathogenic Fungi, was probably offered to relieve students from having to take a three quarter sequence in mycology, a burden that seemed unnecessary to many who may have been basically interested in bacteria, viruses, or nematodes.

Having the two courses, 4050 Phytopathogens and 5130 Plant Pathogenic Agents, may have been a smokescreen. The instructors, Griffin, Fox, and Tolin, offered the two courses during the same hours; thus, graduate and undergraduates were blended into the same course but received credit for having had different courses. This was a device to defeat the University and Graduate School philosophy that undergraduates had not achieved the learning ability of graduate students. Balony!

A new option, Integrated Pest Management (IPM), was to be offered to undergraduates in 1980 in cooperation with the Entomology, Horticulture, and Agronomy Departments. R. W. Tillman was hired to coordinate it. He was given a 100% assignment in instruction. Such an assignment was rare in those times in the College of Agriculture. Despite all this anticipation and preparation, Tillman resigned on June 1, 1980 just before IPM was to come into fruition.

A peak number of students, between 25 and 28, majoring in plant pathology was reached about 1979. Afterward there was a national and local decline in students. The well established, prestigious departments were able to maintain their numbers primarily because they could make better financial offers to graduate student assistants. V.P.I & S.U. lost ground because it could not compete financially and because its faculty were oriented more to commodity rather than fundamental research. The field of molecular biology was making inroads into plant pathology, except at V.P.I. & S.U. A whole new cadre of faculty would have to be hired in the Department before that would be possible at V.P.I. & S.U.

Degrees Granted in Plant Pathology, Foy Era 1975-80

Year	Degree	Recipient (Advisor)	Thesis or Dissertation Title
1975	Ph. D.	B. G. Joyner (Couch)	Influence of <u>Trichoderma harzianum</u> Rifai on growth, chemical composition and root exudation of axenic tobacco.
1975	Ph. D.	G. B. Montgomery (Wills)	Etiology of root rot and decline of English boxwood (<u>Buxus</u> <u>sempervirens</u> cv. <u>suffruticosa</u> L.)
1975	M. S.	H. I . Brown, Jr. (Drake)	Effect of benomyl, topsin M, and botran against <u>Monilinia fructicola</u> and <u>Rhizopus nigricans</u> on peach and nectarine fruits and in vitro.
1975	M. S.	S. O. Phillips (Skelly)	Growth loss of loblolly pine (<u>Pinus</u> <u>taeda</u> L.), white pine (<u>Platanus</u> <u>occidentalis</u> L.) proximal to a periodic source

			of air pollution.
1975	M. S. N.	Jane K. Headland (Griffin)	Severity of natural _Endothia parasitica_ infection of Chinese chestnut, _Castanea mollissima_.
1975	M. S. N.	B. M. Kard (Drake)	Prevention of bitter rot of apples in storage.
1975	M. S. N.	D. A. Roth (Pristou)	Differential resistance of plant introduction lines of _Phaseolus vulgaris_ L. to _Xanthomonas phaseoli_ (E. F. Smith) Dowson.
1975	M. S. N.	F. D. Singleton (Roane)	Control of Helminthosporium stripe of barley with selected seed treatment fungicides.
1975	M. S. N.	H. R. Smith (Drake)	Peach tree decline.
1975	M. S. N.	Cynthia A. Spoor (Stipes)	Control of Fusarium wilt of tomato with cycocel and/or lignasan BLP.
1976	Ph. D.	T. Pass, III (Griffin)	Studies on the physiology of conidial germination by _Aspergillus flavus_.
1976	M. S.	Rosemary H. Ford (Tolin)	Comparison of five naturally occurring strains of tobacco mosaic virus.
1976	M. S.	M. J. King (Moore)	Soybean growth, phosphorus content and foliar symptom expression as influenced by ozone fumigation and phosphorus nutrition.
1976	M. S.	Jenny L.-W. Leong (Tolin)	The interaction of peanut mottle virus and soybean mosaic virus on soybean (_Glycine max_ (L.) Merrill.
1976	M. S. N.	R. C. Bird (Couch)	Effects of chemical adjuvants on turfgrass and turfgrass soils.

1976	M. S. N.	G. L. Clement (Stipes)	The effects of MBC, its salts, and benomyl on the growth and development of selected plant species.
1976	M. S. N.	E. M. Hayes (Skelly)	The effects of an oxidant air pollution regime in southwestern Virginia on eastern white pine (Pinus strobus L.).
1976	M. S. N.	S. J. Justis (Wills)	Diseases of flowering dogwood (Cornus florida L.) and an investigation into the roles of three species of Phytophthora in root rot of dogwood.
1976	M. S. N.	W. R. Okie, III (Stipes)	Control of Fusarium wilt of tomato with systemic fungitoxicants.
1976	M. S. N.	W. W. Osborne, Jr. (Drake)	Postulated methods of infection by Whetzelinia sclerotiorum in peanuts as inferred from evidence from other crops.
1977	Ph. D.	P. P. Hunter (Stipes)	The blight and canker of pinoak (Quercus palustris Muench.) incited by Endothia gyrosa (Schw.) Fr. : Some factors in disease development.
1977	Ph. D.	D. B. Janutolo (Stipes)	Fungitoxicants in the Ceratocystis ulmi-Ulmus americana - soil continuum.
1977	M. S.	B. M. Bradford (Skelly)	The incidence and severity of Heterobasidion annosum (Fr.) Bref. in loblolly pine and the effect on radial growth.
1977	M. S.	Shi-Jean S. Sung (Moore)	Effects of herbicide treatment and ozone fumigation on flue-cured tobacco plants.
1977	M. S. N.	T. R. Bardinelli (Alexander)	Comparison of electrical

			resistances in loblolly pines naturally and artificially infected with Heterobasidion annosus (Fr): Bref. and healthy loblolly pines to a pulsed, electric current.
1977	M. S. N.	G. N. Dawson (Stipes)	Uptake, translocation, and persistence of fungitoxicants and other pesticides in trees including pin oak (Quercus palustris Muench.)
1977	M. S. N.	Debra D. Jones (Drake)	Black root rot of strawberries
1978	Ph. D.	L. W. Kress (Skelly)	Growth impact of O2, SO2, NO2 singly and in combination on loblolly pine (Pinus taeda L.) and American sycamore (Platanus occidentalis L.).
1978	Ph. D.	W. E. Kuriger (Roane)	The effect of Pseudomonas coronafaciens (Elliott) Stevenson winter survival of oats and the role of bacteria and barley yellow dwarf virus in red leaf of oats.
1978	Ph. D.	D. A. Roth (Griffin)	Survival and chemical control of Cylindrocladuim spp. inciting root rot of black walnut seedlings.
1978	Ph. D.	L. E. Trevathan (Moore-Tolin)	Symptom expression and lipid composition of flue-cured tobacco in response to ozone and purified tobacco mosaic virus.
1978	M. S.	J. C. Adams, III (Moore)	Growth and pathogenicity of six isolates of Corynespora cassiicola (Berk. and Curt.) Wei.
1978	M. S. N.	M. D. Hutter (Fox)	Integrated control of clubroot of cabbage incited by Plasmodiophora brassicae.
1978	M. S. N.	C. Jones (Griffin)	Resistance of Chinese

			chestnut, Castanea mollissima Blume, to Endothia parasitica (Murr.) And. and And. in different cold-hardiness zones in the eastern United States.
1978	M. S. N.	Jane E. Polston (Tolin)	Preparation of six Extension publications on virus diseases in Virginia.
1978	M. S. N.	Nancy D. Prichard (Drake)	A review and study of Prunus stem pitting.
1978	M. S. N.	Patricia A. Truax (Stipes)	Comparative distribution of Arbotect 20-5, CG64251, Lignisan BLP, and Naurinol in Ulmus americana following administration with a Sterrett-Creager miniature pressure injector.
1979	M. S.	J. B. Dalley (Drake)	Golden Delicious leaf blotch, a physiological disorder.
1979	M. S.	T. K. Kroll (Moore)	The effects of TIBA on soybean susceptibility to Macrophomina phaseoli (Tassi) Goid. and Phomopsis sp. Sacc.
1979	M. S.	Raylene L. LeRoy (Tillman)	A qualitative and quantitative model of apple powdery mildew development.
1979	M. S. N.	Barbara J. Ballard (Couch)	The effects of various root exudates on broom rape germination.
1979	M. S. N.	C. W. Conner (Stipes)	Movement and disappearance of captan and difolatan in Woodstown loamy sand soil.
1980	Ph. D.	D. N. Appel (Stipes)	The influence of selected urban site factors, host nutrition and water stress on the decline and blight of pin oak (Quercus palustris Muench.) Fr. incited by Endothia gyrosa (Schw.) Fr.

1980	Ph. D.	B. M. Bradford (Moore)	The role of phytosterols in the pathogenesis of Phytophthora infestans on tomato.
1980	Ph. D.	J. B. Jones (Roane)	The interaction of Xanthomonas transluscens and Septoria nodorum on Triticum aestivum.
1980	Ph. D.	D. T. Krigsvold (Griffin)	The ecology of Cylindrocladium crotalariae (Loos) Bell and Sobers microsclerotia in field soils.
1980	Ph. D.	R. S. Webb (Alexander-Skelly)	The incidence and severity of Heterobasidion lobolly pine (Pinus taeda L.) unthinned annosum (Fr.) Bref. in plantations and seed orchards.
1980	M. S.	Leslie A. Bower (Wills)	Biotic and abiotic stress factors influencing infection and colonization of Buxus sempervirens var. suffruticosa L. by Paecilomyces buxi (Link ex Fr.) Bezerra.
1980	M. S.	A. S. Carpenter (Drake)	An ecological study of Xiphinema americanum Cobb, 1913, in a Virginia peach orchard.
1980	M. S.	P. J. Graham (Griffin)	Relationship between peanut canopy, temperature and Cylindrocladium black rot development and effects of soil temperature and water potential on the germinability of Cylindrocladium crotalariae microscterotia.
1980	M. S.	Judy L. Trimble (Skelly)	Epicuticular wax and stomata characterization of two Pinus strobus L. clones differing in sensitivity to ozone.
1980	M. S.	Marsha M. Ward (Skelly)	Variation in the response of loblolly pine to ozone.

1980	M. S. N.	Sheau-Ching Chang (Orcutt)	Some pathological and biochemical observations on streptomycin treated 'Columia' oats infected with Pseudomonas coronafaciens.
1980	M. S. N.	C. E. Grant (Roane-Phipps)	Etiology and control of a damping-off disease of soybeans in Virginia.
1980	M. S. N.	Deborah J. Martindale (Drake)	Cost benefit of using sticky red spheres for monitoring the apple maggot, Rhagolatis pomonella.
1980	M. S. N.	W. R. Terry (Drake)	Rhizoctonia solani as a pathogen of cabbage and possible management procedures for its control.
1980	M. S. N.	Dayle H. Zanzigger (Tolin)	The role of weed hosts and nematode vector in the ecology of neporviruses in Eastern North America.

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A History of Plant Pathology in Virginia: The Foy Era (1974-1980)

Fruit Pathology

During the Foy Era, C. R. Drake served as fruit pathologist at Blacksburg. His appointment was split three ways, 10% instruction, 30% research, and 60% extension. In both research and instruction, he worked to improve production of apples and peaches in southern and southeastern Virginia. He also devoted time to strawberries, cane fruits, grapes, and nectarines. K. D. Hickey was the pathologist at the Winchester Fruit Laboratory until May 1, 1976, when he resigned to become Professor of Plant Pathology and Scientists-in-charge of the Fruit Research Laboratory of the Pennsylvania State University at Biglerville. He was replaced by Keith S. Yoder on November 11, 1976. Although there appears to be a period when the Winchester Station was without a pathologist, Hickey continued projects into the Foy Era that he had initiated at Winchester and cooperated with Virginia growers from his Biglerville location until Yoder arrived on the scene. The Winchester based projects had been outlined in a news item announcing Hickey's appointment at Biglerville: "His duties...have included the evaluation of potential fungicides for fruit disease control, evaluation of application methods, spray timing, and other factors necessary in the development and maintenance of up-to-date recommendations for disease control on fruit.------ In recent years he has been active in doing research on low volume and alternate row spraying in orchards and their effect on disease control and has related this information on spraying methods." (Phytopathology News 10 (8) : 6-7 1976). Most of Hickey's publications in the 1974-76 period were in Fungicide and Nematicide Test Results. Powdery mildew of apple received special attention because it was difficult to control. New materials were being examined but by the time Hickey resigned, satisfactory control had not yet been found, especially on 'Jonathan.' When new procedures and materials were approved, recommendations were promptly incorporated into the annual Virginia Spray Bulletin for Tree Fruits (Va. Coop. Ext. Ser. Publ. 219) and the annual Virginia Plant Disease Control Guide (Va. Coop. Ext. Ser. Control Series 2). Needless to say, when Yoder took the position, he continued these projects in both research and extension.

K. S. Yoder began studying Virginia fruit diseases in the late fall of 1976. He was appointed 75% research and 25% extension time. He came to Winchester after several years of experience in the development of fruit fungicides while working at the. DuPont Laboratories in Wilmington, Delaware. Fungus resistance to fungicides had been a primary topic of his research and he was well aquatinted with eastern orchard diseases. Although there is little evidence that he devoted much time to resistance of fungi to fungicides, he continued evaluating new fungicides and methods of applying them. Reports of progress were given regularly at meetings of the Cumberland-Shenandoah Fruit conference, The Virginia State Horticultural Society, and in the American Phytopathological Society annual publication Fungicide and Nematicide Test Results. When deemed feasible, spray recommendations were modified. Thus, his primary mission was "to provide the Virginia industry with economical disease management information, emphasizing orchard monitoring and timely use of management measures to reduce overall chemical inputs and to advise growers of changes in fruit pesticide regulations." (From a 1996 description of the "Alson H. Smith, Jr. Agricultural Research and Extension Center"). In the Foy Era, Hickey and Yoder executed these objectives exceptionally well.

Even though Hickey was in Pennsylvania for two-thirds of the Foy Era, Yoder and Hickey interacted through various grower groups which found political boundaries as something to be recognized but otherwise ignored. The Cumberland-Shenandoah Valley Fruit Conference was comprised of professional fruit workers in four states (Md., Penn., Va., W.Va.) and pesticide industry personnel. Information was generated, exchanged, pooled, and shared with growers in respective states. Furthermore, members of the Conferences participated in preparation of regional publications, executing regional experiments, and holding regional field days. Yoder and Hickey prepared an eloquent review on the status and control of apple powdery mildew. Although published in 1983, the article included much of the expertise and information the two had generated in the Foy Era. (Plant Disease 67: 245-248). Powdery mildew remained an undefeated adversary beyond the Foy Era.

Some specific accomplishments by Yoder included finding apple powdery mildew inoculum in 1977 at an earlier growth stage than before and a subsequent recommendation in the 1978 Spray Bulletin to spray earlier. He clarified the confusion by growers in recognizing the differences between Phytophthora collar rot and apple graft union necrosis, a virus disease. Growers had been wasting fungicides thinking their trees had collar rot when in fact they had the virus disease (Va. Fruit 68 (3): 51-53). In 1977, a Benlate-resistant strain of *Penicillium expansum* was discovered in local apple storage facilities. Managers were advised on how to decontaminate the storages. Yoder was invited to serve on the EBDC (ethylene bis dithiocarbamate) Fungicide Benefits Assessment Team. This was a very important assignment as the eastern U. S. fruit industry was heavily dependent upon EBDC fungicides to control several important foliage and fruit diseases. Re-registration of these products was vital to keep growers in the East in a competitive position. Yoder and C. R. Drake forwarded data collected under RPAR (rebuttable presumption against registration) to the Fungicide Benefits Assessment Teams representing these materials.

From the foregoing, one may conclude that all fruit work during the Foy Era was centered at Winchester. On the contrary, C. R. Drake at Blacksburg was contributing to the betterment of fruit and fruit growers statewide. Throughout the Foy Era, he tested numerous fungicides in a high density planting at Blacksburg and in commercial plantings in southwestern Virginia. Target diseases were on apple, leaf blotch, sooty blotch, fly speck, powdery mildew, and fruit rots, especially post-harvest rots. On peach, he emphasized brown rot, Rhizopus rot, scab and powdery mildew. Results of these tests were reported regularly at the Cumberland-Shenandoah Fruit Conference and in the American Phytopathology Society annual publication, Fungicide and Nematicide Test Results (FTN). Significant results and new recommendations were incorporated into various Extension publications. In 1975, Drake made use of an abandoned apple orchard at Woolwine, Patrick Co., where he must have reasoned that if he controlled diseases there, he could control them anywhere. Certainly, fungicides would be rigorously tested. However, fruit was severely damaged by hail and only reliable data on powdery mildew were obtained. Polyram and EL222 gave excellent results.

Drake cooperated with both Hickey and Yoder on various aspects of fruit disease control and they all collaborated in publishing many useful Extension bulletins and leaflets. The fruit industry was well-served during the Foy Era.

Soybeans

Most of the effort on soybeans in the Foy Era was toward detecting viruses, resistance to them, and making a genetic analysis of resistance to viruses. This was a cooperative project involving a field crop pathologist, C. W. Roane; a virologist, S. A. Tolin; a plant breeder, G. R. Buss; and a graduate student, E. R. Shipe. The work was supported by grants form the Virginia Soybean Commission.

Surveys for virus diseases were conducted throughout the Foy Era. Soybean mosaic (SMV) was found to be widespread and demonstrated to be seedborne. Peanut mottle (PMV) was found only south of the James River and generally distributed throughout peanut producing counties. It was most severe in soybeans following peanuts. 'York' was found to be resistant to both SMV and PMV; thus, for the Foy Era it was recommended for use in rotations with peanuts. Toward the end of the Foy Era, two cvs., 'Shore' and 'Ware', both carrying resistance to PMV, SMV, and peanut stunt virus (PSV) were released. The addition of PSV resistance was fortuitous because it was not known until these two cvs. were named and released that they were triply resistant. It was also recommended that soybeans should not follow peanuts in rotations, as volunteer peanut plants would furnish virus inoculum. In one such circumstance, over 80% of the soybean plants displayed virus symptoms.

Studies were made to determine the percentage of seed transmission of viruses in soybean. SMV was consistently transmitted from generation to generation through seeds; PMV was not. In surveys where bean pod mottle (BPMV) and peanut stunt (PSV) virus disease were also found, caused milder symptoms similar to those induced by tobacco ring spot virus (TRSV), known as bud blight. Soybeans grown next to clover fields frequently exhibited bud blight-like symptoms leading us to believe TRSV was common, but Tolin's work and inoculation experiments revealed that TRSV was rare in soybean except near tobacco fields. The culprits were BPMV and PSV.

In the breeding program, resistance to SMV and PMV received priority. Resistance to these viruses was believed by some to be conditioned by the same gene. The cv. York was resistant to both. We found its parents, 'Dorman' and 'Hood' each to be resistant to one of the viruses, Dorman to PMV and Hood to SMV. Furthermore, many lines in the breeding program were found to be resistant to one or the other virus and some were resistant to both. It was already pointed that SMV is seed-borne in soybean and PMV is not. In a genetic analysis of SMV and PMV resistance a cross of York X 'Lee 68' was studied. As the progenies were advanced to F_3, Lee 68, susceptible to SMV and PMV, was found to be resistant to PSV. Thus, in one experiment, we had the opportunity to study simultaneously the genetics of reaction to three viruses. After partitioning populations of seed from each F_2 plant into three aliquots, triplicate nurseries could be planted and seedlings therein could be inoculated with different viruses. The genotype for each F_2 plant could be established. Genes conditioning reaction to all three viruses segregated monogenically; reaction to PSV was independent of reaction to PMV and SMV but reactions to the later two were linked by 3.7% recombination. Despite this study and reports that a line could be resistant to one virus, there were those who continued to say that resistance to PMV and SMV were conditioned by the same gene.

There was one final aggravating aspect of this work. Preliminary results of the study had been published (Phytopathology 70: 692; Soybean Genetics Newsletter. 7: 100-102) but when the detailed manuscript was submitted to the Journal of Heredity the editor required that the PSV genetics be deleted because the data was not "clean" enough. It clearly showed that PSV resistance was independent of PMV and SMV resistance (J. Heredity 14: 289-291). Genetics of reaction to viruses remained a viable topic for many years, even into the molecular genetics years.

Several inoculation experiments were conducted to determine the effects of viruses on growth and yield of soybeans. In 1974, 0/3, 1/3, 2/3, and 3/3 of the plants in plots of 4 cvs. (Clark, Essex, Kent, Wye) were inoculated with 3 viruses (BPMV, PMV, SMV); BPMV was the most destructive, PMV the least. However, since PMV is the most frequently occurring virus, its impact on commercial production is greatest. It has long been known that SMV caused seeds to mottle (also called bleeding hilum, streak) especially in the dark hilum cultivators. From the various inoculation experiments, it was discovered that all viruses (BPMV, PMV, PSV, SMV, TRSV) caused seed mottling or bleeding hilium. On cvs. with light colored hila, mottling occurred but was inconspicuous and consequently, these types are not downgraded by the buyers.

During the surveys, soybean brown stem rot, caused by Cephalosporuim gregatum, was found to be widespread north of The James River. Roane thought that growing resistant cvs. might be the solution to controlling it but a uniformly infested plot of land would be needed for tests. It was easy to isolate the fungus but isolates were difficult to increase. By culturing the fungus on steamed grain, enough inoculum was generated to inoculate a half-acre plot. Test plants in the first year had no symptoms of brown stem rot. The process was repeated for two more years but no plants ever developed symptoms. Since no reliable field test was developed the urge to breed or select for brown stem rot resistance ebbed. Growers were encouraged to practice 3 year rotations to minimize losses. The work on viruses began to utilize both time and funds.

Soybeans were grown throughout the peanut producing counties; peanut and soybean are hosts to many of the same pathogens. The U.S.D.A. pathologist, K. H. Garren and D. M. Porter and beginning in 1978, the state pathologist, P. M. Phipps, all studying peanut diseases, sometimes reported on soybean diseases they encountered. In August 1978, Phipps and Porter reported finding Sclerotinia blight in several fields of York and Essex soybean. Both Sclerotinia minor and S. sclerotiorum were present. S. minor predominated. Sclerotinia sclerotiorum had been known on soybean in Virginia for many years but S. minor having been first discovered on peanut in the United States in eastern Virginia in 1971, was probably first recognized on soybean in 1978.

Powdery mildew is fairly common on soybean in Virginia in late summer. Martha K.

and C. W. Roane examined some cleistothecia in collections and observed what appeared to be branched and unbranched appendages in different collections. Knowing that there had been some confusion in the early literature as the fungus had first been assigned to Erysiphe but later was reassigned to Microsphaera, they submitted a manuscript entitled, "What causes powdery mildew of soybean?" The editor proposed that it be re-titled, "Erysiphe and Microsphaera as dual causes of powdery mildew of soybeans." The authors did not agree (Plant Dis. Reptr. 60: 611-612. 1976). Later, it was pointed out that the "Erysiphe" cleistothecia were probably immature Microsphaera cleistothecia. The authors conceded and consoled themselves that they had caused others to take a better look.

Soybean and peanuts were common suscepts of several diseases. Among them, Cylindrocladium black rot, CBR, caused by Cylindrocladium crotolarie. The damage by this disease was less to soybean than to peanut but having two crops in a rotation that succumbed to the same pathogen made it difficult to control the pathogen. Although soybeans were a very profitable crop, in about six counties of southeastern Virginia, peanuts were king. Most studies on CBR centered around survival of its primary propagule, microsclerotia, in soil. That work will be covered in the sections on peanut and soil microbiology. As a soybean disease, CBR received little attention.

Peanuts

At the beginning of the Foy Era, two U. S. Department of Agriculture plant pathologists were stationed at The Tidewater Agricultural Research and Extension Center, Suffolk, Virginia. Kenneth H. Garren had been assigned there since 1955. He had worked to reduce losses caused by Sclerotium rolfsii, Pythium myriotylum and Aspergillus flavus. In 1966, D. Morris Porter joined with the assignment to find more effective control measures for peanut leafspot. Garren worked mostly on diseases of underground parts, Porter on diseases of aerial parts.

In 1978, Patrick M. Phipps was hired by the Virginia Agricultural Experiment Station and Cooperative Extension Service on a 40/60 basis. At first, he concentrated on developing a series of Extension demonstrations and generating useful Extension publications for peanut area growers. For his more basic studies, he concentrated on nematodes and Sclerotinia blight. With three pathologists devoting full time to peanut diseases, and pathologists in Blacksburg also concentrating part time to these problems, peanut growers were very well served.

Garren had found in the mid-sixties that Pythuim myriotylum for the most part and Rhizoctonia solani to a lesser extent caused peanut pod rot. After demonstrating that applying a heavier rate of landplaster would decrease losses due to pod rot, he devoted time to seeking resistant cultivars. Cooperating in this work were Porter and P. H. Van Shaik (Peanut Sci. 2: 15-18, 1975). They found that, in general, the most widely grown cultivars in Virginia were the most resistant. After publishing that report, Garren narrowed his research to Cylindrocladium black rot (CBR) and mycotoxigens, especially Aspergillus flavus. In the mid-seventies, much emphasis was on detection of CBR by remote sensing.

In 1970, Cylindrocladium crotolariae was found by K. H. Garren, D. M. Porter, and A. H. Allison, causing black root rot (CBR) of peanut in Nansemond County (now Suffolk) (Pl. Dis. Reptr. 55: 419-421). By 1972, CBR had been found in all peanut-producing counties of North Carolina and Virginia. Garren, G. J. Griffin, Porter, and with N. L. Powell, agronomist, as leader, cooperated with the National Aeronautics and Space Administration staff at Wellops Island, Virginia to study by remote infrared sensing the distribution, rate of spread, and losses caused by CBR (Peanut Sci. 3: 25-29, 1976; Pl. Dis. Reptr. 60: 1003-1007, 1976). They found that CBR could easily be detected in known areas of infestation and, as a consequence, previously unknown areas of infestation were detectable, and because plants were killed in detected areas, yield losses could be determined. Powell, Porter, Pettry, and Cobb employed this remote sensing technique for the detection of Sclerotinia blight and estimating damage and loss caused by it (Peanut Sci. 3: 21-24; 4: 75-77). The method was remarkably accurate but because of the costly equipment needed (multi-engined aircraft, remote airbases, photo equipment), the work was discontinued after a contract with NASA expired. Thereafter, the researchers engaged in conventional studies.

Garren, Porter, Griffin, and graduate students D. T. Krigsvold and J. D. Taylor examined soils to determine survival modes of the CBR fungus. Microsclerotia were the survival propagules. Under the leadership of Griffin, factors affecting the density and survivability were studied. They found that microsclerotia were clumped rather than randomly distributed and environmental factors more than crop sequence affected survival (Phytopathology 71: 1297-1302). Summer droughts and excessively cold winters destroyed microsclerotia and after such weather events Phipps and M. K. Beute of North Carolina reported that CBR was less severe (Phytopathology 67: 1104-1107). This field research was reinforced by controlled experiments of Griffin, Powell, and students D. A. Roth and P. J. Graham, who found that germinability of microsclerotia was depressed when infested soil was incubated at 5 degrees Celsius, -3 degrees Celsius, or -10 degrees Celsius for four weeks. Microsclerotia did not appear to survive the -10 degrees Celsius regime. Air drying to -2000 bars also resulted in apparent loss of germinability. However, restoring moisture and incubation at 26 degrees Celsius (not a critical temperature) for 2 to 4 weeks resulted in partial recovery of germinability (Phytopathology 68: 887-891; Canad. J. Microbiol. 25: 157-162, 1979). As Griffin explained it, membrane damage by freezing or heat was not fatal but repair of the membranes required several days; as a result, it appeared that one could "bring 'em back alive."

Concurrently, Garren and T. A. Coffelt (U. S. D. A. Plant Breeder at Suffolk), were examining peanut germplasm for CBR resistant cultivars and sources of resistance. Initially, they found poor tolerance among 11 Virginia types. The one Spanish type tested had excellent tolerance (Pl. Dis. Reprtr. 60: 175-178, 1976). Later after examining a broader spectrum of germplasm, they reported Spanish types to be the most resistant, Valencia types the least resistant, and Virginia types intermediate (Peanut Sci. 9: 1-8, 1982).

There were efforts to reduce the impact of CBR by treating soil with various chemicals. Porter and associates found PCNB, DCNA, benomyl, chlorothalonil, and $CuSO_4$ to be only partially effective (Pl. Dis. Reptr. 59: 697-701, 1975). Research Associate S. B. Hanounik, statistician W. B. Pirie, and Extension Plant Pathologist Osborne collaborated in a greenhouse study of sodium azide ($NaNO_3$) on CBR. They found that the chemical reduced CBR (Pl. Dis. Reptr. 61: 431-435, 1977). B. A Womble and Garren also sound that sodium azide offered some promise for CBR control (Proc. Amer. Peanut Res. Ed. Assoc 10: 53, 1978.). Graduate student C. I.

Umechuruba working with Hale and Griffin found sodium azide effective in sandy soils but not in clumpy clay soils (Pl. Dis. Reptr. 62: 1-5, 1978.). By the end of the Foy Era, no feasible chemical control for CBR had been found.

Sclerotinia minor was found for the first time in the United States on a farm in eastern Virginia in 1971. Thereafter, it was observed throughout the U. S. peanut producing states and its severity greatly intensified. Fungicides applied for Cercospora leaf spot control resulted in greater losses from Sclerotinia blight. Captafol and chlorothalonil in particular while effective against peanut leaf spot seemed to favor Sclerotinia blight. Thus, other fungicides were suggested for leaf spot control where the blight was a known threat (Compenduim of Peanut Diseases. Amer. Phypothol. Soc., 1984). Growers had to wait a while for economic methods of control of CBR Sclerotinia blight. Intense research was underway.

J. C. Wells, Extension Plant Pathologist at North Carolina State University, and Phipps at the Suffolk station collaborated in 1980 to produce a beautifully illustrated publication entitled, "Peanut Disease Guide" (Va. Coop. Ext. Serv. Pub. 896; also issued by N. C. Ext. Ser.). Each photograph was accompanied by a brief description of the disease, its cycle, factors favoring it and the principles of its control. Since details of control could be provided in other releases, frequent revision would not be necessary. The guide should be an enduring publication. At the end of the Foy Era, graduate student Roberta Dow, under the guidance of Porter, Phipps, and Powell initiated studies leading to forecasting peanut leaf spot. This work would be continued after the Foy Era.

Thus, it seems that peanut diseases were being adequately studied during the Foy Era.

Tobacco

Prior to 1974, tobacco disease research was conducted at four locations., The flagship station was at Chatham where three pathologists were stationed. At Blacksburg, two tobacco research pathologists and one tobacco extension pathologist were stationed. Tobacco pathology was also conducted at Charlotte Court House and Glade Spring under the supervision of Blacksburg and Chatham pathologists. In 1974, a new station, primarily for centralized tobacco research was opened at Blackstone and the Charlotte C. H. and Chatham stations were closed. The new station was named the Southern Piedmont Research and Extension Center. None of the pathologists had to relocate. W. H. Wills had already transferred to Blacksburg; J. L. Troutman had resigned, and J. L. La Prade had retired. Only extension specialist W. W. Osborne and research pathologist L. D. Moore, both of Blacksburg, were devoting any time to tobacco pathology. Obviously, Virginia's leading cash and revenue generating crop deserved more intensive pathology research. The situation improved when on January 15, 1975, John J. Reilly was appointed Assistant Professor and Research Pathologist at Blackstone. In 1977, Wyatt Osborne took a disability retirement leaving tobacco growers without any Extension Specialist in pathology. In April 1979, Dean Komm was appointed Assistant Professor and Extension Specialist for tobacco pathology and he too was station at Blackstone. Thus, during the Foy Era, tobacco pathology was virtually completely shifted to Blackstone. Some tobacco virology, physiology and nematology was still conducted at Blacksburg by S. A. Tolin, L. D. Moore, and J. A. Fox, respectively.

John Reilly was appointed to a research position in the virtual center of the tobacco production area at a time when there was no tobacco Extension Specialist in plant pathology. At a field station, when problems arise and there are queries about plant disease and diagnoses to be made, one cannot say, " I am in research; it's not my responsibility." In order to maintain support from the commodity groups and growers, someone has to step forward. Thus, for four years until Komm became the Extension Specialist for tobacco Reilly had to serve tobacco as both research and extension specialist. As a result his research efforts may have been diluted by mandate. From a list of his publications beginning in 1976 until Komm was appointed in 1979, two-thirds were Extension (12 of 18). Four were titled "Flue-cured tobacco variety information for (the years 1976, -77, -78, -79)." Three agronomists and Reilly were the authors. No doubt, Reilly provided disease reactions and edited statements pertaining to plant pathology. Even after Komm arrived, Reilly was co-author of this annual publication well into the '80's'. Another publication that was revised and issued annually, "Virginia Pest Management Guide," had a subsection in the section on "Tobacco" titled "Disease Control." Reilly and other pathologists prepared this section, (S. A. Tolin, virus diseases; J. A. Fox, nematode diseases; J. D. Taylor, miscellaneous information.). It covered seed-bed preparation, seedling disease control, field fumigation, variety selection, harvesting, and curing. The entire publication was a manual for County Extension Agents; it covered most of Virginia's agricultural plant products.

From the beginning, Reilly studied the effects of three chemicals on control of tobacco mosaic virus primarily during transplanting. Milk had been touted for many years as a suitable product for controlling TMV by spraying it on plants before they were pulled and by having workers wash their hands in it before and during transplanting operations. Reilly compared the effectiveness of milk with Monosan (= sodium alginate) and a phosphate detergent. His conclusion was, "Both milk and Monosan were better than not washing, but neither was as effective as washing in a strong detergent solution" (Tobacco Sci. 23: 97-99, 1979). Reilly also investigated the effect of various chemicals with potential for controlling black shank caused by Phytophthora parasitica var. nicotianae. Propamocarb and metalaxyl surfaced as the most efficacious of the several tested. These materials are convenient in that they can be used in the transplant water, applied in rows as granular, or as spray treatments to young plants and no waiting period is required between application and transplanting. However, these materials gave best results in combination with the more resistant cultivars. Treatments economically feasible with susceptible cultivars were not found (Plant Dis. 64: 274-277, 1980.). R. G. Henderson retired from the Department in 1973, but in 1978 he contributed two papers on tobacco breeding. He worked with Agronomist J. L. Jones of Blackstone to evaluate the results of a two-year (1970, 1971) study on F_1, hybrids of male sterile dark-fired tobacco. Hybrids yielded 97 to 114% of the higher yielding parent in crosses and averaged 109%. Black shank resistance and quality were intermediate to parents of hybrid. The results were not encouraging enough to continue the work (Tobacco Sci. 22: 109-111, 1978).

In a second paper, Henderson and J. F. Chaplin, U. S. D. A. Agronomist, Oxford, N. C., found perfect correlations between reactions to root knot nematodes (RKN) and potato virus Y (PVY) in tobacco. Plants homozygous and heterozygous resistant and homozygous susceptible to RKN were inoculated with PVY, veinal necrosis strain. Homozygous resistant plants developed an acute veinal and stem necrosis, heterozygous plants developed mottling and vein banding typical of PVY infection. Either the genes conditioning reactions to these two pathogens are tightly linked or there is a single pleiotrophic gene controlling the two characters. Whatever the genetic situation, this relationship had been used for several years in Virginia to select tobacco lines for RKN resistance by obtaining their reactions to PVY (Tobacco Sci. 22: 126-127,1978).

An interesting observation was made by J. A. Fox in 1976. Spores of Corynespora cassiicola were found in along with nematodes that had been separated from soils of tobacco fields. The fungus was isolated and a student, J. C. Adams III, used it as the subject for a M. S. thesis. He found that lesions developed on wounded inoculated stems of tobacco. Foliar inoculations yielded lesions on one of four tobacco cultivars tested. Results with other species except tomato were varied; 'Tiny Tim' tomato was susceptible. Fox, subsequent to the 1976 discovery, found spores of C. cassiicola in nematode extracts (sugar flotation method) of soils from widely scattered tobacco, soybean, and peanut fields in central and eastern Virginia. It was concluded that although the fungus has the potential for becoming pathogenic on tobacco, it apparently exists as a saprophyte [Tobacco Sci. 24: 122-125, 1980; Adams, J. C., III, 1978, Growth and pathogenicity of six isolates of Corynespora cassiicola (Berk. & Curt.) Wei. M. S. Thesis, Dept. Pl. Path. & Physiol., V.P.I. & SU. 50pp.].

There was an attempt by L. D. Moore, Associate Professor of Plant Pathology at Blacksburg, to relate total nonstructural carbohydrate (TNC) content of tobacco to reaction to Phytophthora parasitica var. nicotianae. He could find no differences in TNC for moderately resistant 'Vesta 5' and susceptible 'Virginia Gold.' Decline of TNC was correlated with increased disease severity (Tobacco Sci. 20: 10-13, 1976.). Graduate student L. E. Trevathan and Moore evaluated the effects of different levels of calcium on response to ozone in a single cultivar, NC88, of flue-cured tobacco. Although the authors did not say, they must have chosen NC88 because of its susceptibility to weather fleck caused by natural exposure to O_3. A negative correlation was observed between Ca content of foliage and ozone damage. A positive correlation was observed between the amount of Ca supplied and its content in leaves. It was known that increased Ca content and increased sugar contents are positively correlated and sugar content and ozone damage are negatively correlated. These correlations may explain the relationship between Ca content and ozone damage (Tobacco Sci. 20: 67-68, 1976). Moore also cooperated with T. R. Terrill, Associate Professor of Agronomy, and Reilly of the Blackstone station to evaluate genotype effects on response to ozone. They found that cultivars with similar genetic background reacted similarly and concluded that cultivars and breeding materials should be rated annually, under different environmental conditions, if progress was to be made in breeding cultivars resistant to O_3 damage (Tobacco Sci. 21: 29-30, 1977).

These same workers examined the effects of major fertilizer nutrients on weather fleck. They concluded that phosphorus was the most critical element affecting fleck, high levels producing the least fleck; nitrogen was secondary and potassium was irrelevant. They published a chart of optimum fertilization for two of the three cvs. used in the study, NC88 and Coker 347 (Moore, Reilly, Terrill, 1997).

Trevathan, Moore, and Orcutt (1979), investigated the effects of ozone on lipid concentration in two weather fleck-susceptible cvs. Ozone caused an increase in total lipid concentration; different ozone levels caused corresponding changes in lipid concentration but these changes were not correlated with symptom expression.

Cereal Diseases

Small grains: During the Foy Era, 1974-1980, the project on breeding disease-resistant wheat and barley cultivars began to mature. T. M. Starling, the plant breeder; C. W. Roane, the plant pathologist; and H. M. Camper, Jr., agronomist and station superintendent at Warsaw, aided by a host of technicians but most notably research supervisors William Sisson at Warsaw and Allen Price at Blacksburg released several cultivars of barley. The cultivars, 'Henry', 'Surry', and 'Maury', all at the time of release in 1975, were resistant to powdery mildew, leaf rust, net blotch, and scald; some were highly tolerant of barley yellow dwarf virus. 'Maury', released a year later, was similar but susceptible to leaf rust and net blotch. All had stiff straw, excellent yielding ability and test weights. They fulfilled the aims to breed competitive, multiple disease resistant cultivars. These cultivars were registered in Crop Science in 1980 (Crop Sci. 20: 284-284, 1980).

Only one wheat cultivar, Potomac, was released during the Foy Era. This was a joint release with the Maryland Agricultural Experiment Station from a line bred in Virginia. It was characterized by resistance to leaf rust, powdery mildew and soil-borne viruses.

Some old diseases plagued our wheat and barley in the Foy Era. In 1972 and again in 1975, scab caused serious damage to wheat in Virginia. Distribution of wheat and variation in maturity assured that damage was spotty. The primary cultivars affected were 'Arthur' and 'Blueboy.' It was estimated that about 2% of the Virginia wheat crop was destroyed. However, because of the nature of the disease, it is very difficult to calculate the true loss. In addition to reduced grain yield, the fungus causing it, Gibberella roseum, produces a variety of toxins. When scab occurs, the threshed grain contains kernels covered with pink mycelium and spores. In the grain trade, these are called tombstones and when they are present above a certain percentage, the grain is graded scabby and is rejected by the buyer. The scab fungus kills several spikelets and the rachis at the site of infection, uninfected kernels distal to this site many ripen but are shriveled. This contributes to yield and test weight reduction. Rejected grain may be used by the grower as feed, but because it contains mycotoxins, such as T-2 toxin, zearalenone, emetic and refusal factors, it must be in a cost increasing process diluted with other scab-free grain to bring the toxins to such a low level that no symptoms occur in the recipient animals. Toxin levels can be determined and a safe dilution level may be prescribed, but the procedure is costly.

Stem rust struck eastern Virginian wheat fields unexpectedly in 1974 and 1975. Typically, in Virginia stem rust (Puccinia graminis) occurs only in southwestern Virginia where native or Alleghany barberry, Berberis canadensis, abounds. This plant is an alternate host of P. graminis and normally stem rust occurs only when wheat or oats are planted near it. Outbreaks in southwestern Virginia do not spread to eastern Virginia because crops in the Piedmont and Coastal Plain ripen before spores of the rust fungus can be produced in western Virginia and be blown eastward. For years, large wheat fields occurred in the barberry-infested areas and attempts were made to produce rust-resistant cultivars but wheat virtually disappeared from the region when by 1965, wheat production had shifted to the Coastal Plain. Breeding for stem rust resistance was deleted from the wheat breeding program.

In 1974, stem rust struck a number of cultivars in the Coastal Plain. Rust susceptible varieties, 'McNair 701' and 'Blueboy' had become widely planted in Southeastern U. S. and in the fall of 1973, Virginia fields were showered with spores. In early spring, pockets of rusted wheat in Georgia furnished additional inoculum that blew northeastward into North Carolina and Virginia where stems of McNair 701 were scored as high as 80% severity. The epidemic was repeated in 1975. Varieties growing in various nurseries in eastern Virginia reacted diversely. McNair 701, Blueboy, and their derivatives were severely rusted but 'Arthur' and 'Blueboy II' and many Virginia breeding lines remained rust-free. Before a breeding program to protect Virginia wheats was initiated, states to the south discontinued production of McNair 701 and Blueboy and the problem disappeared, in addition, no overwintering pockets were detected in the South. The episode reminded us that our crops remain vulnerable to freakish occurrences of plant diseases.

About 1972, labels for all mercurial seed treatment compounds were cancelled. There followed an increased incidence of barley stripe and covered smut. Mercurial compounds had been very effective against these diseases. In Virginia, the appearance of stripe in foundation, registered, and certified barley fields meant that some fields failed to qualify in their intended category. Roane and Starling collaborated to find the most efficacious products and favorable environmental regimes that would ensure the barley certified seed program would not be disrupted. In two years, (1979, 1980) of experimenting, carboxin at 6 and 8 oz/100 lbs seed, carboxin + thiram, and carboxin + mancozeb at 2 + 3 oz controlled stripe in early fall plantings (warm soil) but much higher rates were required in late fall plantings (cold soils). So we were caught between the proverbial "rock and a hard place." By planting early, stripe could be readily controlled but there would probably be a high incidence of barley yellow dwarf (BYD); by planting late, BYD would be of minor importance but stripe would be difficult to control (Barley Newsletter 25: 42-44, 1981). By using heavy doses of carboxin (Vitavax) plus thiram or mancozeb, Bruce Boehm, superintendent of the Virginia Crop Improvement Association farm at Mt. Holly, Westmoreland county, was able maintain the production of foundation barley seed without a loss.

Cephalosporium gramineum causes stripe of wheat, barley and rye in the Great Plains and Pacific Northwest. In 1975, it was detected in a small area of winter wheat nursery in Blacksburg. Its origin could not be determined (Pl. Dis. Reptr. 60: 345, 1976). In May 1977, symptomatic volunteer rye was observed near Blacksburg and in 1979, rye plants growing in a housing development where rye straw had been used for mulch to help establish a new lawn exhibited stripe symptoms. The straw was believed to be imported from Illinois. In Augusta county in June 1979, wheat and barley in yield trails on the Shenandoah Valley Research Station (the original Cyrus McCormick Farm) were symptomatic. The fungus was recovered from wheat but not from barley (Pl. Dis. 64: 325, 1980).

Corn: During the Couch Era, 1965-1974, maize virus diseases and gray leaf spot became very destructive in Virginia. In the Foy Era, there was a continued cooperative effort between agronomists and plant pathologists to improve resistance and decipher genetics of resistance to these diseases. Supplemental financial support was furnished by the Virginia Agricultural Foundation and Virginia Corn Commission.

Although tests for reaction to maize dwarf mosaic virus (MDMV) could be made at Blacksburg as a result of artificial inoculation, it was also necessary to obtain response to infection by maize chlorotic dwarf virus (MCDV). This could be done only in the presence of johnsongrass. Therefore, continued cooperation with a farmer, Cliff Wood, who lived at Wingina in Nelson County, where highway Va 56 crosses the James River, was considered necessary. Test plots had been planted on the Wood farm since the beginning of the couch Era. Cliff was an excellent cooperator who had learned to cope successfully with johnsongrass and as a result had reestablished a once failing corn crop as a profitable feed crop for his dairy herd. As a research cooperator, he always had the land ready at planting time. From 1974 to 1976, C. F. Genter was the cooperating breeder and C. W. Roane and Sue A. Tolin were the pathologists. Genter resigned and in 1977, H. S. Aycock replaced him. Fortunately, Aycock was interested in continuing to breed for and in studying genetics of MDMV resistance. The Wood farm remained the principal site for testing commercial hybrids for reaction to MDMV and MCDV. From data obtained there, varietal recommendations were made to farmers who had johnsongrass/virus problems. Experimental hybrids were also tested and from results with these, commercial seed corn producers selected appropriate inbred lines from which to make adapted, resistant hybrid varieties. Gradually, losses from the viruses were suppressed even though johnsongrass infestations persisted.

One study on the inheriatnce of reaction to MDMV had been completed by Roane, Tolin, and Genter. Only an abstract had been published (Proc. Amer. Phytopathol. Soc. 4: 140, 1977). Two resistant inbred lines, OhO7B and Pa91 and their progeny were scored in F_1, F_2, and F_3 generations. OhO7B crosses segregated monogenically, resistance dominant. T8 crosses segregated in unexplainable inconsistent ratios. A significant fact of this work is in the manner of classification of individual plants. A new scale was devised in which seven types of responses were described. This was necessary because all previous classification scales had been devised for use in naturally infected populations where both MDMV and MCDV were present. The new scale is more useful where only MDMV is present. The scale was illustrated in the 1983 publication of this study (Phytopathology 73: 845-850, 1983). A further significant facet of this study was the pedigreed method of following progenies into the F_3. Most previous genetic studies with MDMV reaction were based on estimating genes in diallel systems. This study was the first to use the methods Mendel had taught us and the outcome was entirely different from those previously published by others. It lay the groundwork for subsequent illuminating studies. Genetics of MDMV resistance was carried much beyond the Foy Era.

As mentioned earlier, gray leaf spot (GLS) was very damaging and because the no-till method of growing corn was becoming more popular, GLS was becoming even more damaging. At the second Interregional Corn Conference at Cincinnati, Ohio, February 9-12, 1976, Roane and Genter summarized the work they had done to find hybrid varieties and inbred lines resistant to GLS.

From observations on commercial hybrids through 1974, it was apparent that little resistance was available for immediate relief from GLS. Two hybrids, McNairX190 and Northrup-King PX79 gave the most resistant reactions but in nurseries where they were showered with spores from neighboring plots, it could not be predicted whether on a field basis they could offer adequate protection. This, incidentally, is one of the weaknesses of predicting field performance from small plot performance. In 1974, a test field in Augusta county with a record of sequential corn crops and severe GLS was used to test 193 commercial and experimental hybrids and 541 in bred lines. From this test 26 inbred lines were selected for intercrossing and 180 crosses were made and planted in 1976 at the Augusta county site. Eight inbred lines were identified as contributing the greatest resistance. The GLS tests in Augusta were continued in 1976 and 1977. No data was obtained in 1976 due to a severe drought but in 1977, two Northrup-King entries were superior among 18 commercial hybrids. Only one experimental V. P. I. hybrid exceeded them in resistance but it flunked the yield test. After 1977, no further work was done with GLS in the Foy Era.

Genter, the corn breeder resigned after the 1977 growing season; D. E. Brann, and R. L. Harrison, Extension Agronomists, managed the corn tests in 1978 and H. S. Aycock, corn breeder, resumed the corn breeding and testing program in 1979. Testing for GLS would be resumed in 1981.

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A History of Plant Pathology in Virginia: The Foy Era (1974-1980)

Forest Pathology

John M. Skelly was the dynamic leader of forest pathology during the Foy Era. He was ably assisted by L. W. Kress and a number of other graduate students. Emphasis was on what came to be known as annosus root rot of loblolly and white pine and air pollution damage to several species of forest trees. Skelly also prepared a number of Extension publications on forest tree diseases. During the Foy Era, Skelly was promoted to Professor in 1978 and he was relieved of Extension duties so that he could concentrate on research. Most of the research was a continuation of that initiated in the Couch Era.

E. M. Hayes, a graduate student advisee of Skelly, made a study of ambient oxidant levels at three sites in Virginia mountains. The sites were on Salt Pond Mountain at the Horton Center, Giles County; at Rocky Knob, Floyd County; and at Dayton, Rockingham County. Sites were monitored from May 1, 1975 to March 31, 1976 in Giles and Floyd Counties, and until only October 1975 in Rockingham. The effects of oxidants on white pine were observed. Hayes noted that increases in oxidants occurred when weather patterns brought air masses from the north and northeast. Decreases occurred when air masses came from the northwest, west, southwest, south, and southeast. The highest concentration was observed on July 3, 1975; there followed significant injury to the white pine test plants (E. M. Hayes. 1976. M. S. Thesis, VPI & SU; Proc. Amer. Phytopathol. Soc. 3: 326, 1976; Plant Dis. Reptr. 61: 778-782, 1977). Kress and C. Nicholson constructed and used open-top indoor chambers with charcoal filters for experiments to determine effects of air pollutants upon small plants of loblolly and white pine and sycamore. They observed high and low sensitivity among clones and hybrids of these species and found that high or low sensitivity to oxidants was apparently inherited (Proc. Amer. Phytopathol. Soc. 3: 130, 3: 228; 4: 86, 4: 87, 4: 120). It was also reaffirmed by Skelly and Y. S. Yang that earlier observations correlating radial growth retardant with peak production periods at the Radford Army Ammunition Plant were correct. Indicator plants were sought for detecting broad-scale episodes of high oxidant periods. Common milkweed was found to be promising (Duchelle. S. F. 1981, M. S. Thesis VPI & SU., Duchelle, Skelly, Kress. 1980. Phytopathology 70: 689).

Judy Trimble and Marsha Ward made further studies on sensitive and insensitive clones of pine species. Trimble examined thickness of epicuticular wax and density of stomata on white pine needles but found no correlations with these features and sensitivity to ozone. Alkane content of wax was greater in the tolerant clone (Trimble, 1980. M. S. Thesis.). Ward compared sensitivity to ozone in half-sibs of loblolly pine. Ozone at 0.10 ppm surpressed growth and biomass accumulation in all clones but some clones resisted expressing symptoms. Again growth and biomass accumulation did not correlate well with foliar sensitivity (Ward, 1980. M. S. Thesis). Air pollution research was continued beyond the Foy era.

The following thesis and dissertations addressing air pollution effects on forest trees were completed during the Foy era:

> Phillips, S. O. 1975. Growth loss of loblolly pine (Pinus taeda L.), white pine (P. strobus L.), and sycamore (Platanus occidentalis L.) proximal to a periodic source of air pollution. M. S. Thesis.
>
> Hayes, E. M . 1976. The effects of an oxidant air pollution regime in southwestern Virginia on eastern white pine (Pinus strobus L.). M. S. Thesis.
>
> Nicholson, C. R. 1977. The response of 12 clones of eastern white pine (Pinus strobus L.) to ozone and nitrogen dioxide. M. S. Thesis.
>
> Kress, L. W. 1978. Growth impact of O_3, SO_2, and NO_2 singly and in combination on loblolly pine (Pinus taeda L.) and American sycamore (Platanus occidentalis L.). Ph. D. Dissertation.
>
> Trimble, J. L. 1980. Epicuticular wax and stomata characterization of two Pinus strobus L. clones differing in sensitivity to ozone. M. S. Thesis.
>
> Ward, M. M. 1980. Variation in the response of loblolly pine to ozone. M. S. Thesis.

Skelly led a group of student researchers through the rigors of investigating the etiology and epidemiology of pine root rot caused by Fomes annosus. During the span 1975 to 1980, the fungus was renamed Fomitopsis annosa and finally Heterobasidion annosum. Such instability in names prompted M. C. Shurtleff to say in his book " How to Control Plant Disease in Home and Garden" that he preferred to use common names because they have more stability. The disease became known familiarly as annosus root rot. Students involved were B. Bradford, H. D. Hertert, and R. S. Webb; S. A. Alexander also participated. Their research validated the belief that H. annosus was a primary pathogen of loblolly pine which reduced the growth rate and often predisposed trees to attack by the pine bark beetle (Phytopathology 65: 585-591, 1975; Proc. Amer. Phytopathology Soc. 2: 127, 155, 1975; 3: 324, 326, 1976; 4: 120, 1977; Phytopathology News 12: 166, 1978). Dissertations and thesis concerning this research prepared from 1974 to 1980 were:

> Bradford, B. 1977. The incidence of Heterobasidion annosus (Fr.) Bref. in loblolly pine plantations and the effect on radial increment growth. M. S. Thesis. VPI & SU.
>
> Webb, R. H. 1980. The incidence and severity of Heterobasidion annosum (Fr.) Bref. in loblolly pine (Pinus taeda L.) unthinned plantations and seed orchards. Ph. D. Dissertation. VPI & SU.

Interest in restoring chestnut (Castanea dentata) to its former place in American forests had gripped pathologists, geneticists and others in the late 1960's and was gaining momentum in the 1970's. In Virginia, the exploratory work was initiated by

R. J. Stipes and J. R. Elkins, a chemist of Concord College in Athens, West Virginia. Elkins had spent a sabbatical leave in 1975 with Stipes studying chemical compositions of American and Chinese chestnuts and their hybrids and had been appointed Adjunct Professor of Plant Pathology. Martha Roane, a recent Ph. D. graduate in mycology at VPI & SU, took an interest in the genus Endothia and diseases caused by Endothia spp.; she was also appointed Adjunct Professor. This group and several graduate students made numerous investigations into cultural characteristics of Endothia spp. They were soon joined by G. J. Griffin who became involved in chestnut studies because of his love of woodlands and desire to see the chestnut restored. He was an excellent soil microbiologist and methodologist. With Stipes expertise in uptake and translocation of systemic fungicides, the team produced an impressive array of publications on Endothia and diseases caused by members of its genus.

It is uncertain when interest in chestnut blight arose; apparently, work with pin oak canker caused by Endothia gyrosa led into studies of taxonomic criteria of the genus Endothia (Proc. A. I . B. S., 1975, Paper 1473; Va. J. Sci. 26: 65, 1975; 27: 60, 1976; 28: 70, 75, 77, 1977; 29: 71, 76, 1978). Certainly the contagious enthusiasm of John Elkins while on sabbatical leave in Stipes laboratory had infected Stipes, Martha Roane and Gary Griffin. Some of the early published notes were on chemical comparisons between American and Chinese chestnut trees and their hybrids (Proc. W. Va. Acad. Sci. 49: 9, 1977; 50: 9, 1978) and chemical comparisons among isolates of Endothia parasitica and other Endothia spp. (Proc. A. I . B. S. 1975, Paper 1473; Va. J. Sci. 26: 25, 1975; 27: 60, 1976; 28: 70, 75, 1977). They also extended experimentation of soil-injection of systemic fungicides that had been applied to elm for Dutch elm disease control to chestnut. Translocation, deposition at infection sites and efficacy of chestnut blight control were noted (Sugarloaf Mountain Bul. 6, 1975; Proc. Amer. Phytopath. Soc. 4: 95, 1977). The group sought means of controlling chestnut blight by injecting benomyl and other systemic fungicides into the soil of chestnut root zones (Proc. Amer. Phytopath. Soc. 4: 95, 1977, Proc. Amer. Chestnut Symp., Morgantown, W. Va., Jan. 4-5, 1978). Although benomyl was taken up by trees, it did not come in contact with blight fungus colonies and thus was no value.

Three avenues of blight control seemed open to chestnut workers: application of systemic chemicals, a procedure useful only for individual trees or nursery stock; breeding disease resistant lines; and use of hypovirulent strains of E. parasitica which have a mitigating effect on pathogenicity of naturally occurring virulent strains.

Breeding for blight resistance was begun in 1922 by Clapper and Gravatt, the latter was a V.P.I. graduate, B. S. 1911, M. S. 1912, under H. S. Reed. Many of the F_1 hybrids between American and Chinese chestnut produced by them are surviving at sites in Virginia. These and other breeding lines from Connecticut have been planted at Lesesne State Forest in Nelson Co., Virginia. Individuals up through the 5th generation are represented among surviving trees. The Virginia Division of Forestry has been the principle cooperating agency (Dierauff, T. A. 1977. Chestnut research in Virginia. Nut Grow. Assoc. Annu. Rep. 68: 130-134; Roane. M. K., G. J. Griffin, and J. R. Elkins. 1986. Chestnut Blight, Other Endothia Diseases, and the Genus Endothia. Amer. Phytopath. Soc. Monograph). Although the Nut Growers Association is vitally interested in chestnut restoration for nut production, the emphasis at Lesesne S. F. has been on selection of timber-type trees. Tom Dierauff was the principle forest pathologist assigned to the Lesesne S. F. project in the Foy era.

In 1975, efforts to implement hypovirulence as a means of controlling chestnut in the United Sates were underway primarily at the Connecticut Agricultural Experiment Station. In Virginia, under the leadership of G. J. Griffin, a survey for hypovirulence was conducted. Although some hypovirulent isolates were obtained, W20 and PCM, their virulence was greater than that of the European-derived hypovirulent reference culture, Ep43. Griffin et al. concluded that sampled surviving trees were not infected with hypovirulent E. parasitica and, thus, may have some degree of resistance (MacDonald, W. L., F. C. Luchok & C. Smith, eds. 1978. Proc. Amer. Chestnut Symp., W. Va. Univ. Books, Morgantown).

In the forgoing section, excessive discussion has been devoted to chestnut blight. Should chestnut once again be restored to the forest canopy, tribute must be paid to those everywhere who believed and persisted. Virginian's, even "naturalized" ones, will have contributed considerably to the task.

A canker disease of pin oak, caused by E. gyrosa was found for the first time in the United States at Hampton, Virginia 1970 (Roane, M. K., R. J. Stipes, P. M. Phipps, and O. K. Miller. 1974. Mycologia 66: 1042-1047.) Since this disease has been observed mostly in landscape trees, it will be discussed under "Pathology of Ornamental and Landscape Plants."

Thesis and dissertations relative to Endothia spp., chestnut and oak blights and cankers, 1975-1980:

Headland, Jane K. 1975. Severity of natural Endothia parasitica infection of Chinese chestnut, Castanea mollissima. M. S. Proj. & Rept.

Dawson, G. B. 1977. Uptake, translocation and persistence of fungitoxicants and other pesticides in trees including pin oak (Quercus palustris Muenchh.). M. S. Proj. & Rept.

Hunter, P. P. 1977. The blight and canker of pin oak (Quercus palustris Muenchh.) incited by Endothia gyrosa (Schw.) Fr. : Some factors affecting disease development. Ph. D. Dissertation.

Jones, C. 1978. Resistance of Chinese chestnut, Castanea mollissima Blume, to Endothia parasitica (Murr.) And. & And. in different cold-hardiness zones in the eastern United States. M. S. Proj. & Rept.

Appel, D. N. 1980. The influence of selected urban site factors, host nutrition and water stress on the decline and blight of pin oak (Quercus palustris Muenchh.) incited by Endothia gyrosa Fr. Ph. D. Dissertation.

Vegetable Pathology

Vegetable disease research was conducted mostly at the Eastern Shore substation of the Virginia Truck and Ornamentals Research Station. R. E. Baldwin was the pathologist there and he cooperated with R. C. Lambe and T. J. Nugent most of his efforts were of an individual nature. This work was primarily evaluation of new cultivars, pesticides, and procedures; it did not culminate in many peer reviewed journal articles but rather in brief articles in Fungicide and Nematicide Tests. There were 19 such articles in the 1975-1980 period; six described tests with materials to control cucumber anthracnose and downy and powdery mildews; four addressed potato seed-piece treatment; two pertained to tomato early blight and fruit rot control; two stressed sweet potato sprout treatment for control of scruf; and two were on control of root-rot of potato and carrot. There were also items on control of potato early blight, and strawberry gray mold, and leaf search. These items were addressed to the scientific community and the results were used as springboards for release to farmers of current disease measures. The growers received needed information from articles in the Vegetable Growers News (VGN), a monthly publication from the Truck Station.

In the period 1975-1980, Baldwin authored 24 articles in VGN on vegetable diseases based on information from publications mentioned in the preceding paragraph. Schedules for pesticide applications were frequently included. The final article of the period addressed control of soybean cyst nematode which by then had become a widespread problem on the Eastern Shore. Despite its recognition as a truck-crop producing county, Accomack had become one of the state's leading soybean producer and growers were demanding attention. Baldwin answered their call.

A long-standing problem for cabbage growers in Southwest Virginia is club root. M. D. Hutter reviewed the status of the disease in his M. S. project and report and graduate student L. W. Datnoff was assigned to study the disease and seek new control measures. Fox advised Hutter; Lacy advised Datnoff. T. K. Kroll began studies on the disease in the late '70's' with Moore and Lacy as co-advisors.

Hutter thoroughly reviewed the literature through early 1978. Sanitation, application of lime, use of disease-free seedlings, and crop rotation were the principle means of club root control. The newest measure was use of pentachloronitrobenzene (Terrachlor) in the transplant water (Hutter, M. S. Proj. & Rept., 1978). Datnoff discovered that ponds in the problem area had high numbers of resting spores of Plasmodiophora brassicae in the sediment (up to $2X10^7$/g). In laboratory experiments, he found that NaOCl in irrigation water was effective in reducing the incidence of clubroot. This was not tested in the field (Datnoff, M. S. Thesis, 1981). Kroll initiated his studies on resistance to and chemical control of P. brassicae in 1979, but the results were not available in the Foy era.

Most vegetable pathology was handled through Extension Service releases. The publications were "Plant Pathology: Vegetable and Field Crop Research Summary", Va. Truck and Ornam. Res. Sta.; and, "Commercial Vegetable Production Recommendations for Virginia", VPI & SU Pub 456-420, both published annually. Sections in these publications provided up-to-date information for disease control of vegetables grown throughout Virginia. Extension Specialists and Agents could use them as sourcebooks for preparing leaflets and hand-out literature.

Four other projects and reports were prepared on vegetable diseases during the Foy era, but no original research was involved:

> Okie, W. R., III. 1976. Control of Fusarium wilt of tomato with systemic fungitoxicants. M. S. Proj. & Rept. Hutter, M. D. 1978. Integrated control of clubroot of cabbage incited by Plasmodiophora brassicae. M. S. Proj. & Rept.

Spoor, Cynthia A. 1978. Control of Fusarium wilt of tomato with Cycocel and/or Lignasan BLP. M. S. Proj. & Rept.

Terry, W. R. 1980. Rhizoctonia solani as a pathogen of cabbage and possible management procedures for its control. M. S. Proj. & Rept.

Pathology of Ornamental and Landscape Plants

Two landscape tree diseases that had received attention from pathologists for a number of years were mimosa (Albizzia julibrissan) wilt (caused by Fusarium oxysporum f. sp. perniciosum) and Dutch elm disease (caused by Ceratocystis ulmi). Indeed, the latter entered North America in 1930 through the port cities of Hampton Roads. Mimosa wilt in Virginia was first discovered by T. J. Nugent to be killing trees in 1941. A third disease, pin oak canker (caused by Endothia gyrosa) was recognized by Stipes and P. M. Phipps in 1970. This disease was the topic of dissertations by P. P. Hunter and D. N. Appel during the Foy era.

Dutch elm disease eradication in the thirties had failed. The number of surviving American elm trees was gradually diminished. Destruction of trees in cities where elms were the predominant shade providers has been devastating. Stipes and his student D. B. Janutolo concentrated on the use of systemic fungicides to control Dutch elm disease. A number of factors enter into successful chemotherapy of infected trees. As a consequence, the disease may be arrested but the inciting fungus is rarely eliminated. Thus, continued application of fungicides is necessary. The procedures are clumsy and not adaptable to large populations. Thus, many trees have died; only a few have survived. Summaries of the situation appear in Janutolo's Ph. D. dissertation (Janutolo, D. B., 1977. Fungitoxicants in the Ceratocystis ulmi-Ulmus americana-soil continuum. Ph. D. Diss. V. P. I. & S. U.) and the elm compendium (Stipes, R. J., and R. J. Compana, eds. 1981. Compendium of Elm Diseases. Amer. Phytopathol. Soc.).

Stipes and his associates studied several aspects of mimosa wilt. Stipes and G. J. Griffin reported on numbers of macroconidia produced in lenticils and the high concentration of spores in soil beneath wilted trees (Pl. Dis. Reptr. 59: 787-790, 1975) and P. M. Phipps published with Stipes papers resulting from his M. S. thesis project. He emphasized the histology of developing wilt noting that infection occurred through roots and the fungus (Fusarium oxysporum f. sp. perniciosum) microconidia spread through the xylem elements leading to and colonization of distal parts of the tree. He also reported on control experiments with benomyl and thiabendazole. Used as soil drenches these materials were efficacious only if applied before roots were exposed to Fusarium spores. Thus, the most important control measure remained the removal of diseased trees and destruction of them by burning (Phytopathology 65: 188-190, 504-506, 1975; 66: 839-843, 1976).

Pin oak canker and blight caused by Endothia gyrosa, was first discovered in Hampton, Virginia in 1970. The disease was the subject of dissertations by P. P. Hunter in 1970 and D. N. Appel in 1980. Hunter found from monthly inoculations that May was most favorable for disease development and that lower osmotic water potentials in the host following pruning favored diseases development. Appel examined host nutrition, site factors, and water stress for their effects on the disease. Surprisingly, infection percentages were not correlated with root-confining factors, pH, major and minor elements in soil; even so, trees of least vigor were most susceptible to blight. Appel recommended regular watering to reduce drought stress, sanitary pruning practices, and removal of trees that did not recover normally from pruning stress. He provided evidence to support Hunter's hypothesis that water stress was a very important predisposing factor in pin oak blight (Proc. Amer. Phytopathol. Soc. 4: 84, 1977; Phytopathol. News 12: 206, 1978; Pl. Dis. Reptr. 62: 940-944, 1978).

In addition to the studies reported above, there were two first reports of fungi occurring on trees. Glomerella cingulata was found on Acer platanoides and Scoleconectria cucurbitula was found on Cedrus deodara (Va. J. Sci. 29: 47, 76, 1978).

In the mid-seventies, nurserymen who propagated Japanese holly (Ilex crenata) noted many plants grew poorly after transplanting to containers. The problem was investigated by Wills and Lambe; they found that Thielaviopsis basicola was causing a root rot (first report) and impairing growth (Pl. Dis. Reptr. 62: 859-863, 1102-1106, 1978). Excellent photographs of diseased plants were included. They made numerous isolations and inoculations and concluded T. basicola colonized a broad spectrum of related hollies. Isolates from I. crenata colonized several species of woody and agronomic plants, indicating the fungus was not very host specific.

A disease of boxwood (Buxus sempervirens) called "decline" began to cause concern to growers in northern Virginia in 1968. Paecilomyces buxi seemed to be the primary organism associated with many root diseases Phytophthora, Fusarium, Pythium, and Rhizoctonia spp. were frequently present. The disease was the subject of considerable research by Wills, Lambe, and graduate student G. B. Montgomery (Pl. Dis. Rept. 59: 1105-108, 1975; 61: 404-408, 1976; Montgomery, Ph. D. Dissertation, V. P. I. & S. U., 1975).

The organism P. buxi has history of confusion in the literature having been named Verticillium buxi and Volutella buxi (Pl. Dis. Reptr. 59: 105-108) and since those writings, Sesquicillium buxi (Farr et al. Fungi on Plants and Plant Products in the United States, Amer. Phytopathol. Soc. Press, 1989). Mary C. McBryde (Miller) first isolated it during preparation of her M. S. thesis (V.P.I., 1933.) and J. G. Harrar also found it in his survey of ornamental plant diseases in Virginia (Pl. Dis. Reptr. 21: 217, 1937). Not until Wills and Lambe started their investigations of boxwood decline, was the organism isolated again from Virginia boxwood. During the Foy era, no control measures were suggested. Wills and Lambe had no success in controlling the disease by soil fumigation with methyl bromide.

Wills and Lambe investigated biological control of boxwood decline. They observed Mortiella sp. isolates from boxwood were antagonistic to Phytophthora and Pythium spp. in culture. They found by inoculating azalea and boxwood roots with Mortiella sp. one week before inoculating them with Pythium and Phytophthora spp. that symptoms caused by these fungi were ameliorated but boxwood decline was not. Mortiella was found non-antagonistic to fungi other than Oomycetes (Phytopathology 70: 694, 1980.). Other aspects of biological control were investigated in the 1980's.

Thesis and Dissertations on Landscape Trees, 1975-1980:

Dawson, G. B. 1977 - See Endothia studies.

Hunter, P. P. 1977. - See Endothia studies.

Janutolo, D. B. 1977. - Fungitoxicants in the Ceratocystis ulmi-Ulmus americana-soil continuum. Ph. D. Dissertation.

Truax, Patricia A. 1978. Comparative distribution of Arbotech 20-5, CG 64251, Lignasan BLP, Nuariniol in Ulmus americana following administration with a Sterrett-Creager miniature pressure injector. M. S. Proj. & Rept.

Appel, D. N. 1980. See Endothia studies.

Thesis and Dissertations on Ornamental Shrubs, 1975-1980:

Montgomery, G. B., 1975. Etiology of root rot and decline of English boxwood (Buxus sempervirens cv. suffructicosa L.). Ph. D. Dissertation.

Bower, Leslie A. 1980. Biotic and abiotic stress factors influencing colonization of Buxus sempervirens var. suffructicosa L. by Paecilomyces buxi (Link Ex. Fr.) Bezerra. M. S. Thesis.

Nematology

Research on nematodes during the Foy Era in Virginia was dominated by Lawrence Miller. He studied and reported on the morphometric, parasitic, and pathogenic variation of cyst forming nematodes of the genera Heterodera and Globodera. He repeatedly demonstrated their interspecific and intergeneric compatibility, and proposed that species within each genus may have had a common ancestor but by geographic isolation they have become relatively host specific and morphologically distinct. Species of cyst nematodes with which he worked are Heterodera schachtii on sugarbeet, H. glycines on soybean, H. carotae on carrot, H. avenae on cereals, H. humuli on hops, Globodera rostochiensis and G. pallida on potato, G. solanacearum on tobacco, G. virginiae on horse nettle, and G. tobacum on tobacco. (The last three have been consigned to G. tobacum; their original specific epithets are given subspecies rank.)

Miller was ably assisted by Lorraine Ormrod (later L. O. Graney) who was both a graduate student and laboratory technician. Although Miller retired on January 1, 1980, he continued his research on cyst nematodes until his death in March 1996. He was not one who relished manuscript preparation; his research in the Foy Era is found in abstracts published in the following journals:

Journal of Nematology 8: 296-297, 1976; 11: 299, 1979; 12: 223, 1980. Nematologica 27: 35, 1976. Phytopathology 70: 688, 1980. Proceedings of the America Phytopathological Society 2: 125, 1975; 3: 125, 329-220, 1976; 4: 217, 1977. Phytopathology News 12: 67, 1978. Virginia Journal of Science 26: 44, 1975; 27: 35, 1976; 28: 54, 1977; 29: 39, 43, 1978; 30: 32, 1979, 31: 29, 78, 84, 1980.

In 1971, Miller's attention was drawn to some malformed plants of Carduus nutans (musk thistle) and C. acanthoides (plumeless thistle) growing in Rockingham Co. He found the malformations to be associated with the presence of Ditylenchus dipsaci, the stem and bulb nematode. Through 1975, he was able to induce symptoms in thistle plants but not in 16 other species known to be hosts of D. dipsaci, including teasel, Dispsacus spp., from which D. dipsaci was originally described (Proc. Amer. Phytopath. Soc. 3: 329-330, 1976.). In Virginia, D. dipsaci may be found in alfalfa and narcissus.

There are several other items of interest regarding nematology in the Foy Era. J. A. Fox joined forces with D. A. Orcutt, Plant Physiologist in the Department, to examine the various effects sterols might exert on nematodes and host plants parasitized by them. Graduate students Carolyn Jake and D. M. Evans participated in these studies. Evans and Fox found that Metopirone, an inhibitor of steroid synthesis, exerted a female-inducing effect on sex (Proc. Amer. Phytopathol. Soc. 2: 122, 1975; J. Nematol 8: 283-284, 1976; 9: 207-210, 1977; 10: 211-216, 1978).

Fox and L. Spasoff who had retired from the Department in 1974 reported in 1976 on a procedure for selecting vigorous tobacco plants in the presence of large populations of H. solanacearum (now G. tobacum subs. solanacearum). They observed that some vigorous plants inhibited the development of nematodes (designed resistant), but some allowed nematode development (tolerant). Based on plant weight and nematode development, four plant classes were recognized: resistant-tolerant, resistant-intolerant, susceptible-tolerant, and susceptible-intolerant. They concluded that resistance and tolerance were inherited independent by and they inferred that breeding programs should combine these factors (J. Nematol. 8: 284-285, 1976).

Prior to 1980, predictive assays had not been utilized for nematode management. Phipps and Fox introduced the procedure for peanut production in 1980. Their predictions for use of nematicides based on assaying about 350 farms in 1979 for nematode population levels. At that time, 95% of the Virginia peanut acreage was treated with nematicides. Based on the assays, only about 45% should require treatment. They also indicated that after peanuts, 89% of the fields would require treatment to grow peanuts again; after soybeans, 71% required treatment; and after corn, 51%. (Fields that brought the average down to 45% were not mentioned. Most fields in the peanut production area would be planted to one of these three crops.) Thus, for 1980, they could predict which fields needed treatment thereby resulting in big savings for peanut growers. The assay/prediction procedure was developed further in the 1980's (Proc. Am. Peanut Res. & Ed. Assn. 12:35, 1980.).

Stem pitting of peach had been found to be a problem for some Virginia orchardists. The disease was known to be caused by a nematode-transmitted virus (now tomato ringsport virus, TomRSV). T. K. Kroll, a graduate student, was hired to make a 10-county survey of peach orchards to determine its prevalence and determine the presence of associated nematode vectors. Stem pitting was found to be widespread and although absence of vectoring nematodes was not a limiting factor, Xiphinema americanum and Helicotylenchus sp. populations were higher near pitted than healthy trees (Va. J. Sci. 31: 82. 1980).

In 1975, S. B. Hanounik published with his advisor, W. W. Osborne, results obtained during his Ph. D. project completed in 1974. Hanounik and Osborne reported that as nematode (Meloidogyne hapla) density increased, the nicotine content in roots of 'NC 95' (Res.) and 'McNair30' (Susc.) increased. However, leaf nicotine increased in NC95 but decreased in McN30 probably because root damage provided less nicotine to translocate. In another study, where M. incognita predominated, populations were studied after methyl bromide treatment under McN30 plants, after fumigation, a low initial population increased slowly at first then rapidly past mid-summer because more roots than in untreated areas provided more food. In untreated plots, high initial populations increased rapidly at first, then leveled off and finally decreased because of a depleted quantity of roots (Proc. Amer. Phytopath. Soc. 2: 213, 1975).

Osborne retired in early 1977 and Extension Nematology at Virginia Tech lay dormant for awhile. In 1979 and 1980, Fox filled some of the gap by turning to nematicidal control of nematodes in various crops. Phipps and Fox were the two primary cooperators. With support from Research Supervisor Charlie Harris and Laboratory Technician Sue Meredith, tests were also conducted on tobacco cyst nematodes and on peanut, corn, and soybean. These tests usually led to nematode control recommendations in miscellaneous Extension publications. (Amer. Phytopathol. Soc. Fungicide and Nematicide Test Results 35: 226, 228, 229, 231, 233, 1979; 36 ; 184-185, 1980).

Fox resigned at the end of the Foy Era and Alama P. Elliott was hired to exploit developed knowledge in nematology.

Virology

Much of the work in virology is reviewed in sections on tobacco, cereals, and soybean. Reviewed here will be research not otherwise mentioned in commodity sections. Sue A. Tolin is the departmental virologist; some accomplishments by Tolin and her cooperators will be discussed.

Tolin maintained cooperation with various virologists and programs through "regional, national and international programs in order to maximize exchange of information as well as materials and techniques for virus identification so as to develop solutions to problems in the States with a minimum of research input on the problem." (Tolin in 1979 Comprehensive Review, Res. Proj. 612065). Research in Tolin's laboratory was centered on developing techniques for virus identification by serology and host symptomatology; on purifying, characterizing, and determining biochemical relationships among naturally occurring isolates of viruses; and on cooperating with other pathologists and breeders to develop virus-resistant crop cultivars, to determine genetic and other mechanisms of resistance, and to appraise virus-induced crop loses. The work on breeding and genetics was reviewed in the section on soybean pathology.

Graduate student Rosemary Ford conducted a study on five strains of tobacco mosaic virus (TMV) from various sources. One strain had been isolated in 1927; others of different ages and origins were compared to it. A strain collected in 1975 in flue-cured tobacco was nearly identical to it; a third yellow mosaic strain was isolated from a legume host and was distantly related to other strains and a mutant strain was consider intermediate. Ford's thesis appeared to be a very comprehensive study of TMV strains.

Dayle Zanziger for her M. S. project reviewed the literature on nepoviruses (nematode transmitted, isometric viruses) and demonstrated that a number of symptomless weeds common to orchards in Virginia were inoculum sources. Samples of red clover, marrow leaf plantain, and dandelion collected in peach orchards, yielded either tobacco or tomato ringspot viruses (TRSV or TmRSV).

Both Ford and Zanziger continued their education and earned Ph. D's; Ford at V. P. I. & S. U., Zanziger at University of Maine. An amusing sidelight to Zanziger's thesis is found in the acknowledgements. She wrote, "Genuine appreciation is expressed to Dr. L. I. Miller whose mumbling enthusiasm, infectious energy, and intellectual curiosity provided considerable inspiration." That was Miller in a nutshell.

Satellites were relatively newly discovered components of viruses at the time of the Foy Era. Tolin collaborated with J. R. Diaz-Ruiz and J. R. Kaper of the U. S. D. A. at Beltsville in studying the role of satellites in certain viruses, especially peanut stunt virus (PSV). By virtue of this collaboration, Diaz-Ruiz was named Research Associate in the Department. PSV is a tripartite virus of the cucumovirus group. The satellite was determined to have an innocuous effect in the pathogenicity of PSV (Virology 88: 166-170, 1978). This paper represents pioneering research on the role of satellites in viruses.

For the most part during the Foy Era, virologists, graduate students, and other researchers devoted attention to the taxonomy of viruses from legumes, tobacco, and various weeds.

Thesis and Dissertations in Virology, 1975-1908:

Ford, Rosemary H. 1976. Comparison of five naturally occurring strains of tobacco mosaic virus. M. S. Thesis.

Polston, Jane E. 1978. Preparation of six Extension publications on plant virus diseases in Virginia. M. S. Proj. & Rept.

Trevathan, L. E. 1978. Symptom expression and lipid composition in flue-cured tobacco in response to ozone and purified tobacco mosaic virus. Ph. D. Diss. Moore and Tolin, co-advisors.

Zanziger, Dayle, H. 1980. The role of week host and nematode vector in the ecology of nepoviruses in Eastern North America. M. S. Proj. & Rept.

Turfgrass Pathology

Since Couch arrived on campus in 1965, turfgrass pathology had been his province. Having given up department headship, he had to re-establish himself as a full-time researcher, teacher, and author. He moved to a ground floor office near his laboratory and growth room and as was typical of his character, remodeled, redecorated, and refurbished a plain plaster-walled room into an elegant office. Thus, he became a first class member of our beloved Price Hall's "engine room" crew.

Most of Couch's publications centered around summarizing the status of turfgrass pathology in review and encyclopedia articles and in conference proceedings. Since he was an entertaining and informative speaker, he was frequently invited to talk to golf course and turfgrass management groups. He also began a total revamping of his book, <u>Disease of Turfgrass</u>. Although most of his research efforts were in testing and comparing the efficacy of new fungicides on various turfgrass species, he did not avail himself to the annual A. P. S. publication <u>Fungicide and Nematicide Tests</u>. Only one technical article was published in a peer reviewed journal. Thus, it appears that Couch contributed more to Extension pathology than to research pathology in the Foy Era. He contributed to the instruction program by lecturing in course PPWS 5180, Diseases of Landscape Trees, Ornamentals, and Turfgrass, jointly offered with Stipes, Wills, and Couch.

One student completed an M. S. under Couch's guidance in the Foy era:

> Bird, R. G. 1976. Effects of chemical adjuvants of turfgrasses and turfgrass soil. M. S. Proj. & Rept.

New Plant Diseases, Pathogens, and Hosts Reported 1975-1980

1975

> Wheat spindle streak mosaic virus, in Richmond County, previously thought to be only wheat soil-borne mosaic virus. Roane and Tolin, unpublished.

> Peanut stunt virus in crown vetch, a reclassification of a virus described as cucumber mosaic virus in 1967 (Tolin and J. D. Miller Phytopathology 65: 321-324).

> Wheat stem rust in eastern Virginia. While not new in Virginia, Puccinia graminis created havoc on 'McNair 701' and 'Blueboy' wheats in 1975, a rare event for the Coastal Plain 1975. (C. W. Roane and T. M. Starling, 1975 Wheat Newsl 22: 122, 1976)

> Wheat stripe, Cephalosporium gramineum, occurred in a small area of wheat nurseries at Blacksburg (C. W. Roane and T. M. Startling, Pl. Dis. Reptr. 60: 345, 1975). White clover rust, Uromyces nerviphilus occurred on hybrids of Trifolium repens at Blacksburg in 1974 and 1975. First report for Virginia (M. K. Roane and J. D. Miller, Pl. Dis. Reptr. 60: 432-433, 1976).

> Scots pine western gall rust, first report, from Bedford County (J. M .Skelly, Pl. Dis. Reptr. 60: 222, 1976).

1977

> Cesphalosporium stripe of rye, Cehpalosporium gramineum (now Hymenula cerealis) was found near Blacksburg on volunteer rye (Jones, J. B. , et al, Pl. Dis. 64: 325, 1980).

> Norway maple anthracnose, Glomerella cingulata, on Acer platanoides (Roane, M. K., and Stipes, Va. J. Sci 29: 47: Stipes and G. L. Clement, Ibid., p. 76, 1978).

> Deodor canker, Scoleconectria cucurbitula on Cedrus deodara (Ibid., p. 47).

1978

> Soybean stem blight, Sclerotinia minor, was first observed in 1978 (Phipps and Porter, Pl. Dis. 66: 163-165, 1982).

Service to Professional Societies

Service to professional societies is voluntary and sometimes very time-consuming. During the Foy Era, the faculty participated in the committee and administrative functions of several professional societies, i.e., the American Phytopathological Society, American Peanut Research and Education Association, Society of Nematology, Mycological Society of America, Virginia Academy of Science. Foy himself was not a member of any pathology related society. Participation in the American Phytopathological Society (A. P. S.) was most evident; P. D. indicates a Potomac Division function:

S. A. Alexander - Forest Pathology Comm., 1978-80. P. D. - Local Arrangements Comm., 1979, Program Comm., 1979; Auditing Comm., 1980.

R. E. Baldwin (Painter, VA) - P. D. - Awards Comm., 1979; Resolutions Comm., 1980.

H. B. Couch - A. P. S. Councilor for P. D., 1973-1977; Nominating Comm, 1975; Diseases of Ornamental Plants and Turf Grasses Comm., 1977-79; Phytopathology Classics Comm., 1978-80; Special Publications Comm., 1974; P. D. - Awards Comm., 1975; Nominating Comm., 1980

C. R. Drake - P. D. - Resolutions Comm., 1977.

G. J. Griffin - Associate Editor of Phytopathology, 1977-79.

K. D. Hickey - Apple and Pear Disease Comm., 1972-74; Business Manager, Fungicide & Nematicide Tests, 1971-74; P. D. - Awards Comm., 1975.

L. W. Kress - Pollutions Effects on Plants Comm., 1980; Special Illustrations of Plant Pathogens, 1980; P. D. - Resolutions Comm., 1979.

R. C. Lambe - Ornamental Plants & Turfgrass Diseases Comm., 1979-80; Associate Editor, Fungicide & Nematicide Tests, 1979-80.

L. I. Miller - A. P. S. Meeting Site Comm., 1974.

L. D. Moore - Pollution Effects on Plants Comm., 1974; Membership Comm., 1974-77; Chm. 1976; Phytopathology News Comm., 1978-80; Necrology Comm., 1978-80; Environmental Quality Comm., 1974-75; P. D. - Secretary-Treasurer, 1978-80; Program Comm., 1976, Chm. 1978; Awards Comm. 1977-80.

P. M. Phipps - New Fungicide and Nematicide Data Comm., 1979-80.

C. W. Roane - Environmental Quality Comm., 1974-75; Compendium Comm. (Subcomm. Of Publications Comm.), 1974-75; Phytopathology Monographs & Reviews, 1975-80; Compendium Comm., 1980. P. D. - Resolutions Comm. Chm. 1975; Vice-Pres. 1977-78, Pres. 1978-79; Awards Comm. Chm., 1978; Associate Editor; Plant Disease Reptr/Plant

Disease 1978-80.

J. M. Skelly - Publications Comm., 1974-78; Phytopathology Classics Comm., 1974-77, Chm. 1975; Pollution Effects on Plants, 1977-79, Chm. 1979; Special Illustrations of Plant Pathogens, 1975-78, Chm. 1977-78; Teaching Comm., 1974-75; Slide Salon Comm., 1974; P. D. Program Comm. 1977-78.

R. J. Stipes - Teaching Comm., 1974; Forest Pathology Comm. 1974-77; Chm. 1976; Subcomm. of Teaching Comm. on International Plant Pathology Glossary, 1974-75, Chm. 1975; Monographs & Reviews Comm. 1978-1980; P. D. - Program Comm. 1978, 1980; Nominating Comm., 1975.

R. W. Tillman -Teaching Comm. 1977-79, Chm. 1979; P. D. - Program Comm., 1978.

S. A. Tolin - Plant Virology Comm. 1977-80, Chm. 1980; Member Comm., 1977-79, Chm. 1979; Associate Editor, Plant Disease Reporter 1975-1977; P. D. - Program Comm. 1975; Auditing Comm., 1979; Nominating Comm., 1978; Awards Comm., 1980.

W. H. Wills - P. D. - Nominating Comm., 1977; Auditing Comm. Chm., 1980.

K. S. Yoder -Chemical Control Comm., 1979-1980; Editorial Board, A. P. S. Fungicide and Nematicide Tests, 1980-; P. D. - Program Comm., 1976.

American Peanut Research and Education Association

K. H. Garren - Pres. 1974-1975.

D. M. Porter - Chm., Bailey Awards Comm. 1978-80. Chm. Finance Comm. 1976.

Southern Soybean Disease Workers Council

W. W. Osborne - Member Program Planning Comm. 1925; Award for being first Pres. of SSDW.

Extension-Industry Peanut Workers - Award from, for meritorious service, July 1980.

1980-81 Chm., Publicity and Publications Comm. - Osborne

1980-81 Chm., Soil-borne disease Comm. - Phipps

Tobacco Workers Conference

1975-79 S. A. Tolin - Editorial Board, Tobacco Science.

Virginia State Horticultural Society

K. S. Yoder - Program Comm., 1978.

Virginia Pesticide Association

C. R. Drake - Member of Advisory Board.

K. S. Yoder - Member of Advisory Board and Publicity Comm. 1978-80.

Cumberland - Shenandoah Fruit Workers Conference

C. R. Drake - General Secretary.

Society of Nematology

J. A. Fox - Chm., Host-Plant Resistance Comm., 1976-79.

L. D. Miller - Executive Comm. 1974-78. Editor, Journal of Nematology 1974-75; President, 1976-77.

Virginia Academy of Science

M. K. Roane - Botany Section, Secretary 1975-76, Chm. 1976-77; Member Local Arragnements Comm. 1978, Chm.; Public Relations Subcomm. 1980; Chm., Flora Comm. 1979-81. Editor, Jeffersonia 1979-81; Member Council 1979-81.

R. J. Stipes - Chm., Botany Section, Section of Agriculture. Va. Jour. Sci. Editor 1980.

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C. W. Roane
November 2000

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A History of Plant Pathology in Virginia: The Hooper Era (9/1/1980-6/30/1984)

Gerald R. Hooper was appointed to succeed Chester L. Foy as Head of the Department of Plant Pathology and Physiology on August 18, 1980. The second comprehensive review of the Department had been held in the week of February 26 to March 2. 1979. It would become Hooper's lot to carry out the recommendations of the review panel.

Hooper was born on August 28, 1937 in Belvedere, California. He adopted the abbreviated name "Gary" by which he is known. He earned a B. S. degree, majoring in botany and minoring in chemistry at Brigham Young University, 1953. He earned the Ph. D. degree at the University of California, Riverside, 1968, majoring in plant pathology. He gained considerable experience in teaching and research as Assistant Professor at Riverside, 1968-1971, and California Polytechnic Institute, San Luis Obispo, 1971-1972. He became Associate Professor and Professor (1977) at Michigan State University, 1972-1980, where he was Director of the Center for Electron Optics. He taught electron microscopy and conducted research on virus diseases of woody fruit crops and the ultrastructure of various fungi.

Hooper began his tenure at V.P.I. & S.U. with a faculty of 10 professors, 6 associate professors, 8 assistant professors, 5 adjunct professors, 1 visiting professor, and 3 research associates:

Professors:

> Samuel W. Bingham - Plant Physiologist, weed control on highways, golf courses, turf.
>
> William E. Chappell - Plant Physiologist, weed and brush control, rights-of-way.
>
> Houston B. Couch - Plant Pathologist, turfgrass pathology.
>
> Charles R. Drake - Plant Pathologist, fruit crop pathology, coordinator of the plant protection program.
>
> Chester L. Foy - Plant Physiologist, immediate past Department Head, weed control, herbicide additives.
>
> Gary J. Griffin - Plant Pathologist, soil microbiology, peanut and forest tree pathology, chestnut blight.
>
> Curtis W. Roane - Plant Pathologist, diseases of cereals and soybean, genetics of host-parasite interactions.

John M. Skelly - Plant Pathologist, forest pathology, air pollution studies, extension.

Roland J. Stipes - Plant Pathologist, diseases of landscape trees.

Wirt H. Wills - Plant Pathologist, ornamental plant diseases, fungal pathogens.

Associate Professors:

James S. Coartney - Weed Scientist, nursery crops, Christmas trees, extension.

Maynard G. Hale - Plant Pathologist, gnotobiology, plant stress.

Robert C. Lambe - Plant Pathologist, ornamental and nursery crop diseases, extension.

Laurence D. Moore - Plant Pathologist, physiology of diseases, tobacco and turfgrass pathology.

David M. Orcutt - Plant Physiologist, plant stress, instruction.

Sue A. Tolin - Plant Pathologist, virology, virus diseases of legumes, tobacco, corn.

Assistant Professors:

Samuel A. Alexander - Plant Pathologist, forest tree and Christmas tree diseases.

Kriton K. Hatzios - Plant Physiologist, herbicidal action.

Dean A. Komm - Plant Pathologist (Blackstone), tobacco pathology, extension.

George H. Lacy - Plant Pathologist, phytobacteriology, vegetable crop diseases.

James R. Martin - Plant Physiologist (Warsaw), weed and disease control, IPM, extension.

Patrick M. Phipps - Plant Pathologist (Holland), peanut pathology.

Orvin E. Rud - Plant Physiologist (Holland), weed control, peanut, soybean, corn.

Keith W. Yoder - Plant Pathologist (Winchester), tree fruit pathology.

Adjunct Professors:

L. S. Dochinger - USDA Forest Service.

John R. Elkins - Professor of Chemistry, Concord College, Athens, West

Virginia.

Kenneth H. Garren - USDA, Holland, Virginia, peanut pathology.

D. Morris Porter - USDA, Holland, Virginia, peanut pathology.

Martha K. Roane - Plant Pathologist, fungal taxonomy, Rhododendron diseases, chestnut blight.

Research Associates:

J. R. Diaz-Ruiz - USDA, Beltsville, virology.

Lance W. Kress - Graduate student, Blacksburg, air pollution, forest pathology.

M. L. Link - Graduate student, vegetation management on rights-of-way, herbicide application.

There were several personnel changes during the Hooper Era.

Faculty Hired (all as Assistant Professors except Grayson):

David E. Babineau - 1981, Plant Pathologist, IPM in cereals and soybean, Warsaw.

Anton B. A. M. Baudoin - 1981, Plant Pathologist, instruction.

Boris I. Chevone - 1980, Plant Physiologist, air pollution.

Jeffrey F. Derr - 1984, Weed Scientist, weed control in horticultural crops, primarily extension.

Alma P. Elliott - 1980, Plant Pathologist, nematology.

Edward S. Hagood, Jr. - 1981, Weed Scientist, herbicide application, weed identification, primarily extension.

Randolph L. Grayson - 1984, Professor, Plant Pathologist, Director of the Electron Microscope Laboratory.

Erik L. Stromberg - 1981, Plant Pathologist, diseases of agronomic crops.

Michael J. Weaver - 1980, Plant Pathologist, Coordinator of the Chemical Drug and Pesticide Unit. Grape disease specialist, extension.

John W. Wilcut - 1984, Weed Scientist, Holland, cereals, soybean, and peanut, primarily extension.

William E. Winner - 1982, Plant Physiologist, Director of the Air Pollution Laboratory.

Hired as Research Associate:

Robert L. Wick __ Manager of the Plant Disease/Nematode Clinic.

Faculty Separating:

William E. Chappell - 1983, Professor, Weed Scientist, retirement.

James S. Coartney - 1982, Associate Professor, Weed Scientist, transferred to the Department of Horticulture.

John M. Skelly - 1983, Professor, Plant Pathologist. Resigned to become Head of Department of Plant Pathology, Pennsylvania State University.

Robert L. Wick __ 1984, Research Associate. Resigned to become Assistant Professor, University of Massachusetts.

Thus, during the Hooper Era there was a net gain of 8 faculty positions.

As previously mentioned, it would fall Hooper's lot to implement the recommendations put forth by the panel of the 1979 Comprehensive Review. Some suggestions included:

1. Renaming the Department to reflect more fully its mission of plant protection.
2. As a further reflection of its mission, the Department should have "An undergraduate degree in plant protection......The undergraduate program need not be the sole responsibility of this Department, but the Department's contribution should be a clearly identified component. Nothing strengthens a department so much as having undergraduate students of its own."
3. A coordinated plant physiology program involving an inter-departmental faculty was recommended.
4. In order to strengthen its identity and enhance its funding, the weed science group should align itself more closely with commodity groups.
5. There should be a strengthening of research in plant stress as it would relate well to the overall mission of plant protection.
6. The panel criticized plant pathology research as being "A collection of many small projects which were difficult to relate...Serious consideration should be given to sacrificing breadth.for great depth...we urge that research goals be established by the plant pathology faculty, and individual researchers." As a result, the "Department should be able to present a logical, dependable approach to the College administration for resources."
7. The author's own reaction is that the criticism of the plant pathology program was unfounded, that the non-specific recommendation was in a sense the panel grasping for straws. The Department was well aware of its financial plight and the administration was being forced into a situation whereby it had to do more with less. The Review Panel did not offer any specifics. The statement therefore seemed to typify those of bureaucrats. Unlike their recommendations for the instruction, physiology, and weed programs, the panel did not have much to offer the pathology programs. Perhaps without saying so, or being reluctant to say so, the panel endorsed the pathology program.

So how did Hooper respond to the recommendations of the Review Panel?

1. In 1983, the Department became the Department of Plant Pathology, Physiology and Weed Science. This appeased the weed people whose field had grown rapidly and the addition of "Weed Science" gave them a feeling of professional credibility. It also favored the hiring of weed scientists who now knew they would not be an obscure addendum to an established

department.

2. Apparently, the Review Panel overlooked the fact that R. W. Tillman had been hired to establish an IPM program at both the undergraduate and graduate level. Anton Baudoin was hired in the Hooper Era to continue these efforts. Therefore, Hooper responded at least in part to the second recommendation.
3. Beginning in 1980, a group composed of faculty from the Departments of Plant Pathology and Physiology (not yet renamed), Biochemistry, and Biology developed an Inter-departmental Plant Physiology Program. Although it was faculty initiated about the time Hooper arrived, he fully supported this initiative. It continues to the present.
4. The weed science group was strengthened by the prompt hiring of replacement faculty for Chappell, Kates, and Rud in the persons of Derr, Hagood and Wilcut.
5. There was a strengthening of research in plant stress which Hooper supported. This area was a great supplement to plant pathology and a course "Physiology of Plant Stress" initiated by M. G. Hale in the Foy Era was a welcome addition to the education of plant pathology graduate students. Hooper supported it passively.
6. In response to establishing research goals, nothing revolutionary happened during the Hooper Era as had happened under Couch. R. L. Grayson was added to the Departmental faculty in 1984 and appointed Director of the Electron Microscope Laboratory. W. E. Winner was appointed Director of the Air Pollution Laboratory but all other appointments were into vacant positions (Babineau for Martin, Baudoin For Tillman, Chevone for Kress, Derr for Chappell, Elliott for Fox, Hagood for Kates, Stromberg for Pristou, Weaver was a sidewise move, and Wilcut for Rud.) In general, the goals remained as they had been at the inception of the Hooper Era. Changes in personnel had little impact on the Departmental mission.

From here forward, emphasis will be on accomplishments and changes in plant pathology as reported in the various sections.

Instruction and Related Topics

The Hooper Era began with an impressive list of plant pathology courses offered by the Department. The following list is compiled from the 1980 University Catalogue.

The instructors where known are included:

2960 - Field Study - hrs. & cr. arr.

3010 - Plant Pathology - 3 (3), II or V. (Couch).

3020 - Plant Pathology Laboratory - 3 (1), II or V. (Wills).

3030 - Forest Pathology Laboratory - 3 (1), II. (Skelly/Alexander).

4010 - Air Pollution Damage to Plants - 3 (3), I. (Skelly/Moore).

4040 - Diseases of Crop Plants - 7 (3), II. (Drake).

4050 - Phytopathogens - 4 (4), I. (Griffin, Wills, Tolin).

4060 - Principles of Pesticide Application - 5 (3), III or V. (Bingham).

4960 - Field Study - hrs. & cr. arr.

4970 - Independent Study - hrs. & cr. arr.

4980 - Special Study - hr. & cr. arr.

4990 - Undergraduate Research and Thesis - hrs. & cr. arr.

5020 - Principles of Plant Disease Control - 3 (3), III. (Stipes).

5030 - Plant Parasitic Nematodes - 7 (3), II, alt. even yrs.

5040 - Plant Virology - 6 (4), I, alt. odd yrs. (Tolin).

5090 - Genetics of Host - Parasite Interactions - 3 (3), II, alt. even years. (Roane).

5111 - Seminar - 1 (1), III.

5120 - Concepts and Practices of Pesticide Application - 5 (3), III. (Bingham).

5130 - Plant Pathogenic Agents - 4 (4), I. (Griffin, Wills, Tolin).

5150 - Diseases of Field Crops - 6 (4), I. (Roane).

5170 - Epidemiology of Plant Diseases - 6 (4), III.

5180 - Diseases of Landscape Trees, Ornamentals and Turfgrasses - 4 (3), III; alt. even yrs. (Stipes, Wills, Couch).

5190 - Phytopathogenic Fungi - 6 (4), III. (Wills).

5221 - Clinical Plant Pathology I - 6 (2), II. (Griffin).

5222 - Clinical Plant Pathology II - 6 (2), III. (Miller).

5311 - Pest Management Systems I - 5 (3), II.

5312 - Pest Management Systems II - 9 (3), III.

5900 - Project and Report 1-3 (1-3) arr.

5970 - Independent Study - hrs. & cr. arr.

5980 - Special Study - hrs. & cr. arr.

5990 - Research and Thesis - hrs. & cr. arr.

6020 - Principles of Plant Disease Development - 3 (3), I; alt. odd year. (Couch).

6040 - Physiology of Pathogenesis - 6 (4), III; alt even yrs. (Moore).

7990 - Research and Dissertation - hrs. & cr. arr.

Added to the courses above were those in plant physiology and weed science to make an impressive showing for the Department in the catalogue. It may be noted that for some courses no instructor is named. This is due to the departures of J. A. Fox who taught 5030 and co-taught 4050 and 5130, and R. W. Tillman who was to teach 3020, 5170, 5311, and 5312. Fox and Tillman would be replaced by A. P. Elliott and Anton Baudoin, respectively.

Several courses in plant physiology were valuable to plant pathology majors. Required for M. S. (thesis) and Ph. D. programs was:

5100 - Water Relations and Mineral Nutrition - 6 (4), I. (Hale).

Courses frequently elected were:

5060 - Plant Metabolism - 6 (4), II. (Moore).

5110 - Physiology of Plant Stress - 3 (3), II. (Hale).

The Department offered two options for M. S. degrees. One was a non-thesis option in Plant Protection. For comparison, the two programs of study are shown. From 1973-1980, an average of 5.5 degrees per year were granted in the non-thesis program, but for the Hooper Era only 1.5 were granted.

Minimum Requirements for M. S. (Non-Thesis) Degree in PlPP (Plant Protection)

General Microbiology	1 term	
Plant Pathology 1 term, with laboratory	PlPP 4020 Plant Growth Regulation	4
PlPP 4030 Principles of Vegetation Control	4	
PlPP 4040 Diseases of Crop Plants	3	
PlPP 4210 Insect-Pest Management	4	
PlPP 5020 Principles of Plant Disease Control	3	
PlPP 5111 Seminar	1	
PlPP 5120 Concepts and Practices of Pesticide Application	3	
PlPP 5130 Plant Pathogenic Agents	4	
PlPP 5221 Clinical Plant Pathology	I2	
PlPP 5222 Clinical Plant Pathology	II2	
PlPP 5311-12 Pest Management Systems	6	
PlPP 5900 Project and Report	6 maximum	

Minimum Requirement for the M. S. (Thesis) Degree in Plant Pathology

Biometry (or Statistics)	2 terms
General Microbiology	1 term, with laboratory
Introductory Mycology	1 term, with laboratory
Plant Anatomy or Morphology	1 term
Plant Pathology	1 term, with

	laboratory
PlPP 5100 Plant Water Relations and Mineral Nutrition	4
PlPP 5111 Seminar	1
PlPP 5990 Research and Thesis	9-15
Select 6 or more additional credits from plant anatomy, morphology, taxonomy, cytology or ecology.	6
Select 12 additional credit in plant pathology.	12

The decline of students in the non-thesis Plant Protection program caused the faculty to re-evaluate the program. During the Moore Era 1984-1997, the program was virtually extinct.

In the 1984 Comprehensive Review, reasons were given for declining enrollment in Plant Protection. First, there has been a decline in enrollment nationwide in Agricultural Colleges; second, there has been a decline in job opportunities; third, the number of course credits required was greater than for a thesis M. S.; fourth, (and this is the writer's opinion) there was not a clear-cut distinction between the project and report required in Plant Protection and a thesis. Some advisers required as much effort for a project and report as they would for a thesis; and fifth, Plant Protection students had to finance their own course of study.

It was also noted that during the Hooper Era several course changes and less than the required minimum number of students in courses caused cancellations of courses that were not student-acceptable and curriculum revisions. These problems are self destructive. Students seek more favorable environments from which to launch a career.

An integrated plant management (IPM) curriculum had been established in 1980 as an option for Horticulture and Agronomy undergraduates, with PPWS and Entomology contributing many of the courses, and two advisors. In effect it was a committee-operated curriculum administered from the Dean's office. The curriculum was precipitated by four factors:

1. A national movement to educate undergraduate students in the philosophy and techniques of IPM.
2. The perceived demand in the job market for people with an IPM background.
3. Political pressures within the University (meaning what?)
4. A need to resolve scheduling problems associated with the undergraduate plant protection options in Agronomy and Horticulture.

By 1984, 10 IPM majors had graduated; 15 were enrolled. This was an unrealistic number to sustain a curriculum. Reasons given in the 1984 Comprehensive Review for failure of enrollment to increase were:

1. A decline of enrollment in most agricultural colleges an at V.P.I. & S.U. in particular.
2. Failure of an increased number of job opportunities in IPM to materialize.
3. Lack of familiarity with IPM by the general public.
4. Failure of students to be exposed to IPM courses until the 3rd year.

Thus, by the end of the Hooper Era, the Department, with the IPM curriculum foundering, had not yet established itself as a Department for undergraduate majors. Lack of interest and declining enrollment will probably doom the curriculum. However, there are very few successful undergraduate plant pathology programs in agricultural colleges nationwide; it remains a province of graduate schools.

Graduate education in the Department remained healthy during the Hooper Era. Thesis and dissertations encompassed diverse subject matter. Although none reflected the impact of molecular biology on plant pathology, such studies were under way in bacteriology and virology. The Ph. D. dissertations by Rosemary Ford and Penny Hunst, advisees of Sue A. Tolin, came as close to molecular as the Department would reach. Their contribution will be discussed in the section on Virology. Most thesis and dissertations had practical implications for plant health management.

Several course changes were made during the Hooper Era. The following list gives changes from the list at the beginning of this section:

> Forest Pathology Laboratory to Forest Pathology __ 3030 to 4270
>
> Air Pollution Damage to Plants from plant pathology to plant physiology, title change; new title, Plant Responses to Air Pollutants. Still 4010.
>
> Phytopathogenic Agents - 4050, and Plant Pathogenic Agents - 5130, changed respectively to: Plant Disease Agents (Fungi) - 5001. Plant Disease Agents (Viruses, Prokaryotes) - 5002. Plant Disease Agents (Nematodes, Vectors, Parasitic Plants, & Environment Stress) - 5003. Plant Disease Agents - 5130 combined with 5003, 5040 combined with 5002. 5221 & 5222 Clinic I & II now 5010.
>
> 6020 Principles of Plant Disease Development - not listed in '84.
>
> 5790 into 5011 - Diseases of Horticultural Crops.
>
> 5311-12 Pest Management Systems I & II becomes Integrated Pest Mgt. I & II.

There was an impending change from the quarter to a semester system requiring again a change in course structure. Thus, from about 1982 to 1986, plant pathology courses were in a state of flux.

Deleted were:

> 4050 - Phytopathogens
>
> 5130 - Plant Pathogenic Agents
>
> 5180 - Diseases of Landscape Trees, Ornamentals and Turfgrasses
>
> 5190 - Phytopathogenic Fungi

Changed to a lower level:

5311 to 4311 Integrated Pest Plant Management, 3H, C, II.

5312 to 4312 Integrated Pest Plant Management 9H, 3C, III.

Changed to higher level:

3030 to 4270 and retitled Forest Pathology, 3H, 3L, 4C, II.

New courses installed:

4680 - Virology, 3H, 3C, I.

5001 - Plant Disease Agents, Fungi (change from 5190)

5002 - Plant Disease Agents, Viruses and Prokaryotes (change from 5040, addition of Prokaryotes).

5003 - Plant Disease Agents, Nematodes, Vectors, Parasitic Plants, and Environmental Stress (change from 5030 and addition of other agents)

5010 - Plant Disease Agents: Clinical Experience

The catalogue entries were prepared about 18 months before the catalogue was published, therefore, some courses were changed before it appeared.

Degrees Granted in Plant Pathology, Hooper Era, 1980-84

Year	Degree	Recipient (Advisor)	Thesis or Dissertation Title (NT = non thesis)
1981	Ph. D.	J. A. Barron, III (Phipps)	Effect of herbicide on *Cylindrocladium crotalariae* and the Cylindrocladium black rot (CBR) disease of peanut.
1981	M. S.	L. F. Benoit	Ozone effect on long term growth and reproduction in eastern white pine.
1981	M. S., NT	C.M. Berg (Lacy)	Bacterial soft rot of iris.
1981	M. S.	L. E. Datnoff (Lacy)	Detection of Plasmodiophora brassicae in and decontamination of irrigation water.
1981	M. S.	S. F. Duchelle (Skelly)	The response of indigenous vegetation in Blue Ridge Mountains of Virginia to photochemical oxidant air pollution.
1981	M. S.	W. H Elmer (Stipes)	Soil fate and systemicity in *Arachis hypogaea* L. of dicloran, iprodione and vinclozolin.
1981	Ph. D.	R. H. Ford (Tolin)	Comparative studies in two strains of peanut stunt virus: Characterization, *in vitro* interaction, and localization of the gene for pathogenicity on *Glycine max* 'york.'
1981	M. S.	L. S. O. Graney (Miller)	Interspecific and intraspecific morphological comparisons of six isolates *Heterodera schachtii* and two isolates of *H. glycines*.

1981	Ph. D.	P. L. Hunst (Tolin)	Soybean mosaic virus: Strains, ultrastructure and movement.
1981	M. S.	A. L. Lackner (Alexander)	Incidence and pathogenicity of *Verticicladiella procera* Kendrick on pines in Virginia.
1981	M. S.	J. E. Nellessen (Skelly)	Screening white pine Christmas tree seedlings for ozone sensitivity.
1981	M. S.	B. L. Tepper (Yoder/Stipes)	Influence of selected fungicides on germination of conidia of *Penicillium expansum* and *Monilinia fructicola* and postharvest control of penicillium blue mold of apple and brown rot of peach and nectarine.
1981	M. S.	W. F. Waterfield, III	Calcium nutrition of three tobacco cultivars affecting lipid content and susceptibility to black shank incited by *Phytophthora parasitica* var. *nicotianae*.
1981	M. S.	R. W. Wendt (Griffin)	Presence of hypovirulent *Endothia parasitica* (Murr.) P. J. & H. W. Anders. In the general population of American chestnut, *Castanea dentata* (Marsh.) Borkh., stump sprouts.
1981	Ph. D.	R. L. Wick (Moore)	Histopathology of Japanese holly black root disease incited by *Thielaviopsis basicola* and the role of endomycorrhizae inresistance.
1981	M. S., NT	J. D. Willmott, III (Roane)	Control of Helminthosporium stripe of barley by using organic solvents to infuse fungicides into seeds.
1981	Ph. D.	Y.-S. Yang (Skelly)	Variation in the physiological processes of eastern white pine (*Pinus strobus* L.) differing in sensitivity to ozone, sulfur dioxide, and nitrogen oxide.
1982	Ph. D.	R. L. Dow (Powell/Porter)	Relationship of environmental factors to development of *Sclerotinia minor* and Sclerotinia blight of peanut.
1982	Ph. D.	F. V. Hebard (Griffin)	Biology of virulent and hypovirulent *Endothia parasitica* on American chestnut (*Castanea dentata*).
1982	Ph. D.	M. L. Mahoney (Skelly/Chevone)	An analysis of the potential effects of air pollutants emitted during coal combustion on yellow poplar and loblolly pine.
1982	M. S.	B. W. Perry (Griffin)	An analysis of spatial changes in the occurrence of Cylindrocladium black rot of peanut utilizing false color infrared photography.
1982	M. S.	M. Rittenhouse (Griffin)	Inoculum pattern and relationship between incidence of black root rot of tobacco and inoculum density of *Thielaviopsis basicola* in field soil.
1982	Ph. D.	M. J. Weaver	The etiology of the decline of Eastern white pine

		(Stipes)	(*Pinus strobus* L.) on Virginia landscapes: A survey of stress factors.
1983	Ph. D.	D. C. Bays (Tolin/Roane)	Variability of the peanutmottle virus reaction in soybean (*Glycine max*).
1983	M. S.	F. J. Butterfield (Tolin)	Identifying of watermelon mosaic virus in pumpkin (*Cucurbita pepo* L.) in Virginia.
1983	Ph. D.	T. K. Kroll (Moore/Lacy)	An analysis of management practices for the control of cabbage clubroot II. An examination of clubroot resistant crucifers.
1983	M. S.	T. M. Kurdyla (Alexander)	Predicting the colonization of *Heterobasidion annosum* (Fr.Fr.) Bref. in thinned loblolly pine (*Pinus taeda* L.) plantations of high hazard site.
1983	Ph. D.	J. J. Muchovej (Couch)	The nature of infection of leaves of *Agrostis paulustris*.
1983	M. S., NT	G. S. Reddick (Chevone)	Ozone effects on forest vegetation.
1983	M. S., NT	M. P. Salazar (Lacy)	Bacterial canker of poinsettia.
1983	M. S.	J. A. Thompson (Elliott)	Biology and economics of control of *Meloidogyne hapla* associated with soybean.
1984	Ph. D.	O. S. Achwanya (Moore)	Effect of ozone, sulfur dioxide and alpha and delta races of *Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav. On bean (*Phaseolus vulgaris* L.).
1984	Ph. D.	E. Grant (Reilly)	Interactions of a tobacco cyst nematode and the black shank fungus with flue-cured tobacco.
1984	M. S.	A. C. Y. Hsia (Elliott)	Studies in host-parasite interactions of plant-parasitic namatodes in strawberry field of Virginia.
1984	M. S.	W. W. P. W. (Wills)	Effects of root media and Kularatine control agents on propagule formations and survival of *Phytophthora cinnamoni* Rands and root rot of azalea caused by *P. cinnamoni*
1984	M. S.	R. K. Niles (Elliott)	Extraction procedures and population dynamice of plant-parasitic nematodes associates with non-bearing apple.
1984	M. S.	P. R. Schmidt (Couch)	Influence of non-oomycete active systemic fungicides on the severity of Pythium blight of bentgrass.

From the foregoing list, there were 17 thesis and six non-thesis M. S. degrees, and 12 Ph. D. degrees conferred in the Hooper Era. The contents and contributions of the thesis and dissertations will be discussed in the various subject matter sections.There was a very tragic event among students during the Hooper Era. Bruce Perry was killed in a water skiing accident after completing the M. S. degree requirements but before the degree was conferred. The degree was conferred posthumously. Thereupon, the Perry Family and the Department established the Bruce Perry Scholarship. According to Kriton Hatzios in the book "50th and 110th Anniversary Celebration, September 24, 1999" (p. 46), "The Bruce Perry Scholarship was established with funds donated by the Arthur W. Perry family and friends in memory of Bruce William Perry (M. S. '82), an alumnus of the Department." The scholarship "Funds annual awards for tuition payments to outstanding students in the Department." The first award was made the 1984-85 academic year. Awardees will be listed for the Moore Era.

Fruit Pathology

In 1983, the Virginia fruit industry was valued at $53 million annually to the growers. The overall value to the state was 3.5 times the grower value, or $185.5 million. The figure will vary from year to year by approximately $5 million (size of crop, quality, carry-over products, etc.). Diseases are the limiting factor for fruit production. The loss would be 100% of fresh fruit without cultural and chemical control. There would be approximately 25% utility fruit, but no US fancy. Weed control in tree and small fruits is a critical production practice. Weeds compete with fruit plants for moisture and nutrients. Weeds also increase disease and insect problems. It has been estimated that good weed control has increased fruit yields by 8% (Comprehensive Rev., 1984). Fruit pathology research and extension was conducted by C. R. Drake at Blacksburg and by K. S. Yoder at Winchester. A. P. Elliott conducted nematode research on some small fruits at Blacksburg.

A great deal of annual effort went into evaluating fungicides for efficacy on apple peach and nectarine. Reports were published for the scientific community (Fungicide & Nematicide Tests vols. 36-40, 1981-1985.) and as recommendations in the annual Virginia Pest Control Guide (Va. Coop. Ext. Ser. Publ. 456-001.). In addition, a Virginia Spray Calendar was prepared annually by the Departments of Entomology, Horticulture, and Plant Pathology, Physiology and Weed Science. Thus, the scientific, commercial, and farmer groups were appraised of this effort.

It was essential to continue "Epidemiological studies to provide more reliable means of forecasting apple scab and powdery mildew infection periods. Correlation of early season sporetrap catches with temperature, humidity, leaf wetness and rainfall data has provided an understanding of the reasons for increased disease prevalence in severe infection years. Research has demonstrated potential for improved disease control and reduction of fungicide usage by more accurate early season spray timing (as indicated by epidemiological studies) and adaptation of the spray interval to the residual characteristics of the fungicide and prevailing weather conditions. Mixtures of two types of fungicides have improved control, particularly where fungicide resistance has occurred" (Comprehensive Review, 1984).

In the late 1970's, Brooks spot, caused by Mycosphaerella pomi, a minor disease of apple, became more prevalent. It was demonstrated by Yoder that fungicides already in use, Benlate + Dikar, would control the disease (Plant Dis. 66: 564-566, 1982.).

Yoder collaborated with his predecessor, K. D. Hickey to publish a review article on the control of apple powder mildew, *Podosphaera leucotricha*. They described the current mildew control measures and highlighted the potential of sterol-inhibiting compounds for mildew control (Plant Dis. 67: 245-248, 1983.).

Sterol-inhibiting compounds had been introduced in the late 1970's as potential orchard fungicides. Yoder had experimented with them and had found them useful in special situations. The research was summarized by Yoder as follows: "Several compounds in the ergosterol biosynthesis inhibitor group have shown outstanding control of major apple and peach fungal diseases when compared to standard compounds in laboratory, greenhouse, and orchard experiments. Field test involving sterol-inhibiting fungicides have demonstrated that disease control is improved if these compounds are applied under slow drying conditions. Deleterious fruit physiological effects, although minimal under1983 conditions in northern Virginia, may also be somewhat accentuated by applications under slow-drying conditions. Outstanding after-infection control of cedar apple rust by triforine and triadimefon was demonstrated with applications several days after an infection period. These are the first fully-registered fungicides which have after-infection activity on rust. However, some of the sterol inhibiting fungicides have provided questionable disease control on apples and some severe phytotoxicity on peach fruit and leaves during 1984" (Comprehensive Review 1984; Plant Dis. 65: 998-1001, 1981; 66: 564-566, 1982.).

Much of the research leading up to the use of sterol-inhibiting fungicides was conducted in a M. S. thesis project by Brian Tepper under the guidance of Yoder and R. J. Stipes acting as co-chairman of Tepper's committee. Tepper studied the chemicals under the proprietary names. Later they were given the names triforine and triadimefon (Tepper, M. S. Thesis, V.P.I. & S.U. 1981; Tepper & Yoder, Plant Dis. 66: 829-831, 1982.).

"Surveys of Winchester area apple storages led to early discovery that *Penicillium expansum*, causal organism of apple blue mold, had become resistant to the benzimidazole-type fungicides in 1977. Subsequent monitoring surveys have demonstrated the presence of resistant strains in most northern Virginia storages (totaling over 5 million bushels, or half of the state's crop). Benzimidazole-resistant peach brown rot organism, *Monilinia fructicola*, was detected in 1981. A sterol-inhibiting fungicide with a different mode of action provides excellent control of these resistant organisms," (Comprehensive Review 1984).

"A field test of commercial fruit fungicides showed that several compounds now being considered for re-registration by EPA are more effective than the best alternatives if these materials were not re-registered. This test has added to the data base needed to support re-registration of these fungicides which compose over 60% of those now used by Virginia growers to control a group of apple diseases which can cause complete losses if left uncontrolled during wet growing seasons." Both Drake and Yoder participated in the re-registration program (Comprehensive Review, 1984).

Drake was interested in high density plantings of orchard trees and trellis culture of apples. In dense culture, he was able to observe disease reactions, detect the most resistant cultivars, and conduct fungicide tests on a minimum area. He also cooperated with an orchardist, J. M. Harmon in Patrick County, on the evaluation of peach cultivars for disease reactions; 100 peach and 27 nectarine cultivars were tested. Several cultivars were found to resist one or more diseases.

Virus disease research was handled by Yoder at Winchester as a contribution to

Regional Project NE-14 in cooperation with Tolin and Elliott at Blacksburg. They sought to improve methods of virus detection in fruit trees, report the effects of viruses, and develop management programs to minimize losses from them. Target viruses were tomato ring spot virus (TmRSV) causing apple union necrosis and stem pitting of stone fruits; apple stem pitting virus (SPV); apple chlorotic leaf spot virus (CLSV); and apple stem-grooving virus (SGV). Single and multiple virus inoculations revealed the potency of dual infections.

Alma Elliott oversaw a survey of nematodes in apple orchards, vineyards, and strawberry and blueberry production sites. Virtually all species of plant parasitic nematodes were recovered. Graduate student R. K. Niles produced the only major research report from these studies. He studied the population dynamics of nematodes in two non-bearing orchard sites. Much of his thesis was devoted to seeking consistent, efficient extraction procedures (R. K. Niles, V.P.I. & S.U. M. S. Thesis, 1984.). More details appear in the section on Nematology.

Under the guidance of Elliott, graduate student A. C.-Y. Hsia, conducted a study on strawberry nematodes in Virginia during 1983. Hsia surveyed many fields on a state-wide basis; *Pratylenchus* spp. were the most widely distributed. He also detected nematodes in the genera *Meloidogyne, Tylenchorhynchus, Hoplolaimus, Helicotylenchus*, and *Xiphinema*. A special study was made on the host-nematode relations of 'Guardian' strawberry and *M. hapla*, the northern rootknot nematode. In field tests, Aldicarb plus DCPA (=Temik + Dacthal) were found to be effective in reducing nematode densities (Hsia, V.P.I. & S.U., M. S. Thesis, 1983.).

M. J. Weaver worked as a graduate student assistant in the Chemical, Drug, and Pesticide Unit at V.P.I. & S.U. from 1977 to 1980. From 1980 to 1991, he was a member of the Department with faculty status. After he completed a Ph. D. program in 1982, Hooper assigned him to responsibility for an Extension program in integrated pest management of grape and strawberry disease. Weaver refined the grape disease control recommendations and brought them in line with those of neighboring states. He contacted many grape growers and taught them to diagnose and control grape diseases. His expertise was in safe and proper use of pesticides. He was a co-author of the publication, "Disease of grapes and their control in Virginia" (Va. Coop. Ext. Serv., Publ 450-232, 1984.). He made no progress with strawberry diseases.

There was no great leap forward in fruit pathology during the Hooper Era. Instead, there was constant effort to obtain research results that would provide growers with the information to keep them competitive in profitable operations. Drake and Yoder collaborated to revise the spray bulletins and other disease control publications making sure that the latest pesticide information was distributed. Both utilized the popular printed media, Extension publications, radio and TV, demonstrations, field days and personal contacts to achieve their goals. Growers were never lacking for current information

Soybean

The research in soybean pathology was directed primarily toward locating sources of virus resistance, the genetics of this resistance, and incorporating new or useful sources of the resistance into productive cultivars. Leaders in this work were C. W.

Roane, pathologist who coordinated field work, including planting, inoculating, and scoring; Sue A. Tolin, virologist who identified and maintained viruses, increased and oversaw preparation of inoculation for field studies, and G. R. Buss, plant breeder, who acquired cultivars and lines, propagated and maintained seed stocks, and made crosses between various soybean cultivars for genetic studies. Lloyd Flinchum, Research Supervisor, was the principal technician who managed greenhouse and field plantings, and maintained equipment pertinent to planting, culture, inoculation and harvesting. Several graduate students, especially David Bays and Rosemary Ford, contributed to the project.Simultaneous with the genetic study, Tolin advised three doctoral students, Ford, Penny Hunst, and Bays in studies of the biology and variation of soybean-infecting viruses; namely, Ford on peanut stunt virus (PSV), Hunst on soybean mosaic virus (SMV), and Bays on peanut mottle virus (PMV). For dissertation titles, see the Instruction section of the Hooper Era. Their research will be discussed in the Virology section.

The problems facing the soybean virus research group were discussed in the Foy Era. To summarize, a few genes for reaction to viruses had been discovered but until the V.P.I. & S.U. group started its research, no allelism tests had been conducted. Numerous soybean cultivars had been described as having resistance to SMV or PMV, none was known for PSV. The V.P.I. group had made some progress in identifying gene loci and recognizing alleles. Most of what had been accomplished was recorded in abstracts of papers read at American Phytopathological Society meetings or in The Soybean Genetics Newsletter. During the Hooper Era the first refereed paper appeared (J. Heredity 74: 289-291, 1983) and several additional abstracts were published. It was shown that genes in 'York' conditioning reaction to SMV and PMV were closely linked (3.7 ± 0.8% recombination) Therefore, they were often inherited as a unit and despite the fact that they were known to occur separately in the parents of York, many researchers believed PM and SM resistances were conditioned by a single gene. Until further evidence was available, the gene for SMV reaction was considered to be *rsv*, which was later relabeled *Rpv*, consistent with information from other authors. Tests for allelism were already underway.

A preliminary report on allelism for *Rpv* genes was published in 1983 (Soybean Genet. Newsl. 10: 102-104.). In that paper, the cultivars York, Shore, Arksoy, and Dorman were shown to have a gene conditioning reaction to PMV at a common locus and the gene in 'CNS' was at a different locus. Since additional genetic studies were underway, the authors (Buss, Roane, Tolin) refrained from labeling the CNS gene.

In an additional preliminary report by Roane, Tolin and Buss, the inheritance of SMV resistance was studied in three resistant cultivars; 'Marshall' and 'Kwanggyo' were monogenic and 'P. I. 96983' was digenic resistant. Previously, P. I. 96983 had been reported as mongenic. The discrepancy was explained by the choice of SMV strains used by the various workers. The SMV strain employed in Virginia detected two genes, the strains used by others apparently were virulent against one of the two genes and thus gave monogenic segregation in F_2 (Soybean Genet. Newsl., 10: 136-138, 1983.).

From the information available, Roane, Tolin, and Buss proposed application of the gene-for-gene hypothesis to the soybean-SMV interactions (Soybean Genet. Newsl. 10: 139-143, 1983.). The paper was intended to stir up reaction from other soybean scientists but little was noted possibly because so few were involved in soybean-virus genetics and because genetic analysis of viruses was not yet feasible. Viruses could be classified into virulence groups (strains) and this fact along with knowledge of genetic differences in the host made application of the gene-for-gene hypothesis possible. Bays, in his study of variability in PMV, concluded that with a selection of PMV isolates, one could identify PMV resistance genes in soybean (Bays, Ph. D. Dissertation, V.P.I. & S.U., 1983.). This is one of the practical values of the gene-for-gene concept.

In other soybean research, the control of nematodes, primarily in peanut-producing counties, received considerable attention. The change in densities of nematode populations before planting and after four cultivars were grown were reported. 'Essex' supported the greatest increase, 'Bedford' the least. 'Forrest' and 'Lee 74' were intermediate. When only *Heterodera glycines*, the soybean cyst nematode, was considered, reproduction was highest on Essex and Lee 74, and lowest on Forrest and Bedford (Phytopathology 73: 832, 1983.). Under certain conditions, the spiral nematode, *Helicotylenchus dihystera* was damaging to soybean.

Results with nematicide treatment of soybean fields were reported in the publication Fungicide and Nematicide Tests 37: 199-198, 1982; 38: 10-11, 1983. Recommendations to growers based on the published reports were incorporated in the annual Virginia Cooperative Extension Service publication "Virginia Pest Control Guide," Publ. 456-001. Nematicides recommended in 1983 for soybeans and were, non-fumigants, Nemacur 15G, Mocap 10G, and Temik 15G; fumigants, Soilbrom 90 and Telone II. Phipps and Elliott were the principal researchers in cooperation with Stromberg and Babineau.

Graduate student J. A. Thompson made a study of the "Biology and economics of control of *Meloidogyne hapla* associated with soybean," in which he field tested for effective and economically optimum rates of nematicide application. Elliott was his mentor (Thompson, M. S. Thesis, V.P.I. & S.U., 1983.). He found that with Nemacur (= phenamiphos), 2.25 kg/ha gave an optimum profit.

Peanut

The most important contribution to peanut pathology by anyone associated with the Department was the publication by the American Phytopathological Society in 1983 of the "Compendium of Peanut Diseases." It was edited and compiled by D. M. Porter, Plant Pathologist, U.S.D.A., A.R.S., assigned to the Suffolk, Va. Tidewater Research Center; D. H. Smith, Plant Pathologist at the Plant Disease Research Station, Yoakum, Texas; and R. Rodriguez-Kabana, Plant Pathologist at Auburn University. Porter also prepared the following sections and contributed 44 colored photographs: Sclerotinia Blight, Diplodia Collar Rot, Botrytis Blight, Genetic Disorders, Chlorophyll Deficiency, Lightning Injury, Hail Injury, Frost Injury, and Drought Stress.

P. M. Phipps, V.P.I. & S.U. Research and Extension Plant Pathologist at the Center prepared the section on Cylindrocladium Black Rot, and contributed 5 color photographs. S. A. Tolin, Plant Virologist at V.P.I. & S.U., Blacksburg prepared the section on Peanut Stunt and contributed one color picture. K. H. Garren, U.S.D.A. Plant Pathologist, a retiree from the Tidewater Research Center contributed two color photographs. Two V.P.I. & S.U. Entomologists, S. L. Poe and J. C. Smith, also contributed sections and photographs.

In 1982, the Compendium editors had collaborated to publish an 85 page chapter,. Peanut Diseases, in the book Peanut Science and Technology, edited by H. Pattee and C. T. Young, American Peanut Research and Education Society. No doubt, this paved the way for the peanut disease Compendium.

The fungus diseases demanding attention in the 1980's were Cylindrocladium black rot (CBR), Sclerotinia blight (SB), and leaf spot. Both Phipps and Porter were bearing down on these diseases. CBR, caused by *Cylindrocladium crotalariae* (teleomorph, *Calonectria crotalariae*), had been the primary "bad boy" of the Couch and Foy Eras. In the Hooper Era, Phipps continued interest in CBR by seeking chemical means of controlling it. In 1981, he reported Terrocide, Terrogel and Vapam effectively reduced CBR incidence and microsclerotial populations and increased peanut yields and per acre crop value. The Great Lakes Chemical Corp. labeled their products as Terr-O-Cide and Terr-O-Gel. They were formulated with mixtures of either ethylene dibromide or 1, 3-dichloropropane and trichloromethane. Vapam, a product from Stauffer Chemical Co., contains sodium methyldithiocarbamate which releases methyl isothiocyanate (MIT) into the soil (Fungicide & Nematicide Tests 37: 96, 1982.). However, by 1983, none of these products were labeled for control of CBR during the Hooper Era. They could be used on peanut for other purposes.

In March 1981, J. M. Barron, III completed a dissertation on the "Effects of herbicides on *Cylindrocladium crotolariae* and Cylindrocladium black rot (CBR) disease of peanut." Barron obtained no evidence that herbicides decreased the incidence of CBR but both dinitramine and dinoseb at some rates of application increased the severity of CBR (Peanut Sci. 10: 101-106, 1983.).

Gary J. Griffin and several graduate students (J. A. Barron, III, T. B. Brenneman, P. Graham, D. T. Krigsvold, C. Rittenhouse, L. Specht, and J. D. Taylor) in cooperation with Phipps and M. G. Hale, and with the help of Technician G. S. Tomimatsu, a former graduate student, made intensive studies into the distribution and density of CBR inoculum. They found that microsclerotia did not occur randomly in the soil but were clumped. They also determined that the number of necrotic sites on a root system was far below the number of infection sites. Significant publications relating to this work are: Phytopathology 71: 1297-1302, 1982; 72: 511-517, 859-864, 1982; Canad. Jour. Plant Pathol. 5: 81-88, 1983.

In 1982, Bruce W. Perry completed a non-thesis report entitled, "An analysis of spatial changes in the occurrence of Cylindrocladium black rot of peanut utilizing false color infrared photography" in which he studied photographs available from N. L. Powell of the Suffolk research center. Perry assessed the changes in fields producing peanuts in even years 1974, 1976, and 1978, and in odd years 1975, 1977, and 1979. He observed fluctuations and new foci of CBR.

He concluded that "With all its potential problems the aerial photograph is a practical and economical way to analyze plant disease." Perry graduated, went on vacation to Connecticut and was killed in a boating accident while water skiing, June 20, 1982. In consequence of this tragedy, the Perry family and friends established the Bruce Perry Scholarship for graduate students in the Department. The scholarship was first awarded in 1984 to Sandy Overton.

Roberta Dow completed her Ph. D. Dissertation in 1982 on a study of environmental factors affecting the development of Sclerotinia blight (SB). She reported R. H. of 95-100% for at least 12 hours was necessary to activate inoculum and that all disease phases were optimal at 20-25 C. Young plants were more susceptible than old ones. These and other parameters were incorporated into a disease forecasting system. The system was not as successful for forecasting use of fungicides as had been the leaf spot advisory. Dow's study was the most comprehensive analysis of environmental factors affecting SB.

Significant publications related to research on *Sclerotinia minor* are: Phytopathology 70: 720-722, 1980; 73: 636-640, 1983; 74: 755, 757, 1984; Peanut Sci. 8: 48-52, 1981; Plant Dis. 65: 591-594, 1981; 66: 385-387, 1982.

In the Hooper Era, Sclerotinia blight (SB) succeeded CBR as the most destructive disease. Porter devoted almost full-time to SB research, and CBR was supplanted by SB in Phipps' program. The SB fungus had been found in Virginia in 1971, and by 1982 it had been declared the most destructive peanut disease. The majority of Porter's publications in the Hooper Era pertained to SB. Most addressed the pathology and ecology of the fungus whereas Phipps sought chemical approaches to control but no chemicals were labeled for it during the Hooper Era (Fungicide and Nematicide Tests 37: 96, 1982; 38: 77-79, 1983; 39: 139-140, 1984.).

Control of peanut leaf spot caused by *Cercospora arachidicola* and *Cercosporidium personatum* had been the subject of continuous research at Suffolk since 1938. During the Hooper Era, Phipps annually tested materials for efficacious control of leaf spot (Fungicide and Nematicide Tests 36: 88, 1981; 37: 97, 1982; 38: 76, 1983; 39: 140-141, 1984; 40: 152-153, 1985.). Results from these tests were incorporated with recommendations published in popular farm press articles and in annual Extension Service pest control guides. About 10 products were recommended singly or in various combinations in 1983 (Va. Pest Control Guide. Va. Coop. Ext. Ser. Publ. 456-001 rev. ann.).

One objective of the leaf spot tests was to demonstrate that the leaf spot advisory, developed by a computerized agro-environmental monitoring system (AEMS) was a reliable means of recommending spray dates for leaf spot control. From 1979 to 1983, 4.2 fewer sprays per season were applied than when a 14-day scheduled program was followed. Production and crop values were about equal under both programs, but because the advisory program reduced pesticide applications, it was much more profitable (Dept. Comprehensive Review, Nov. 5-8, 1984: 207).

A predictive nematode assay pilot program was initiated by Phipps with the North Carolina Department of Agriculture at Raleigh. The program is similar to the soil testing program for fertilizer needs. Samples are obtained in late winter, nematode species and counts are determined and growers are advised to apply nematicides only if potentially damaging populations are detected. As a result 60% of the peanut acreage was treated in 1985, down from 95% in 1979. This represents a major saving to growers (Comprehensive Rev., 1984: 208, 216.).

Tables describing appropriate pesticides for peanut disease were published annually in the Virginia Pest Control Guide, Va. Coop. Ext. Publ. 456-01. Product, rates of formulation, method and timing of application, and precautions were listed for each disease requiring pesticide usage.

This section on peanut pathology cannot be closed without paying tribute to Kenneth H. Garren who ended his career at the Tidewater Research and Education Center, Suffolk, on January 16, 1981. He served as a U.S.D.A. research plant pathologist in Suffolk from 1955 to 1981, and thereby was an adjunct professor in the Department. He had contributed significantly to the control of stem rot by the herbicide-non-dirting procedure, and to the pathology of pod rot, black rot, and Aspergillus generated mycotoxins. In 1982, he was elected Fellow in the American Peanut Research and Education Society; the nominators stated:

"The nominee is regarded as an outstanding peanut scientist. This recognition is world-wide. His global work, however, has not been confined to peanuts. He is recognized as an excellent technical writer and also as a competent writer and speaker on peanuts at the popular or semi-technical level. He has a reputation as a good interpreter and explainer of the research of others, a good reviewer of research results, and as an editor of technical writings. He has been called the world's authority on peanut diseases by such people as Dr. Coyt Wilson, Associate Director of Research Emeritus, V.P.I. & S.U. and Dr. Ron Gibbons, Leader of the Groundnut Improvement Programme of ICRISAT. Some of his ideas, concepts and methodologies in plant pathological research on peanuts are evident today and are in common practice in many institutions."

Thus, Virginia lost an eminent scientist and guardian of peanut culture. Additional comments about peanut pathology may be found in sections on Nematology and Virology.

Tobacco

An interesting summary of the importance of tobacco as an economic resource in Virginia appears in the Departmental Comprehensive Review of 1984. It is reprinted here:

> "Tobacco is the major farm income-producing crop grown in Virginia. The crop value was over $170 million in 1983. Tobacco production involves over 15000 farms and provides the equivalent of 7760 year round jobs. Tobacco is grown in 50 of Virginia's 96 counties. Besides income from farms, tobacco creates income from auction warehouses, processing plants, leaf storage facilities, and tobacco manufacturing. Virginia is the second largest tobacco manufacturing state in the United States. In addition, the need for farm and manufacturing materials, supplies, and equipment, as well as services ranging from transportation to advertising, gives significant additional employment and adds millions of dollars to personal and business income of the state.
>
> There are four types of tobacco grown in Virginia, flue-cured (39,000 acres), burley (10,000 acres), dark-fired (5,000 acres) and sun-cured (500 acres). The diseases and disease losses are different for each type and change due to the location. During the past five years the losses due to disease and disorders has ranged from 1.5% to 6% of the crop value or 2 to 8 million dollars. These losses are less than or equal to losses which occur in other tobacco states.

> The diseases and disorders in which losses greater than 0.1% of crop value have occurred in the past five years are as follows: blue mold, tobacco mosaic virus, black shank, nematodes (root knot and tobacco cyst), black root rot, aphid-borne virus complex (tobacco etch virus, etc.), weather fleck, chemical injury, angular leaf spot. Other diseases and disorders are considered minor but can cause severe losses to individual producers in unusual circumstances. At this time, viruses are the leading cause of losses in both flue-cured and burley tobacco." (Comp. Rev., 1984: 198).

John J. Reilly at the Blackstone Research Center was the principal research worker involved in tobacco pathology. He cooperated with Dean Komm, Extension Pathologist and T. R. Terrill and J. L. Jones, Research and Extension Agronomists, respectively, also located at Blackstone. He also conducted research projects in cooperation with Alma P. Elliott, G. J. Griffin, L. D. Moore, and Sue A. Tolin, all at Blacksburg.

Although it was stated in the Comprehensive Review, 1984, that viruses were most destructive pathogens of tobacco, there were no profound research devoted to them in the Hooper Era. Cultivars and breeding lines were routinely screened for reaction to tobacco etch and tobacco mosaic viruses; there was no other research addressing them. Reilly published a paper describing effects of sequential virus infections on flue-cured tobacco cultivar 'Speight G-28.' Plants were inoculated with tobacco etch virus (TEV), tobacco mosaic virus (TMV), and tobacco ring spot virus (TRSV), one, two, or three viruses in all sequential combinations. In the sequences, second inoculations were made two weeks after the first and third inoculations two weeks after the second. Uninoculated plants were superior in all respects. Generally, TMV was the least destructive alone and TEV was most destructive. In double and triple inoculations, damage was greatest when TEV was first and least when TRSV was first. Correct diagnosis by symptoms was usually correct for single inoculations, but difficult or impossible with multiple inoculations. The three viruses are vectored differently; TMV by sap; TEV by aphids; TRSV by nematodes. Thus, multiple infections are quite probable (Tob. Sci. 27: 23-27, 1983).

Reilly and Komm experimented with different concentrations of milk sprays for control of TMV, in an effort to verify to farmers that the recommended rates of application he followed. Their experiment showed that the recommended rate provided the minimum effective concentration of milk. As a result, they recommended that the concentration should be increased rather than decreased (Tob. Sci. 27: 62-62, 1983).

The most destructive fungous diseases of tobacco were blue mold, black shank, and black root rot. Reilly cooperated with pathologists from Georgia, North Carolina, and South Carolina in testing 28 released cultivars, 35 candidate cultivars and one breeding line for reaction to *P. parasitica* var. *nicotianae* (P.p.m.) at three infested sites (No Virginia site included.). Reilly conducted greenhouse tests by a method that had been developed by Troutman, Henderson, and LaPrade at Chatham, Virginia (Tob. Sci. 4: 109-111, 1962.). The workers concluded that field tests were more reliable for selecting the most resistant cultivars than were greenhouse trials. The latter were considered useful in determining reactions to specific biotypes (Tob. Sci. 28: 153-155, 1984.).

A significant cooperative effort was the Predictive Nematode Assay procedure (Elliott et al. Ext. Pub. 450-070, 1982, -017, 1983, etc.) originally developed by Osborne, later coordinated by Fox and Elliott. All field station pathologists participated. The approach was to predict the need or not to use nematicides. Properly executed, the program reduced the needless treatment of some fields with toxic chemicals. Samples were taken from farm fields designated for tobacco production the following spring. Based on populations of nematodes in the sample, rotations, nematicide applications, or no treatment were recommended. The Plant Clinic had an unpublished chart of threshold numbers to guide clinician in making recommendations.

Reilly collaborated with Komm and Elliott in reviewing the history of nematode detection and losses caused by the tobacco cyst nematode (TCN) 1961-1982 (Plant Dis. 67: 1249-1251, 1983). They reported spread and losses caused by TCN and implied that the predictive nematode assay detected many previously unknown infestations.

The interaction of *P. parasitica* var. *nicotianae* (Ppn) and the tobacco cyst nematode (TCN), *Globodera solanacearum*, was the subject of a dissertation project executed by Earl Grant with Reilly and Elliott acting as his co-advisors. Studies with black shank, caused by Ppn were conducted by Grant, wherein he inoculated moderately resistant flue-cured 'Coker 319' and susceptible 'Va 81' with zoospore populations of 10, 20, 30, 40, and 50 per gram of dry soil. For Va 81, disease development was rated 100%; for Coker 319, disease development increased linearly with inoculum load (Grant and Reilly, Phytopathology 72: 707, 1982.).

In a comparable study with TCN, inoculum densities of 1, 5, 10, 20, and 40 cysts per cm3 of soil decreased plant height and shoot dry weight of susceptible cultivars 'McNair 944' and Coker 319 but not of resistant cultivar Va 81. The higher density (40) was most detrimental (Grant, Reilly, and Elliott, J. Nematol. 14: 443, abstr.).

Grant found interactions between the two pathogens to be, "Antagonistic, additive, or synergistic and dependent on cultivar resistance, inoculum densities, sequence of pathogen infection, and soil moisture and temperature. On cultivars resistant to the fungus (resistance was never 100%), the interaction was "Antagonistic in a high moisture-low temperature regime and synergistic in a high temperature-low moisture regime" (Grant, Ph. D. Dissertation, 1984.).

In a split root system, TCN on half, Ppn on the other half, the nematode had to be present on the same root for synergism to be expressed. In sequential inoculations, simultaneous inoculations resulted in maximum disease. Certain combinations of metalaxyl and fenamiphos gave season-long control of Ppn and early season control of TCN (Grant, Ph. D. Dissertation, 1984.).

Reilly cooperated with Komm and Elliott to seek optimum control procedures for Ppn and TCN. Results were published in both technical (Fungicide & Nematicide Tests 37: 201, 1981; 38: 15, 17, 18, 1982.) and Extension publications (Va. Coop. Ext. Ser. 436-047, 1981, revised annually; Va. Pest Control Guide 1981, Ext. Publ. 456-001. rev. ann.). The presence of both TCN and Ppn in the same field seriously complicated tobacco production.

Reilly participated with L. D. Moore and T. R. Terrill in three studies on air pollution effects (weather fleck) of tobacco (Tob. Sci. 21: 29-30:, 1977: Proc. Am. Chem. Soc.

Symposium 269-289, 1977; Weed Sci. 30: 260-1=263, 1982). In the first, it was shown that cultivars varied in degree of weather fleck at different locations in different years. Some were little affected and some were constantly susceptible. Thus, genotype appears to affect response making resistance a breedable trait (Tob. Sci. 12). In the second study, varying N-K-P ratios revealed that high phosphorus and high nitrogen favored low reactions to air pollutants (Chem. Soc. Symp). In the third study the effects of three herbicides, isopropalin, pebulate, and diphenamid, on weather fleck were examined (Weed Sci. 30). Isopropalin and diphenamid "reduced oxidant injury 2 to 4 weeks after transplanting but not later in the season. Pebulate had no consistent affect."

The status of tobacco disease control is thoroughly described in the 1983 issue of Extension Publication 456-001, pp. 219-231; D. A. Komm prepared these pages. All methods of disease control are considered for each economically important disease in Virginia. There are extensive tables listing specific diseases, chemicals and their commercial names, rates of application, and methods of application. The final tables list disease reactions of available flue-cured, fire-cured, and burley tobacco cultivars.

Cereal Crops

With the appointment of Erik L. Stromberg on November 1, 1981, cereal pathology research began to take a different turn. Up to then, Curtis W. Roane had emphasized breeding disease resistant crops in cooperation with the corn and small grains breeders. The testing of fungicides had not been dealt with. Stromberg immediately met this challenge. In addition, David E. Babineau had been hired at Warsaw to expand the integrated pest management program in soybean and small grains. Thus, a more balanced program was assured.

Small grains. - Barley and wheat were the major small grain crops in Virginia in 1980. Some oats were produced, but small acreages did not merit research attention. Rye was used in no-till corn production but was not grown very often for grain; most rye seeds were imported from the Midwest. Rye fields were seeded in the fall and sprayed in early spring with herbicides and liquid fertilizer, and planted to corn in a one-pass operation. In other cases, rye was used as a green manure prior to planting. Thus, few rye grain crops were harvested even though rye was a widely grown species. Little attention was paid to rye unless there were failures to establish a stand for winter cover. Rye is susceptible to halo blight, caused by the bacterium *Pseudomonas coronafaciens*, that in Virginia sometimes kills stands in which case it usually diagnosed as winter-killing. Although a vast acreage of rye is planted, most research effort is on wheat and barley.

Wheat. - Breeding wheat for resistance to powdery mildew, leaf rust, soil-borne viruses, especially wheat spindle streak mosaic virus (WSSMV), and stem rust was the principle effort in the Hooper Era. Three high yielding, high quality cultivars were released in 1980 and 1981 and they entered the commercial market between 1982 and 1984. Through the selection and testing processes in the '70's they remained resistant to leaf rust and powdery mildew. Just before release, some resistances were overcome but because they sustained high yields they were released anyway. The philosophy was, "We are growing cereals for grain, not just green leaves." Thus, 'Tyler' released in 1980 was susceptible to leaf and stem rust but remained resistant to WSSMV and powdery mildew. Its resistances and yielding ability enabled it to become a leading soft red winter wheat grown from Virginia to Missouri. 'Wheeler' was also released in 1980 but its resistance was only to stem rust. It had field tolerance to powdery mildew. However, because of its high quality and grain yield it was released but it did not compete well against Tyler. It was susceptible to three diseases, powdery mildew, leaf rust, and WSSMV (Starling, Roane, Camper. 1984. Crop Sci. 24: 826-827.).

In 1981, 'Massey' wheat was released. It was resistant to powdery mildew, stem rust, WSSMV and Hessian fly but susceptible to leaf rust but again produced high grain yields of high quality (Ibid. 24: 1000.).

'Saluda' wheat was released in 1982; it offered resistance to powdery mildew and leaf rust but was susceptible to WSSMV (Ibid. 26: 200, 1986.).

Breeding wheat for resistance for powdery mildew and leaf rust proved to be very frustrating. Fungi causing both diseases could sustain themselves on the overintering wheat in mild winters. Wheat was widely grown in the South through to Florida and Alabama. The leaf rust and powdery mildew fungi developed during the winter in Florida, Alabama, and Georgia and spores were blown northward as the wheat grew. Virginia wheat was colonized in the fall by local genotypes of these fungi. If resistance only to local populations were needed, Virginia-bred cultivars may have maintained their resistances but against newly evolved and established fungus genotypes that blew in from the South, resistance soon failed. Thus, the objective of breeding disease resistant cultivars seemed useless as resistance to two primary diseases was ephemeral. Even so some top quality, high-yielding cultivars were produced.

On the other hand, glume blotch (*Stagonospora nodorum*) defoliated wheat and caused a head blight that was difficult to deal with. Rows of beautiful plants often produced only chaffy grain but because *S. nodorum* was forever present; by selecting for a grain yield and quality, resistance to it may have been serendipitously achieved.

Since powdery mildew was so difficult to control through resistance, attempts were made to find economical chemical controls. David Babineau initiated some studies on a rented farm near the Warsaw station. He was soon joined by Erik Stromberg. This was a great relief to Roane who at the time was being pressured by growers to develop spray programs for control of small grain diseases. Roane was not trained in the techniques of chemical disease control and did not wish to relinquish time from the genetics and breeding programs to become involved near the end of his career. Thus, the arrival of Babineau and Stromberg was very timely. The production of wheat and barley was about to undergo some technological changes; chemical disease control would be an integral part of this change. Two research factors would contribute. The availability of systemic fungicides (fungicides which are absorbed and translocated making the host resistant) and the intensive management approach to wheat production were topics of investigation during The Hooper Era.

In the intensive management approach, seeding rates, drill width spacing, fertilization, irrigation and pesticides were maximized. The use of protectant and systemic fungicides was practiced. Thus, experiments with protectant and systemic fungicides were initiated. Benomyl and Bayleton were tested as systemics for control of powdery mildew; Bayleton proved to be superior. An interesting sidelight, when powdery mildew was controlled on mildew susceptible 'Blueboy' in 1981, a big increase in yield was recorded, but when applied to 'Tyler' a mildew resistant cultivar, yield was similar for sprayed and unsprayed plots (Babineau, Pl. Protection Newsl., Dept. of Pl. Path., Physiol, & Weed Sci. 2(5), 1982). Stromberg and Babineau collaborated in 1982 to test additional chemicals in large blocks on the farm of Clarence Fitchett in Accomack Co. on Eastern Shore. 'McNair 1002' was the farmer's choice of wheat. Bayleton was again the best chemical. It could be recommended thereafter for powdery mildew control on wheat being grown for seed but not for feed or milling (Stromberg and Babineau, Pl. Prot. Newsl. 2 (3), 1982). It was labeled for powdery mildew of cereals about 1984.

In 1983, Stromberg and Babineau reported wheat powdery mildew to be heavy in early spring and recommended the use of fungicides. They also reported leaf rust to have overwintered on high levels and expected heavy losses because the widely grown cultivars, Massey, Wheeler, and McNair 1003, were very susceptible (Pl. Prot. Newsl. 2 (3), 2 (7). 1983.). No recommendations for powdery mildew and leaf rust control were given in the 1983 Virginia Pest Control Guide, (Va. Coop. Ext. Ser. Publ. 456-001, Rev. Jan 1983).

Gnanambikai Jeyandran, a native of Sri Lanka, completed an M. S. program in 1984, major in Agronomy, and defended her thesis entitled "Inheritance of reaction to *Erysiphe gramimis* DC. F. sp. *tritici* in wheat." She investigated cultivars that were digenic and had genes at the *Pm*, and Pm_3 loci.

It is surprising how many Agronomy majors chose inheritance of resistance to pathogens for their thesis or dissertation topics. A chronological listing of those related to small grains follows:

Chen, Kuo-Chun. 1958. Inheritance of and gene loci for resistance to race 9 of *Erysiphe graminis* hordei El. Marchal in barley. M. S. Thesis.

Chi, Kuo-Ruey. 1962. Inheritance of resistance to *Rhynchosporium secalis* (Oud.) J. J. Davis in barley. M. S. Thesis.

Pineda, Carlos R. 1962. Inheritance of resistance to *Erysiphe graminis* f. sp. *hordci* Em. Marchal race 9 in certain varieties of barley and relationship of the genes for resistance to those previously reported in other varieties. M. S. Thesis.

McDaniel, Milton E. 1965. The use of reciprocal translocation stocks in locating genes conditioning resistance to race 4 of *Puccinia hordei* Otth and certain other characters in barley. Ph. D. Dissertation.

T. M. Starling was the advisor for each of these students. Only the data from K.-R. Chi's thesis were ever published (Starling ,Roane, and Chi. 1971. Inheritance of reaction to *Rhynchosporium secalis* in winter barley cultivars. Pp. 513-519. In Barley Genetics II. Proc. of 2nd Internat Barley Genet. Symp. Wash. State Univ. Press. 622pp.)

A summary of recommended seed treatment products for wheat and other small grain cereals was published annually in the Virginia Pest Control Guide (Va. Coop. Ext. Ser. Publ. 456-001.).

Barley. In barley, emphasis was on breeding cultivars with resistance to leaf rust, powdery mildew, scald, and barley yellow dwarf virus (BYDV). Through the years, durable resistance had been achieved by utilizing powdery mildew and leaf rust resistance found in 'Wong' and 'Cebada Capa,' respectively. Resistance to scald was somewhat ephemeral, there being periodic changes in the virulence of *Rhynchosporium secalis*. Slow progress was being made to incorporate BYDV resistance. In 1982, 'Sussex' barley was released. It incorporated resistance to powdery mildew and scald, and moderate resistance to BYDV and net blotch. Sussex was the first Virginia cultivar with a degree of resistance to BYDV. Four cultivars were tapped for resistance to BYDV, namely, C. I. nos. 9623, 9658, and 9708, and BYVD-resistant 'Atlas.' Sussex was selected from a mixture of germplasm in which a plant carried resistance from one of these four cultivars. It is not known which source was in Sussex but it is suspected that all have the same allele.

Barley stripe, caused by *Helminthosporium gramineum* (now *Drechslera graminea*) had become a problem in Virginia's certified seed production program in the '70's (Foy Era). Formerly, the disease was controlled by treating seed with mercury compounds but because mercury-treated grain had gotten into some food chains, licenses to manufacture mercury seed treatment compounds were cancelled by the U. S. Food and Drug Administration. Later, all labels permitting their use were cancelled. Thereafter, a rise in stripe incidence was observed and researchers sought suitable stripe-controlling materials (Kline and Roane, Pl. Dis. Reptr. 56: 183-185, 1972. Willmott, M. S. Thesis, V. P. I. & S. U., 1981.). The product carboxin (5, 6-dihydro-2-methyl-N-phenyl-1, 4-oxathiin-3- carboxamide), sold as Vitavax, was found to depress the prevalence of stripe, although its target diseases were smuts. In combination with thiram or mancozeb, Vitavax virtually eliminated stripe. The combination of Vitavox and thiram was commercially available and was used to bring stripe under control in the production of certified barley seed (Roane & Starling & Willmott, 1981 Barley Newsl 25: 42-44.)

Graduate student James D. Willmott, III studied the possible enhancement of seed treatment fungicides by using various solvents to infuse the chemicals into the seed. Surprisingly, none of the chemicals was enhanced but stripe was eliminated from all seed lots where ethanol was the solvent (Willmott, M. S. Thesis V.P.I. & S.U., 1981.). The experiment was repeated and ethanol did not work. The year-to-year discrepancy could not be explained (Roane, Starling, & Willmott, 1982.). All the stripe control studies were supported by grant funds from the Virginia Agricultural Foundation.

Note: Vitavax was never labeled for barley stripe control; therefore, to use it legally one had to target loose and covered smuts, thereby controlling stripe.

For over two decades, Roane and T. M. Starling, the small grains breeder at V.P.I. & S.U., had studied the inheritance of reaction to *Puccinia hordei*, the barley leaf rust fungus. In 1982, James R. Larkins completed the requirements for the Ph. D. in plant breeding. His dissertation was entitled, "Location of genes conditioning resistance of barley to leaf rust (*Puccinia hordei* Otth)." Larkins found loose linkage between Pa and gs^5 (glossy sheath 5, a marker for chromosome 2L). By primary trisomic analysis, *Pa7* was assigned to chromosome 3 but there was evidence of linkage between *Pa7* and chromosome 3 markers gs^5 and *als* (absent lower laterals), *uz* (semi-brachytic), and *yst2* (yellow streak2). He also concluded that *Pa3* is located on chromosome 1. Roane had worked on linkage of several *Pa* genes for about 2 decades but could find no linkages with markers for all 14 chromosome arms. It has amazed workers that a species with only 7 chromosomes has been such a difficult subject for linkage studies with *Pa* genes (1989 Barley Newsl. 33: 190-192, 1990).

Each year, Starling, Roane, et al., prepared a publication, "Performance of Small Grain Varieties Evaluated in Virginia in 19XX." Notes on diseases were included whenever there was sufficient disease to make readings. Usually there were notes from Blacksburg, Warsaw, Holland and Painter and sometimes from Blackstone and Orange. These notes and greenhouse data provided the confidence to make recommendations of disease-resistant cultivars and also provided evidence when new pathogen races invaded the region.

<u>Corn</u>. - From 1947 to 1979, Roane had cooperated with the corn breeder, Agronomist Clarence F. Genter, in the development of disease-resistant corn inbred lines and hybrids. Early, the program was directed toward stalk rot and leaf blight resistance. A number of inbred lines were released and several became widely used in the corn seed industry. When the disease maize dwarf mosaic (MDM) was recognized in 1965 as a serious problem to corn production, it became the principal target of the breeding program. As the breeding of MDM-resistant varieties progressed, interest in the genetic analysis of resistance developed. Analysis of several lines was attempted but best results were obtained only from a study of inbred line Oh7B.

During the study, results were facilitated by artificial inoculation in Montgomery Co. where natural infection was very rare. Only symptoms of MDM were expressed; no maize chlorotic dwarf (MCD) occurred. In johnsgrass-infested areas, MDMV and MCDV co-existed and symptoms of MCD interfered with expression of MDM. Thus, MDM genetic work in the field had to be conducted in a johnsgrass-free area.

In studying the effects of MDMV corn, it was soon realized that the scale developed for scoring virus diseases in corn under conditions of natural infection was unsuitable. A new scale was developed and published (Roane, Tolin, and Genter. Phytopathology 73: 845-850, 1983.). In genetic studies subsequent to the development of this scale, monogenic dominance was found in inbred lines B68, Oh1EP, Oh7B, and Va85 with all four having a gene at a common locus. Inbred line T8 was also studied in the same manner but no explanation was found for its behavior. As a line, T8 was variable in its behavior but by selfing and selection stable lines of T8 could not be isolated (Proc. Am. Phytopath. Soc. 4: 140, 1977; Phytopathology 73: 845-859, 1983; 73: 968, 1983.).

Although Genter bred the material for the Oh7B study, he resigned in 1979 to take a position with McNair Seed Company at Laurinburg, N. C. Harold S. Aycock was named Assistant Professor of Agronomy and Corn Breeder in 1979; he showed a keen interest in studying the inheritance resistance to MDMV in the next four years. With him, Roane and Tolin initiated a linkage study of the gene in Oh7B.

Aycock and Roane continued evaluating inbred lines and hybrid varieties for reaction to viruses under conditions of natural infection on the farm of Cliff Wood at Wingina, Nelson Co. Cooperation with Wood had started about 1965. Results obtained at Wingina were included in the publication "Virginia Corn Performance Trials in 19XX," V. P. I. & S. U. Dept. of Agron. Res. Rept. XXX."

During the Couch Era, 1965-1974, gray leaf spot, (GLS) caused by *Cercospora zeae-maydis* had graduated from a minor disease in mountain counties to a major diseases throughout the state. This change was brought about by the spread of no-till corn farming. Erik Stromberg, from the time of his appointment in 1981, took interest in reducing the impact of GLS on corn production. During the Hooper Era, Stromberg undertook this work as an Extension Project but supplemented it with funds granted from the Virginia Corn Commission. In the 1984 Comprehensive Review he reported that he had, "been able to identify adapted hybrids able to produced higher yields under GLS pressure." The test plots were on farms west of Wytheville and near Mt. Jackson in Shenandoah Co. Scores for GLS and yields under GLS pressure were published in the Plant Protection Newsletter a Departmental publication that was sent to all county Extension offices.

Corn seed treatment and nematicide recommendations for corn were listed annually in the Virginia Pest Control Guide (Va. Coop. Ext. Ser. Publ. 456-001.).

Forest Pathology

"The total land area in the state comprised of commercial forests is 15,972,800 acres (63%). Manufacture of forest products is Virginia's largest manufacturing industry. Total number of employees is in excess of 65,000 with a payroll of $700 million annually. The value added by manufacturers exceeds two billion dollars. In 1978, landowners received $90 million for stumpage. With a serious shortage in pine timber production expected by 2000, any reduction in the impact of diseases on forest production will be important. Millions of dollars are lost each year due to diseases. Problems of major concern in Virginia include annosus root rot, white pine root disease, little-leaf disease, rust and canker diseases, oak decline, and declines due to the interactions of root diseases, air pollutants, insects, and site conditions. The most important forest tree disease in Virginia is annosus root rot which causes growth loss and mortality, and predisposes trees to bark beetle attack. Losses due to annosus root rot are estimated in excess of $1,500,000 annually. Therefore, with an increase in intensively managed forest lands, reducing the impact of forest tree diseases on forest production and utilization represents an important goal." This quote is taken from the section on forestry in the 1984 Comprehensive Review, p. 291.

Annosus root rot, caused by *Heterobasidion annosum*, was considered the most destructive forest tree disease of the Hooper Era. It was particularly destructive to loblolly pine, *Pinus taeda*, in the Coastal Plain and Southern Piedmont. Although loblolly pine was native to southeastern Virginia, it was used extensively in reforestation and, consequently, was grown in large plantations that were owned or manged by the forest products industry. Samuel Alexander developed a project to study the incidence and impact of *H. annosum* on loblolly pine strands and to develop a system of management to reduce the impact of the fungus.

Assessing damage from forest tree root rotting diseases is a laborious task. Tree roots must be excavated and roots assayed for infections, a realistic estimate of percentage of infection is determined, and an association of infection extent with radial growth is established. An association between annosus root rot (annosus is from the earlier fungus name *Fomes annosus*) and subsequent southern pine beetle infestations had already been established. As annosus root rot of a tree intensified, susceptibility to beetles increase; thus, beetle infestations became somewhat of an indicator of the extent of annosus root rot. In addition, it had been found that sites of sandy soils with low water tables were high hazard sites. Alexander used statistical procedures to develop models for predicting losses from annosus root rot.

The arduous task of determining disease incidence and severity of annosus root rot is a destructive procedure. T. M. Kurdyla, in an M. S. thesis project, sought a less arduous, less destructive means of measuring incidence and severity in thinned loblolly plantations. The parameters were established from 190 excavated trees. Stem diameter, radial growth, live crown growth, and soil-root samples were used, after multiple regresion analysis, to construct equations (= models) utilizing two, three, or four of the parameters. Kurdyla claimed his models predicted root colonization within 10% of actual colonization as determined by root excavation {Kurdyla, T.M. 1983. Predicting the colonization of *Heterobasidion annosum* (Fr.) Bref. in thinned loblolly pine (*Pinus taeda* L.) plantations on high hazard sites. M.S. Thesis.V.P.I. & S.U.}

In the Virginia Pest Control Guide for 1983 (Va. Coop. Ext. Service Publ. 456-001) there was no reference to annosus root rot, but there was a U.S.D.A. Forestry Bulletin SA-FB/P, 1984 prepared by Alexander and R. L. Anderson, Supervisory Plant Pathologist at the U.S.D.A. Forest Service Office, Asheville, N.C., entitled, "How To Identify Annosus Root Rot and What To Do ABout It," in which a key is diagrammed for the various management options. The diagram was an update from one originally published in 1981. Alexander contributed greatly to it's refinement. It is presented on an accompanying page. Some of the information on loblolly pine had been the result of R. S. Webb's dissertation project executed under the supervision of Alexander and Skelly {R.S. Webb, The incidence and severity of *Heterobasidion annosum* (Fr.) Bref. in loblolly pine (*Pinus taeda* L.) unthinned plantations and seed orchards. Ph. D. Diss., V.P.I. & S.U. 1980. See, also, Phytopathology 71:479-481, 661-662. 1981.}.

The production and marketing of Christmas trees is a major industry in Virginia. Three species of forest trees constitute the bulk of production: white pine, Scotch pine, and Fraser fir. Therefore, Christmas tree diseases seem to fall in the province of forest pathology. In any case, S. A. Alexander, forest pathologist, assumed responsibility for studying them.

Dying of eastern white pine in Christmas tree plantations had been reported by Alexander at several locations in Virginia (Va. Coop. Ext. Serv. Publ. PMG 503, 1980.). It was assumed that *Verticicladiella procera* was the cause of the dying, but pathogenicity tests had not been conducted with *V. procera* isolated from dead or dying Christmas trees. Ann Lackner, in an M. S. thesis project was the first to apply Koch's postulates to this Christmas tree disease (A. L. Lackner, M. S. Thesis, V.P.I. & S.U., 1981; Lackner and Alexander, Plant Dis. 66:211-212, 1982.). Lackner and Alexander later reported an association of bark beetles and weevils with diseased trees. Katherine J. Lewis, in her M. S. thesis project, concluded that weevils rather than bark beetles were the primary vectors of *V. procera* and that the fungus probably invades roots from their feeding tunnels (K. J. Lewis, M. S. thesis, V.P.I. & S.U., 1985.). Lewis further established the *V. procera* propagules in artificially infested soil were unable to infect roots, thus affirming the insert vector hypothesis (Lewis and Alexander, Phytopathology 75:1337, 1985.). W. Elliott Horner further affirmed this hypothesis by showing the root collar zone is the point of initial colonization and insects facilitate it (W. E. Horner, Ph. D. Diss., V.P.I. & S.U., 1985.).

The thesis and dissertation experiments of Lewis and Horner, respectively, were executed in the Hooper Era, though not filed until 1985. Alexander chaired the student's committees. Sometime after Lewis and Horner graduated, Alexander prepared a handout, unnumbered, undated, incorporating inferences from the student's findings. The use of the insecticide Lindane was recommended for keeping insects from bringing in *V. procera*, or for preventing it's spread once it occurred in a plantation.

Only one thesis on Christmas tree pathology was completed during the Hooper Era: Lackner, A. L., 1981. Incidence and pathogenicity of *Verticicladiella procera* Kendrick on pines in Virginia. M. S. Thesis. V.P.I. & S.U.

One dictionary defines a forest as a growth of trees and undershrubs convering a large area. Appalachian forests must have been a magnificent sight when the American chestnut was a towering component of the canopy. Although the tree remains as a persistent member of the flora, it's presence is so insignificant that it is often overlooked. However, several people working in Virginia in cooperation with scientists in other states have begun to record increments of progress toward restoring chestnut to it's former status. During the Hooper Era, chestnut research in Virginia was led by Gary Griffin and his students Fred Hebard and Rusty Wendt; and Adjunct Professor Martha Roane, all of Blacksburg; T. A. Dierauf of the Virginia Division of Forestry of Charlottesville; and John Elkins, a Professor of Chemistry at Concord College, Athens, West Virginia who was, also, an Adjunct Professor in Plant Pathology. Lucille Griffin, wife of Gary Griffin, contributed greatly to the American chestnut research by translating European publications.

An assembly of Experiment Station and U.S.D.A. Forest Service scientists and perhaps other interested persons participated in an American chestnut Symposium at West Virginia University in 1978 (Proc. of the Amer. Chestnut Symp., Jan. 4-5, 1975, W. L. MacDonald, F. C. Cech, J. Luchok and H. C. Smith, eds. W. Va. Univ., Books, Morgantown.). A regional project was formed (Reg. Proj. NE - 140) involving scientists interested in "Biological improvement of chestnut (*Castenea* sp.)." In Virginia, G. J. Griffin, J. R. Elkins, M. K. Roane, and R. J. Stipes were the leaders. The document for the following statement is taken from the 1984 Comprehensive Review of the Department: "The objectives of the contributing Virginia project were: (a) to evaluate the effect of hypovirulence on the host-parasite relations of the chestnut blight fungus, *Endothia parasitica*, (b) to evaluate other hosts and the role of vectors in the production and dissemination of hypovirulent inoculum, (c) to select and breed for resistance to *E. parasitica*, (d) to evaluate selections or progeny for tolerance to hypovirulent strains and (e) to investigate the taxonomic relationship, geographic extent and host range of *E. parasitica* and *E. radicalis*." Results will be presented later.

A group of scientists assembled at Morgantown again in 1982 to discuss progress in chestnut research (Proc. of the U.S.D.A. Forest Serv. Amer. Chestnut Cooperator's Meeting, Morgantown, W. Va., Jan. 5 - 7, 1982, H. C. Smith and W. L. MacDonald, eds., W. Va. Univ. Books, Morgantown, W.Va.). It was obvious from the various presentations that there was contageous enthusiasm and optimism among the participants. Even more, there was determination that some day chestnut would once again be a major component of the forest. Virginia scientists presented four papers. F. V. Hebard, G. J. Griffin, and J. R. Elkins presented a summary of their research on biology of hypovirulent and virulent isolates of *Endothia parasitica* on blight susceptible and resistant chestnut trees (Ibid. pp. 49 - 63). In essence, this was a condensed version of Hebard's Ph. D. dissertation. They reported finding a low level of resistance in a large surviving tree in Floyd Co. They also demonstrated that surviving trees were colonized by hypovirulent strains of *E. parasitica*. Thus, both low resistance and hypovirulent infections seemed necessary for large-tree survival (Phytopathology 71:224. 1981; 73:822, 1084-92. 1983; 74:140-149, 804. 1984.).

Rusty Wendt submitted an M. S. thesis in which he described the presence and frequency of hypovirulent strains of *E. parasitica* in chestnut stump sprouts occurring in Pennsylvania, Virginia, and West Virginia. (R. W. Wendt M. S. thesis, V.P.I. & S.U., 1981.). He isolated 198 cultures of *E. parasitica* and tested them for pathogenicity. Thereupon, he divided the isolates as 96% virulent, 2.5% hypovirulent, and 1.5% intermediate. Strangely, hypovirulent and intermediate forms were isolated only from Virginia; additionally, they occurred more frequently in clear-cut than in mature forest sites.

Wendt, J. Weidhaas, Griffin, and Elkins found that mites associated with blight cankers were carriers of *E. parasitica*; 34.6% of the mites were contaminated, but it was not shown in what form, conidia or mycelium. Furthermore, it was not established that mites were effective vectors (Plant Dis. 67: 757-758, 1983.).

Richard Jaynes of the Connecticut Agricultural Experiment Station and T. A. Dierauf of the Virginia Division of Forestry described at the 1982 Morgantown meeting the status of chestnut breeding at Lesesne State Forest in Nelson Co., Virginia (Proc. U.S.D.A. Forest Service Amer. Chestnut Coop. Meeting, Morgantown, W. Va., Jan. 5 - 7, 1982, H. C. Smith & W. L. MacDonald, eds. pp. 68-73.). Of 12,000 hybrid chestnut seedlings planted 1969 - 1975, only 23 trees had survived selection for form and blight resistance in 1981. None of these trees meet the standards required for reforestation, but by using them as a germplasm pool for further breeding, the ultimate goal may be achieved some day.

Theses and dissertations on chestnut submitted during the Hooper Era:

> Hebard, F. V. 1982. Biology of virulent and hypovirulent *Endothia parasitica* on American chestnut (*Castanea dentata*). Ph. D. Diss. V.P.I. & S.U.
>
> Wendt, R. W. 1981. Presence of hypovirulent *Endothia parasitica* (Murr.)
>
> P. J. & H. W. And. in the general population of American chestnut, *Castanea dentata* (Marsh.) Borkh, stump sprouts. M. S. thesis. V.P.I. & S. U.

Additional research on forest trees is reported in the section on air pollution.

Vegetable Pathology

The annual average farm gate value of vegetables in Virginia was estimated at $47,000,000. This value was calculated at $1,000.00 per acre of vegetables produced. there were approximately 33,500A of vegetables grown on the Eastern Shore (Accomac and Northampton counties). Of this acreage there were 14,000A of Irish potatoes. The remainder is devoted to beans, cucumbers, peppers, squash, strawberries, and crops enumerated below.

Production of vegetables in other regions of Virginia include cabbage 1500A, cantaloupe 400A, broccoli 300A, tomatoes 300A. This acreage is concentrated in Hanover, Halifax, Mecklenberg, Carroll, and Patrick Counties. The once thriving truck cropping industry in the Norfolk area had been lost to housing and industrial development. The Virginia Truck Experiment Station staff found it necessary to devote the most time to ornamental and landscape plants. The station had been renamed the Virginia Truck and Ornamentals Research Station about 1970. Vegetable research and extension was gradually concentrated at the Painter sub-station where in 1981, the plant pathologist, R. E. Baldwin, was named Scientist-in-Charge.

During the Hooper Era, research efforts at Blacksburg were conducted by R. C. Lambe and G. H. Lacy. They concentrated on clubroot and powdery mildew of cucurbits, and late blight of tomato. All other research on vegetable diseases was conducted by Baldwin at Painter. Extension programs at V.P.I. & S.U. were developed by Lambe to transmit research results to vegetable growers in the state.

The research by Baldwin was the easiest to track because he frequently summarized his results and published recommendations in the Vegetable Growers News (VGN), a monthly publication issued by the Virginia Truck and Ornamentals Research Station. Both the Virginia Beach and Painter staffs participated. During the Hooper Era, Baldwin published 25 articles on vegetable pathology in VGN. In each article he described annual experiments listing crops and diseases considered, products and procedures tested, results obtained, and advice to growers. Virtually all important vegetable crops grown in Eastern Virginia were considered. Growers in the region depended heavily on articles in VGN for the latest information. The needs of growers came first; there was virtually no basic research.

At the Painter and Virginia Beach stations, the staff remained in close contact with growers by issuing disease forecasts and presticide application alerts on radio, TV, and in newspapers. Although records for these types of operations are difficult to document, they were vital functions that tightly bound growers to the station staff. The nature of the situation made it impossible to define clearly Research and Extension.

Plasmodiophora brassicae was the subject of M. S. and Ph. D. projects at Blacksburg in the Hooper Era. Clubroot of cabbage had been a problem for growers in Patrick, Carroll, Wythe, and Smyth Counties for many years. Our first plant pathologist, H. E. Reed, had studied it and published on it in 1911 (Va. Agric., Exp. Sta. Bul. 191, 1911.). No further studies were made until 1974 when Lambe and McCart found that pentachloronitrobenzene (Terraclor) used in conjunction with hydrated lime suppressed clubroot in infested fields. Hutter, a graduate student, speculated in 1978 that water sources were contaminated with *P. brassicae* and that use of this water overwhelmed efforts to control the disease and spread it to new fields (Hutter, M.D. M. S. Proj. and Rept. V.P.I. & S.U. 1978.). L. E. Datnoff, another student, confirmed the contaminated water hypothesis when he produced clubroot on cabbage by growing them in pond sediment from infested areas (Datnoff, M. S. Thesis, V.P.I. & S.U. 1981.). He could free infested water by the addition of NaOCi, not a useful field procedure. T. K. Kroll undertook a further study and found that Terraclor or Benlate controlled clubroot when *P. brassicae* resting spore population was 10   spores/g of soil, but not 10^7/g. (Kroll, Ph. D. Diss., V.P.I. & S.U., 1983.). The combination of liming to pH 7.0 and applying Terraclor was the recommentation in 1984 for clubroot control.

Kroll studied the nature of resistance *P. brassicae* in radishes and found resistance was not expressed until after the pathogen penetrated root hairs. Cabbage cultivars resistant in Oregon were susceptible in Virginia, but a broccoli cultivar was resistant in both states. Kroll's studies were carried out with Lacy and Moore as his advisors. Lambe, as a member of the committees of all three students, provided continuity for orientating all of them to the clubroot problem.

Reports on testing pesticides for use on vegetable crops may be found throughout the Hooper Era in Fungicide and Nematicide Tests, volumes 36:56-57, 1981; 37:64; 67, 82-83, 166, 1982; 38:94-95, 107, 109, 1983; 39:60-61, 73-74, 79-81, 84, 1984; 40: 83-85, 1985. (Note: vol. 40 contains reports on 1984 experiments.).

Pathology of Ornamental Plants

It is convenient to divide ornamental plants into nursery crops, landscape plants, and turfgrass. Landscape plants may include trees, shrubs, and herbal plants. For convenience of specialized study, turfgrasses and trees are separated from all other ornamentals. During the Hooper Era, H. B. Couch specialized in turfgrass pathology, R. J. Stipes in landscape tree pathology, and W. H. Wills and R. C. Lambs addressed other woody ornamental and herbaceous plant diseases. G. H. Lacy advised students in the study of some herbaceous plant diseases. L. D. Moore and A.B.A.M. Baudoin were involved in some special studies. According to the 1984 Comprehensive Review, "The nursery crop industry in Virginia has an estimated annual value of $52,500,000. Certain diseases are known to limit the quality and quantity of production of azaleas, rhododendron, Japanese holly and junipers. Increasing land costs and increased demand for nursery crops have stimulated an expansion of production in containers in Virginia. This growth has been accompanied by severe outbreaks of foliar and root rot diseases." Also, "landscape trees around home, along highways, in cemeteries, parks, and historic shrines, on campuses and grounds of industrial complexes are worth millions of dollars in aesthetic value, as screens for noise abatement, privacy, shade providers, as historic and sentimental landmarks, as wood providers, and for other amenity values. The importance of diseases of landscape trees in Virginia has increased with the extended trends toward urbanization, population growth, and the interest in private and federal landscaping. problems associated with increased water, air and noise pollution increase the need to preserve and develop open spaces for use by the general public. Virginia will need a more thorough knowledge of trees, their diseases and management, as well as effective disease control methods."

Turfgrass pathology will be treated in the section following.

Wills and Lambe cooperated in projects on various diseases of woody ornamentals. in response to grower needs, they investigated the etiology and control of black root rot of Japanese holly and root and stem diseases of dogwood, azalea, and rhododendron. Graduate student, S. Kularatne (from Sri Lanka), with Wills as his advisor, studied the efficacy of Aliette®, Subdue®, Truban®, and the fungus, *Mortiella alpina* (as a biologic control agent), for control of the azalea root rot fungus

Phytophthora cinnamomi. He, also, tested several mulching media interacting with the fungus and fungicides. The most significant conclusion was that Subdue and Aliette controlled root rot and Subdue, but not Aliette, suppressed *P. cinnamomi* propagule production.

Robert Wick for his dissertation project studied the histopathology of Japanese holly black root rot caused by *Thielaviopsis basicola*. He presented many photomicrographs and interpretations of them. In response to a question he raised about resistance, he concluded mycorrhizae affected resistance either slightly, or not at all. Moore was his advisor.

Lambe and Wills described a "Stem canker of unknown origin of flowering dogwood in Virginia." (J. Sou. Nurserymen's Assn. 7:1-7; and under different titles in Ornamental South 3:16-18; Plant Propagators Soc. Comb. Proc 1980, 30:526-529; 1981.). They reported that dieback of rhododendron was caused by *Botryosphaeria dothidea*. In preliminary experiments, benomyl was found to control it (1984 Comprehensive Rev. :254.).

Wills and Lambe collaborated to produce numerous articles on diseases of nursery stock in the popular press.

Under the project title of "Biology and control of diseases of ornamental plants and landscape trees", Lambe and Stipes combined to make studies whose objectives were narrower than signified by the project title; namely, to test fungicides in the greenhouse and field against soil-borne and foliar pathogens. No publications were issued and results seemed only preliminary. Lambe also conducted a project "Evaluation of new fungicides and new methods of application to nursery crops. The procedures were similar to those in the preceding project, but only new fungicides would be tested in an effort to determine their efficacy and phototoxicity.

Baudoin and Lambe cooperated to study the epidemiology of Entomosporium leaf spot of photinia. Optimum conditions for infection were 20° C and 9 or more hours of wetness. Only young, expanding leaves were susceptible. No control measures were reported (Phytopathology 74:822, 1984). In another publication, Daconil 2787 foliar applied and Benlate foliar and soil applied were shown to reduce disease (Fungicide and Nematicide Tests 39:195, 1984). Jessie Micales, a graduate student in the Department, executed the trials under Lambe's direction.

In 1982, R. K. Jones, Extension Plant Pathologist at North Carolina State University, and Lambe collaborated to edit N. C. State Pub. A6-286, "Diseases of Woody Ornamentals and Their Control in Commercial Nurseries" (1982). Lambe was author or co-author of seven sections.

Cynthia Berg prepared a report (Bacterial soft rot of iris, M. S. Proj. & Rept., Non-thesis, V.P.I. & S.U. 1981.) with G. H. Lacy as her advisor. She gave a detailed description of most iris pests and diseases. For her project, she compared *Erwinia carotovora* with *E. chrysanthemi*, both causes of iris soft rot. Differences between species were very slight.

Martha Pizano Salazar, also working with Lacy, produced a report (Bacterial canker of poinsettia M.S. Proj. & Rept., Non-thesis, V.P.I. & S.U., 1983.) in which she demonstrated cuttings from California were contaminated with *Corynebacterium* *flaccumfaciens* pv. *poinsettia* and C. f. pv. *flaccumfaciens*, but were symptomless. Bacteria spread from these cuttings to other poinsettia plants and caused cankers.

Stipes was a co-producer of the most significant publication on ornamental diseases in the Hooper Era. With Richard Campana, of the University of Maine, a "Compendium of Elm Diseases" was published in 1981 by the American Phytopathological Society (APS). In addition to being co-editor, Stipes was either author or co-author of 10 disease sections. The entire section on insects and mites was prepared by John Weidhaas, Jr., an Extension Entomologist at V.P.I. & S.U. The Elm Compendium pioneered the publication by APS of compendia on landscape/horticultural (= non-field crop) topics. Previously, compendium subjects were agronomic crops.

A second significant effort, by weight and volume, was graduate student M. J. Weaver's dissertation entitled, "The etiology of the decline of Eastern white pine (*Pinus strobus* L.) on Virginia landscapes: A survey of stress factors," Ph. D. dissertation, V.P.I. & S.U. 1981, 270 pp. Weaver analyzed and correlated various factors, mostly edaphic, leading to decline. Soil compaction was the most frequent contributing factor. During his survey, Weaver discovered the pinewood nematode (*Bursaphelenchus xylophilus*) associated with declining white pine in Rockbridge County, February 1980. The nematode had been reported previously from the Midwest where Scots pine was most severely affected. Weaver later found it in Henrico and Botetourt Cos. (Phytopathology 71;722, 1981.).

During the Hooper Era, Stipes, his colleagues, and student advisees conducted experiments on fungicidal movement in elm and elm soils, and physiochemical taxonomy of *Endothia* spp. Results appeared mostly as abstracts of papers presented at APS and Virginia Academy of Science meetings (Phytopathology 71:766, 1981; 73:964; 1983; Va. J. Sci. 32;105, 1981; 33;125, 128, 1982; 34;140, 1983.). There were, also, papers on philosophy of plant pathology and history of elm diseases (Va. J. Sci. 32;104, 105, 1981; 34:143, 1983.).

In his Extension program, Stipes emphasized education of field (County Agents) personnel in landscape tree disease identification and control. Several popular press articles were published. Sections were prepared for the two manuals "Chemical control of Insects, Plant Diseases, and Weeds in Virginia," Va. Coop. Ext. Ser. Pub. 456-001, 1982 (Revised annually) and "Pest Management Guide for Home Grounds and Gardens," Va. Coop. Ext. Pub. 456-002, 1984. Many personal contacts were made through workshops, in-service training sessions, Master Gardener's programs, agricultural and horticultural conferences, and field forays.

Turfgrass Pathology

The following paragraphs occur in the 1984 Comprehensive Review of the Department. "According to a survey conducted by the Virginia Department of Agriculture in 1982, the State had 826,120 acres of land in maintained turfgrass. The annual expenditure for maintenance of these areas was estimated at $101,500,000. In addition to the many functional roles these grass stands serve (e.g., the absorption of heat, noise and air pollutants, the control of dust and mud, increases the economic value of property, and use in recreation facilities), the cultivation of turfgrass in Virginia is the basis for a significant portion of it's annual business revenue. As such, then, turfgrass culture is an important source of employment for Virginia's work force, and also contributes materially to the State's sales and income tax revenue.

Diseases and weeds rank among the more important of the factors that significantly reduce the quality and performance levels of cultivated turftrass. The estimated expenditure in Virginia in 1982 for weed and disease control in turfgrass was approximately $1,000,000. A strong, well balanced program in turfgrass disease and weed control, then, is important to the stable and continued growth of this agricultural industry in Virginia."

Turfgrass pathology was the province of H. B. Counch in the Hooper Era. If one were to assess his accomplishments in the Era from his publication, record, one would conclude he was on vacation from research. Most of his publications were popular and trade magazine articles and two chapters in the book, "Advances in Turfgrass Pathology," 1981. Actually, Couch was very busy preparing a new book, "Diseases of Turfgrasses" 3rd ed. Although it was not published until 1995, the third edition was not like the first and second editions. It was entirely new; therefore, it was his principal effort for over a decade. For this reason, his reasearch publications were few.

Despite the foregoing statements, Couch remained loyal to Golf Course Superintendants Association of America, the U.S. Golf Association midwest Turfgrass Association, and related organizations for whom he frequently conducted workshops, gave seminars, and otherwise provided them with up-to-date information on turf fungicides. He was, also, an entertaining speaker, therefore, popular speaker.

In the 1984 Comprehensive Review, Couch described in great detail (3 pages) how he would study the infection process and colonization of *Pon pratense*, *P. annua*, and *Agrostis palustris* or Kentucky bluegrass, annual bluegrass, and creeping bentgrass, respectively, by *Curvularia lunata*, *C. geniculata*, *Colletotrichum graminicola*, and *Alternaria tenuis*. By Comprehensive Review time, he was able to report progress with the *A. palustris/C. lunata* study only. Heat stress and treatment with the herbicide trichloroacetic acid (TCA) enabled more frequent infection by *C. lunata*. Apparently, this work was done by J. J. Muchovej in his dissertation. research. (Muchovej, J. J. The nature of infection of leaves of Agrostis palustris. Ph. D. Diss. V.P.I. & S.U. Couch published nothing about this research in technical journals. It appears that the research was an extension of that reported on the Rhizoctonia/tall fescue and Pythium/bentgrass systems (Phytopathology 71:868, 765, respectively, 1981.).

Peter Schmidt conducted experiments in his M.S. thesis program on the "Influence of non-Oomycete active systemic fungicides on the severity of Pythium blight of bentgrass" (V.P.I. & S.U. thesis, 1984.). The fungicides were benomyl, thiophanate methyl, thiophanate ethyl, and triademefon.

The host/pathogen system was *Agrostis palustris/Pythium aphanidermatum*. Benomyl treatments tended to increase disease severity. Thiophanate ethyl and triadimafon applications tended to decrease disease severity.

Although Couch made continuous and frequent reports on specific turfgrass fungi and fungicide tests, perhaps his most significant publications to appear during the Hooper

Era were in the proceedings of a turfgrass disease symposium held in Columbus, Ohio in 1979. The proceedings titled, Advances in Turfgrass Pathology (Harcourt-Brace, Javonovich, Inc., Duluth, Minn. 1981. 197 pp.) were published two years later. Under the title, "Turfgrass pathology--past, present, and future," Couch gave an interesting review of the history of turfgrass pathology, beginning with the establishment of bowling greens in the 13th century. An interesting aspect was the history of fungicides, including Bordeaux mixture, organic mercurials, dithiocarbamates, and systemics. Under a second title, "Relationship of management practices to the incidence and severity of turfgrass diseases." Couch discussed his own research and that of many others relating to environmental and management aspects of turfgrass pathology.

Although Couch was not assigned time in Extension, he participated in turfgrass Extension programs and field days and prepared a number of Extension leaflets. He prepared sections which were updated annually in the "Pest Management Guide for Lawngrass", Va. Comp. Ext. Ser. Pub. 456-004 (Rev 1982, 1983, 1984); "Pest Management Guide for Turfgrass, Ibid 456-009 (Rev. 1982, 1983, 1984.). Thus, suggestions and recommendations for maintaining healthy turfgrass were available to the public through local Extension offices.

Couch taught PlPP 6020, Principles of Plant Disease Development, a course he had installed soon after becoming Department Head in 1965. This was to be a finishing course for Ph. D. candidates. He contributed to the team-taught course, with Stipes and Wills, PlPP 4980, Diseases of Landscape Trees, Ornamentals, and Turfgrass. Outside of the University, he taught a two-day short course on identification and control of turfgrass diseases. The course is part of the educational program of the Golf Course Superintendants Association of America and is one of the requirements for certification by the Association.

It appears that Couch was adequately on top of turfgrass pathology and that the industry and public were well-served by his teachings and service.

Air Pollution

Studies on the effects of air-borne products toxic to plants in Virginia initiated during the Couch Era have been continued to-date. Forest pathologist, J. M. Skelly, was the first to become involved. He was soon joined by L. D. Moore whose specialty was physiology of plant disease. Several graduate students have contributed research. During the Hooper Era, Boris Chevone was hired in 1980 specifically to conduct research in air pollution effects on plants. Skelly resigned in April 1982 and W. E. Winner replaced him later that year.

Hooper had established the Air Pollution Laboratory as a special unit in the Department. It was staffed by Skelly (Professor), Moore (Professor), Chevone (Assistant Professor), Stanley Long (Laboratory Specialist A), a secretary, and several graduate students. Presumably, Skelly was the director, but no document naming him as such was located. When Winner was hired after Skelly's departure, his title was Assistant Professor and Director of the Air Pollution Laboratory (APL).

During the Hooper Era, research at the APL was conducted under four projects; these are enumerated below along with the major accomplishments.

State project--Effect of air pollutants on growth and yield of forest trees, ornamentals, and field crops--Skelly and Moore, leaders (terminated Sept. 30, 1982 upon Skelly's resignation).

Under the guidance of Skelly and Moore, graduate students Steve Duchelle monitored ozone concentrations of five locations along the Blue Ridge parkway and in other Appalachian Mountain areas. Major episodes were observed every year (1976-1982). Of 315 tagged whilte pines, 19 (6%) died by 1979. Approximately 4% were rated very sensitive, 75% intermediate, and 21% were tolerant. *Asclepias syriaca*, common milkweed, was found to be an excellent bioindicator of excessive ozone in the air (Duchelle, S. F. 1981. M.S. Thesis, V.P.I. & S.U.; Plant Disease 65:661-663, 1981; Comprehensive Rev., 1984, p. 367.).

Tobacco was also a subject of investigation in this project. That work was discussed in the Tobacco section of the Hooper Era.

Project in review--The combined effects of gaseous air pollutants and acidic rain on plant growth--Chevone, leader.

Work on this project apparently began in 1983. It was being conducted in the environmental control chambers that had been erected in a greenhouse at the APL. Ozone, sulfur dioxide, and acid rain were the variables investigated. Only preliminary results were reported in the 1984 Comprehensive Review. Both ozone and acid rain reduced growth of seedling loblolly and shortleaf pine. There was no interactive response detected. Tulip poplar interactive (additive) damage was noted in ozone-sulfur dioxide treatments (Comprehensive Rev., 1984, pp. 370-371.).

Research in two regional air pollution projects, IR-7 and NE-121, was continued from the Couch Era through the Hooper Era and into the Moore Era. In IR-7, research was directed toward the "Chemistry of atmospheric deposition; effects on agriculture, forestry, surface water, and materials." Attention was given the chemical climate of North America, the effects of atmospheric deposition on crops, forests, range and wetlands, domestic food animals, fish and wildlife, chemistry of surface and ground wates, metals, masonry stone, and other building materials. Obviously, the objectives are too broad for one program. At V.P.I. & S.U., the chemistry of precipitation was monitored and simulated rainfall conditions were used to supplement and diagnose field data and observations. Over a period of years, average composition of precipitation was determined and simulated in the APL.

Ozone in combination with rain at pH 3.0 reduced root growth of loblolly (*Pinus taeda* and shortleaf (*P. echinata*) pines. Acidity as low as pH 3.4 was detected in Virginia. At pH 4.0, commonly occurring soil bacteria, *Erwinia herbicola* and *Pseudomonas syringae*, were either unable to grow or were greatly inhibited. These studies were carried out at the Horton Center near Mountain Lake on Salt Pond Mountain in Giles Co. under the direction of W. E. Winner and B. I. Chevone (Comprehensive Rev., 1984, pp. 363-365; Air Pollut. Contr. Assoc. J. 34:355-359, 1984.).

In project NE-121, "Reducing the influence of air pollution on plant productivity in the Northeast," Moore, Chevone, and Winner were the leaders. Two objectives paralleled those of IR-7, but a third was to seek methods and materials for ameliorating the effects of air pollution. The physical nature of pollutants and their biological effects were enumerated, much as in other projects. It was pointed out that ozone increased susceptibility of *Rhododendron* spp. and tobacco to *Phytophthora* spp., and that O_3 and SO_2 stimulated development of anthracnose of bean (Comprehensive Rev., 1984 pp. 358-364; Canad. J. Forest Res. 12;202-209, 803-808, 1982; 13;184-187, 1983; 14:150-153, 1984; Phytopathology 73:1234-1237, 1983: J. Environ. Hort. 2;12-16, 1984.). From the results reported, there was no progress in ameliorating the effects of air pollutants. Titles of theses and dissertations concerning air pollution studies may be found in the instruction section. Authors were Duchelle, M.S., 1981; L. F. Benoit, M.S., 1981; Y.- S. Yang, Ph. D., 1981; M. J. Mahoney, Ph.D., 1982; G. S. Reddick, M.S.-N.T., 1983; O. S. Achwanya, Ph.D., 1984.

By the end of the Hooper Era, the characteristics and hazards of air pollutants were thoroughly understood, but no progress had been made to control them. In fact, as long as the burning of fossil fuels continued to accelerate, was there really any hope? Probably not with present technology.

Nematology

Soon after G. R. Hooper became head of the Department of Plant Pathology and Physiology (PlPP), he hired Alma P. Elliott to fill the vacancy in nematology created when J. A. Fox resigned. Elliott appeared to be well-trained to work in Virginia where nematode problems abounded. She had recently completed a dissertation entitled, "Ecology of *Pratylenchus penetrans* associated with navy bean (*Phaseolus vulgaris* L.) " at Michigan State University. After graduation in May, she remained at MSU and served as diagnostician in nematology. She also upgraded several Michigan Extension Service publications on nematology and prepared journal papers on her dissertation research. Hooper appointed her Assistant Professor in PlPP on October 15, 1980.

Elliott conducted research in four areas; namely tobacco, soybean/peanut, fruit, and nematode parasitism. Tobacco research was conducted under projects titled, "Variability of root-knot and cyst nematodes and their population dynamics," and "Parasitism of *Heterodera glycines* and *Globodera solanacearum* by fungi." The first project was conducted in cooperation with Dean Komm, J. J. Reilly and C. E. Grant, all located at the Blackstone station. Field studies were conducted with various nematicides and it was determined that a combination of Nemacur 3 and Furadan 4F very effectively controlled the tobacco cyst nematode, *G. solanacearum*. Two cultivars, Va 81 and PD4 maintained resistance to the nematode in two years of continuous tobacco. Corn and fescue in the rotation effectively reduced populations of *G. solanacearum*. The chemical control studies were summarized in Fungicide & Nemat. Tests 37:201, 1981; 38:15, 17, 18, 1983.

The second project was conducted primarily by Grant in a post-doctoral appointment. He isolated fungi from nematode cysts and, also, exposed fungus-free cysts to fungi isolated from cysts. Most frequently isolated from *H. glycines* were species of *Fusarium* (25%), *Phialophora* (12%), *Verticillium* (10%), *Paecilomyces* (9%) and *Penicillium* (5%). *Diheterosporium* and *Trichoderma* were isolated from cysts of both tobacco and soybean cyst nematodes. Grant found that hyphae of *Phialophora*, *Gliocladium*, *Aspergillus*, *Paecilomyces*, *Verticullium*, and *Diheterosporium*, which were isolated from cysts, could penetrate cysts in cultures (Comprehensive Rev., 1984, pp. 356-357.).

Elliott conducted research on soybean nematodes under the project entitled, "Development and improvement of nematode control practices." Co-leading the project were D.E. Babineau at Warsaw and P.M. Phipps at Suffolk. Thrusts were to determine economic thresholds of damage to soybean by nematodes, determine economic thresholds for profitable control practices, and apply the results to recommendations in the predictive nematode assay program. Financial support was received from the Virginia Soybean Commission.

Helicotylenchus dihystera commonly occurred in Essex soybean fields, but the threshold for damage was a high number, 1500-2000 per 500 cm3 of soil. In an M.S. project, J. A. Thompson studied the northern root-knot nematode (*Meloidogyne hapla*)/ soybean relationship. Thompson reported two generations of second stage larvae were produced in 60 days; of three cultivars, Essex, Forrest, and Lee 74, Essex was the most susceptible; the economic threshold was 50 larvae per 250 cm3 of soil at midseason; and phenamiphos (Nemacur 15G) gave optimum economic control at 2.25 kg/ha for an optimum profit of $275/ha (Thompson J. A. 1983. Biology and economics of control of *Meloidogyne hapla* associated with soybean. M.S. thesis, V.P.I. & S.U. 1983.).

Similar studies on *Heterodera glycines* were conducted by Elliott and the co-leaders. Phenamiphos controlled *H. glycines* at all levels of application and rotation of soybean with corn or peanuts reduced the nematode population (Comprehensive Rev., 1984; Fungicide--Nemat. Tests 37:199, 1982; 38:7,8, 1983.).

Elliott, Phipps, and Komm collaborated on an Extension plan of work titled, "Control of plant parasitic nematodes in crop production." Although it was meant to address nematode problems of both agronomic and horticultural crops, most effort was directed toward peanuts and tobacco. Using information gathered from research projects, nematode control recommendations were up-dated and a computerized procedure was developed to refine recommendations for the predictive nematode assay program (Elliott, A.P., et al. Va. Coop. Ext. Ser. Bul. 450-31, 1981; 450-032, 1982; 450-070, 1982; 450-001, 1983.).

Elliott conducted research on nematodes attacking various fruit plants under the title, "Control of plant parasitic nematodes in small fruit production." In this work she cooperated with K. Yoder of the Winchester station. Three graduate students, R. K. Niles, S. Garber, and A. Hsia, also contributed to the research. Under the guidance of Elliott and Yoder, Miles produced a voluminous M.S. thesis on, "Extraction procedures and population dynamics of plant-parasitic nematodes associated with non-bearing apple." (M.S. Thesis, V.P.I. & S.U., 1984.). The study was conducted over a two-year period, 1981-1982. Niles evaluated six extraction procedures and observed different efficiencies for different nematodes. Five genera, or species, of nematodes predominated: *Hoplolaimus galeatus*, *Macropostonia curvatus*, *Pratylenchus* spp., *Paratylenchus* spp. and *Xiphinema americanum*. The last named, *X. americanum*, is potentially the most destructive because it vectors damaging apple viruses. Populations of all species remained relatively stable throughout the sampling period.

Hsia produced a project and report entitled, "Studies on host-parasite interactions of plant-parasitic nematodes in strawberry fields of Virginia." He found *Pratylenchus* spp. to be most widely distributed, but found that *Meloidogyne*, *Helicotylenchus*, *Tylenchorhynchus*, *Hoplolaimus*, and *Xiphinema* spp. were also present. He worked out some equations to express the relationships for *M. hapla* and strawberry and *P. penetrans* and strawberry. A combination of aldicarb (=Temik 15G) and DCPA

(Dacthal 75W) proved most efficient for reducing densities of nematodes in strawberry fields (Hsia, M.S. Proj. & Rept., V.P.I. & S.U. 1984.).

L. I. Miller had retired, (actually, he retired from the payroll and went on Social Security, but he came to work nearly 7 days a week), on January 1, 1980, but throughout the Hooper Era, he continued studying the morphology and interfertility of root-knot and cyst nematodes. However, from 1980 to 1988, he took a hiatus from publication. In 1988, he resumed publishing. His work will be reviewed in the Moore Era.

Virology

Diseases induced by virus and the efforts to control them by breeding virus-resistant cultivars are discussed in sections on fruit, soybean, tobacco, and cereals. Special emphasis was given to the genetics of reactions to corn and soybean viruses. S. A. Tolin conducted her research on viruses under the project entitled "Identification and characterization of viruses infecting certain crops." In addition to state funds, the work was supported by grants from the Virginia Agricultural Foundation, the U.S.D.A. Cooperative State Research Service, and the Virginia Soybean and Corn Commissions. Three dissertations and one thesis were completed under Tolin's direction during the Hooper Era; these contributed much of the basic information reported on the project.

Rosemary H. Ford was the first to complete a dissertation in virology during the Hooper Era (Comparative studies on two strains of peanut stunt virus. Characterization *in vivo* interaction of the gene for pathogenicity on *Glycine max* 'York'. Ph.D. Diss., V.P.I. & S.U., 1981.). Ford studied two strains of PSV; they were very similar, but could be distinguished by reactions on 'Kanrich' and 'York' soybean and *Chenopodium quinona*. Strain V-1 produced local lesions on York, but strain V-2 became systemic. PSV is a tripartite virus, components being designated RNA1, RNA2, and RNA3. Ford demonstrated RNA3 carries the coat protein gene; RNA3 with either RNA1 or -2 was required to induce symptoms in soybean.

Penny L. Hunst also completed a dissertation in virology in 1981 (Soybean mossic virus: Strains, ultrastructure, and movement. Ph.D. Diss. V.P.I. & S.U. 1981.). Hunst studied two isolates of SMV that had been collected in Virginia; she eventually classified them as strains G1 and G3. Strain G1 caused symptoms in soybean cultivars generally susceptible to SMV; G3 produced mild mosaic in generally susceptible cultivars and severe necrotic symptoms in cultivars resistant to G1. In ultrastructure, pinwheel inclusions were more prevalent with G1 than with G3 and more organized.

In 1983, David C. Bays completed a dissertation entitled, "Variability of the peanut mottle virus reaction in soybean (*Glycine max*)" (Ph.D. Diss. V.P.I. & S.U. 1983).

Evidence for variability of PMV in soybean had been reported previously, but no comprehensive analysis had been made of ths phenomenon. It was important to know if this variability would complicate the program of breeding soybean resistant to PMV. Bays recognized five strain groups based on symptoms expressed on selected soybean cultivars; no serological differences were detected. Pathogenicity varied among strains. None of the strains infected 'Buffalo,' 'CNS,' 'Davis,' 'Haberlandt,' 'Kwanggyo,' 'Peking', and 'Ware.' Four strains infected 'Cumberland,' three strains infected 'Virginia,' and one strain infected 'Arksoy', 'Dorman,' 'Shore,' and 'York.' From genetic studies, CNS and the Arksoy group are known to have different genes conitioning resistance to PMV. In all probability, the 5 strains could be useful in recognizing specific resistance genes.

Fiona J. Butterfield, a graduate student from England, completed an M.S. thesis in 1983 entitled, "Identification of watermelon mosaic virus in pumpkin (*Cucurbita pepo* L.) in Virginia" (M.S. Thesis, V.P.I. & S.U., 1983.). Host range tests indicated WMV was the agent causing symptoms of pumpkins in Carroll Co. Micrographic and antisera studies supported the conclusion that WMV-2 was present.

Pertinent publications relative to virology are found in: Phytopathology 71:227, 859, 883; 72:708, 710-713; 73:615-619, 964, 968; 74:808 (1981-1984). The project is described in the 1984 Comprehensive Review document.

New Plant Diseases, Pathogens, and Hosts Reported 1980-1984

1980

Apple blister spot, caused by *Pseudomonas syringae* pv. *papulans*, was discovered and successfully controlled by adaption of control recommendations from northern states to conditions in Virginia. This involved the use of streptomycin.

During 1996 and 1997, C. W. and M. K. Roane published lists of fungi associated with grasses in Virginia (Va. J. Sci. 47:197-224, 1996; 48:11-46, 1997). Many of the associations were new to Virginia, the eastern United States, and the entire United States in the publication "Fungi on Plants and Plant Products in the United States" (Farr, D. F. et al., Amer. Phytopathol. Soc. Press, St. Paul, Minn. 1989) can be used as an establishing reference. Listed below by years are the host-fungus associations observed during the Hooper Era for the first time in Virginia. Citations are for the *Virginia Journal of Science* volumes 45, 47, and 48.

1980

Sorghastrum nutans - *Stagonospora simplicior* (48:38).

1981

Arrhenatherum elatius - *Ascochyta brachypodii* (47:208).
Bromus ciliata - *Puccinia recondita* (47:210).
Bromus ciliata - *Periconia atra* (47:210).
Festuca elatior - *Stagonospora nodorum* (48:19).
Hystrix patula - *Fusarium sambucinum* (47:22).
Setaria viridis - *Ascochyta sorghi* (48:38).
Setoria viridis - *Stagonospora nodorum* (48:38).
Tridens flavus - *Puccinia windsoriae* (48:41).

1982

Cynodon dactylon - Polymyxa graminis (47:213).
Agropyron repens - Phyllachora graminis (47:200).
Agropyron repens - Urocystis agropyri (47:200).
Arundinaria gigantea - Ascochyta sorghi (47:209).
Bromus inermis - Rhynchosporium secalis (47:210).
Dactylis glomerata - Rhynchosporium orthosporum (47:215).
Danthonia spicata - Curvularia geniculata (47:217).
Danthonia spicata - Microdochium bolleyi (47:218).
Danthonia spicata - Amerosporium atrum (47:218).
Danthonia spicata - Pseudoseptoria donacis (47:218).
Eragrostis curvula - Ascochyta hordei (48;15).
Eragrostis curvula - Colletotrichum graminicola (48:16).
Festuca elatior - Polymyxa graminis (48:16).
Paspalum floridanum - Curvularia geniculata (48:29).
Phleum pratense - Claviceps purpurea (48:32).
Sorghum halepense - Colletotrichum graminicola (48:39).
Sorghum halepense - Phoma sorghina (48:39).
Spartina alterniflora - Phyllachora spartina (48:40).
Spartina alterniflora - Puccinia sparganioides (48:40).
Spartina pectinata - Puccinia sparganioides (48:40).

1983

Avena sativa - Polymyxa graminis (45:281).
Hordeum vulgare - Polymyxa graminis (45:281).
Secale cereale - Polymyxa graminis (45:281).
Zea mays - Polymyxa graminis (45:281).
Agrostis perennans - Epichloe typhina (47:201).
Agrostis perennans - Puccinia coronata (47:201).
Digitaria sanguinalis - Tetraploa aristata (47:222).
Lolium perenne - Ascochyta desmazieresii (48:24).
Muhlenbergia schreberi - Phomatospora dinemasporium (48:25).
Muhlenbergia schreberi - Phyllachora vulgata (48:25).
Muhlenbergia schreberi - Bipolaris cynodontis (48:25).
Muhlenbergia schreberi - Tetraploa ellisii (48:26).
Panicum dichotomiflorum - Polymyxa graminis (48:27).
Phalaris arundinacea - Polymyxa graminis (48:30).
Phleum pratense - Colletotrichum graminicola (48:32).
Poa annua - Polymyxa graminis (48:33).
Agrostis perennans - Mycosphaerella tulasnei (47:201).
Elymus riparius - Phyllachora graminis (48;12).
Elymus riparius - Colletotrichum graminicola (48:12).
Elymus riparius - Phaeoseptoria urvilleana (48:12).
Phalaris arundinacea - Phyllosticta minutaspora (48:31).
Sorghum halepense - Gloeocercospora sorghi (48:39).

It should be noted that no attempt was made to isolate fungi from the host-fungus associations. The aim was to report the occurrence of the associations from *in situ* observations.

Some new or unusual diseases or pathogens were described in the Plant Protection

Newsletter (PPN).

Wax myrtle, *Myrica cerifera*, displayed a die-back caused by *Botryosphaeria dothidea*, a new disease for Virginia (PPN4 (2):2, 1985) reported by Mary A. Hensen.

Alfalfa, *Medicago sativa*, was killed in areas of a field in Bedford Co. by *Rhizoctonia crocorum*, 1984-85. The fungus causes violet root rot and had been found once before in Pulaski Co. (PPN 4(2):3, 1985).

Aside from the grass fungi reported by C. W. and M. K. Roane, not much emphasis was placed on reporting new plant diseases in Virginia. This may be due in part to the discontinuance of The Plant Disease Reporter by the U.S.D.A. and it's replacement by Plant Disease by the American Phytopathological Society beginning in January 1980. A fee was attached to short notices published in Plant Disease, whereas such notices were published free by The Plant Disease Reporter. In effect, this greatly reduced, virtually eliminated, the plotting of epidemics and local disease outbreaks in the United States. Cancellation of The Plant Disease Reporter was a great loss to field pathologists.

Service to Professional Societies and Commodity Groups

The most important professional society for plant pathologists is the American Phytopathological Society (APS) and it's Divisions. Memberships were also held in the Society of Nematology, Virginia Agricultural Chemicals Association, American Association of Golf Course Superintendents, National Peach Council, American Peanut Research and Education Association, Virginia State Horticultural Society, Tobacco Workers Conference, Mycological Society of America, Virginia Academy of Science, and others. The following list shows activities closely related to plant pathology.

S. A Alexander.

APS - Forest Pathology Committee, 1979-83, V-C 80-81, Chm. 81-82.
APS - Potomac Div. (APS-PD) - Auditing Comm. 1980-82, V-C 80-81, Chm. 81-82; Program Comm. 81-82.
Southwide Forest Disease Workshop - Steering Comm. 1979-1982, Chairman, 1981-92.

D. E. Babineau

Southern Soybean Disease Workers - Program Comm., 1982; Virginia Agricultural Chemicals Association, Publicity Comm. 1982.

R. E. Baldwin

A.P.S. - P. D. - Resolutions Comm. 1979-80.
A.B.A.M. Baudoin Teaching Comm., 1983

B. I. Chevone

APS - Air Pollution Effects Comm., 1982-86, Chm. 1984-85.

H. B. Couch

APS - Chairman of Comm. for Development of Bylaws and Charter for APS Registry of Professional Plant Pathologists.
American Association of Golf Course Superintendents - Education Comm. 1981-84.

C. R. Drake

APS - Placement Comm. 1982-84; Plant Disease Losses Comm. 1982-84.
National Peach Council - Chairman of Research and Education Comm. 1982-84.

Alma P. Elliott

Society of Nematology - Placement Comm. 1982-84. Vice-Chairperson 1984;
Comm. on Curriculum Development, 1984.

K. H. Garren

American Peanut Research and Education Society - Bailey Award Comm. 1980-82, Golden Peanut Advisory Comm. 1980-82, Local Arrangements Comm., Chm. 1980. Elected Fellow 1982.

G. J. Griffin

APS - Associate Editor, Phytopathology, 1978-80.

G. R. Hooper

APS - Teaching Comm. 1980-85, V. Chm. 1981-82, Chm. 1982-83; Advisory Comm. for Phytopathology News, 1983; Cassette Tape Information Comm., Chm. 1984-85.
APS - PD - Program Comm. 1982; Representative to National Council of Plant Pathology Department Heads, 1981-83, Chm. 1982-83.

D. A. Komm

APS - Comm. for New Fungicide and Nematicide Data, 1984-86.

L. W. Kress

APS - Publications Coordinating Comm., 1983-84; Illustration of Plant Pathogens and Diseases Comm. 1980-84, Chm. 1982-83; Pollution Effects on Plants Comm. 1980-84

G. H. Lacy

APS - Bacteriology Comm. 1978-84, V. Chm. 1981-82, Chm. 1982-83; Comm. for Organizing Diamond Jubilee Meeting, 1982-83; APS - PD - Graduate Student Paper Awards Comm. 1983-84.

R. C. Lambe

APS - Ornamentals and Turfgrass Comm. 1979-81, Chm. 1980-81; Comm.

on Registration, 1981-82; Associate Editor, Fungicide and Nematicide Test Results 1979-81.

L. D. Moore

APS - Program Comm. 1982-83; Disease and Pathogen Physiology, 1981-84; Pollution Damage to Plants Comm. 1980-84; Membership Comm. 1983-86; Meeting Site Selection Comm. 1983-86; Nominating Comm. 1983-86. Councilor, PD, 1983-85. APS - PD - Secretary-Treasurer, 1978-81; Vice-President, 1981-82; President, 1982-83; American Institute of Biological Science, Councilor, 1983-86.

P. M. Phipps

APS - Editorial Board, Fungicide and Nematicide Tests, Seed Treatment Section, 1983-84; New Fungicide and Nematicide Data Comm., Chm. 1984; Publications Coordinating Comm. 1983-84; APS - PD - Nominating Comm. 1984.
Virginia Agricultural Chemicals Association - Advisor to Board of Directors 1980-81, -83-84.

D. M. Porter

American Peanut Research and Education Society - Bailey Awards Comm; Chm. 1980; Technical Program Comm. 1980-82, Chm. 1980; Public Relations Comm. 1980-82, Chm. 1982;
Associate Editor, *Peanut Science*, 1982-84.

J. J. Reilly

Tobacco Workers Conference - Editorial Board, *Tobacco Science*, 1983-85; Soilborne Disease Comm. Chm. 1983-84; Program Comm. 1983.

C. W. Roane

APS - Genetics Comm. 1982-84; Compendium Comm. 1980-82, V. Chm. 81-82; Monographs and Reviews Comm. 1980-82, Chm. 1981-82; Publications Coordination Comm. 1981-82. APS - PD - Resolutions Comm. 1983; PD Constitution Revision Comm. 1980; Elected Fellow APS, 1984.
Eastern Wheat Workers Conference, Chm. 1978-81; National Wheat Improvement Comm. 1978-81.
North American Barley Research Workers Conference, Co-Chm. 1981-84.

Martha K. Roane

APS - Mycology Comm. 1983-84.
Virginia Academy of Science - Councilor (for Botany Section) 1980-81; Flora Comm. Chm. 1979-81; Local Arrangements Comm. 1982; Publications Comm. 1982-84; Long Range Planning Comm. Chm. 1983-86; Treasurer 1981-82; Secretary 1982-83.

R. J. Stipes

APS - Monographs and Reviews Comm. 1980; APS - PD - V. President, 1983-84, President, 1984-85; Nominating Comm. 1980-81, Resolutions Comm., Chm. 1982; Awards Comm. 1983-84, Chm. 1984.

E. L. Stromberg

APS - Placement Comm. 1981-83, Chm. 1982-83; Regulatory and Foreign Disease Comm. 1982-84, Chm. 1984; APS - PD - Program Comm. 1982-84, Chm. 1984.

Sue A. Tolin

APS - Virology Comm. 1980-81, Chm. 1980; Special Comm. on Status of Women in Plant Pathology, 1980-82; Diamond Jubilee Comm. 1980-82; Public Relations Comm. 1981-84; Special Comm. on Affiliations and Representatives, 1982-84; Fellow, 1984. APS - PD - Program Comm. 1981; Awards Comm. 1980; Nominating Comm. 1982.

W. H. Wills

APS - Associate Editor, *Plant Disease*, 1982-84. APS - PD - Audit Comm. 1980; Awards Comm. 1981.

K. S. Yoder

APS - Chemical Control Comm. 1980-84, Chm. 1981-82; Fungicide and Nematicide Tests, Editor, Pome Fruits Section, 1981-84; Plant Disease Management Comm. 1980-81;

Miscellanea

In preparing the history of plant pathology during the Hooper Era, I have tried to chronicle the important events. A number of minor events that may seem to be of major importance to individuals have been omitted. Several minor events certainly accumulate into major accomplishments, but these are difficult to identify. Plant pathology at the Virginia Department of Agriculture and Immigration and the Virginia Division of Forestry is not well publicized or documented. There may be federal activities still ongoing, but since the barberry and *Ribes* eradicating programs were shut down, I am unaware of any other disease related activities.

At this point, a review of departmental and individual accomplishments may be in order. However, most of these were reviewed in the introductory section where Hooper's response to the 1979 Comprehensive Review Panel were listed.

An unusual event involving two individuals occurred during the Hooper Era. Sue A. Tolin and Curtis W. Roane were name American Phytopathology Society (APS) Fellows at the Guelph annual meeting in 1984. It has been a rare occasion for two individuals from the same department to be "fellowed" at the same meeting. Tolin earned this award by her activities on many important national advisory committees related to biotechnology, microbial germplasm collections, service to the Cooperative State Research Service, and service on many APS subject matter and policy committees. She provided APS with premier liaison with other scientific groups.

Roane was the first V.P.I. & S.U. alumnus to be fellowed. He earned recognition through his leadership on various cereal commodity groups, genetic studies in barley, the development of disease resistant cereal and soybean cultivars, service and leadership on several APS committees, and editorships for Phytopathology and Plant Disease. Recognition of Tolin and Roane was based on extremes in their approach to plant pathology; Tolin for her contributions to national policy, Roane for his life-long effort to develop better crops and to understand the genetics of their resistance. As cooperators investigating virus diseases, their different modes of operation and funds of knowledge complemented so well that successes and accomplishments were assured. Although this was not mentioned in the Fellow citations for either, it was certainly a factor bringing about their recognition, on the same day.

In 1984, the nonprofit service and education American Chestnut Cooperators Foundation (ACCF) was organized with the purpose of distributing seednuts carrying blight resistance. Recipients were asked to report annually on the performance of seedlings grown from the ACCF nuts so that those with resistance might soon be detected. Gary Griffin and his wife, Lucille, were the principal officers and operators of the ACCF. Gary Griffin served as President, Lucille as the Executive Secretary, and the operation was conducted from their home atop Gap Mountain next to U. S. 460.

When Anton Baudoin arrived in November 1981, he began a survey of diseases of several noxious weeds with the intent of finding natural controls for them. He cited DeVine®, the use of *Phytophthora palmivora* in Florida to control milkweed vines in citrus groves, and Collego®, *Colletrotrichum gloeosporioides* f. sp. *aeschynomeme* for control of jointvetch in rice in Arkansas, as two successful biocontrols of weed pests. Baudoin was considering biocontrol of Canada thistle, cocklebur, hemp dogbane, johnsongrass, kudzu, milkweed, morning glory, multiflora rose, musk thistle, nutsedge, and poison ivy.

Charles Drake, fruit pathologist at Blacksburg in 1984, reported severe damage to peach orchards by the peach leaf curl fungus, *Taphrina deformans*. He blamed the unusual severity on the rainy period when dormant sprays should have applied, use of spray concentrates which are less effective than dilute sprays, and failure to spray orchards in 1982 and 1983 due to freeze losses.

There may have been outbreaks of other diseases which deserve mention, but I cannot find documentation for their occurrence. As a historian, I lament the discontinuance of The Plant Disease Reporter in which such events could be documented. Sans the PDR much of epiphytology is no longer recorded.

C. W. Roane
June 2001

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A History of Plant Pathology in Virginia (1888-1997)

By Curtis W. Roane

The Moore Era (1984-1997)

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A History of Plant Pathology in Virginia: The Moore Era (7/1/1984-3/31/1997)

The Moore Era was the second longest since the Department of Plant Pathology and Physiology was established in September 1949. The Wingard Era lasted from September 1949 until October 1964, 15 years. Laurence D. Moore was appointed Interim Department Head on July 1, 1984, and Department Head on July 1, 1985. He served in this capacity until March 31, 1997, or nearly 13 years. Moore actually submitted his resignation as Head as of July 1996, but agreed to continue until a successor could assume the headship. K. K. Hatzios, a professor in the Department, was selected on December 20, 1996, and assumed responsibility on April 1, 1997, thus ending the Moore Era.

In the 13-year Moore Era, there were many changes in the faculty, in disciplines, physical plant, and technologies. Perhaps the most significant change was the introduction of the desktop computer which led to changes in faculty life-style, and resulted in a drastic reduction in secretarial positions. This introduction to the electronic era affected individuals differently. Some at first found it to be a toy or an impediment, and they foundered before adapting to it as a useful tool. Others quickly adapted to it, and almost immediately their activities were enhanced by its use. Certainly the computer provided a fabulously easy mode of communication which improved relations and cooperation among pathologists and other scientists world-wide. Availability of technology for instantaneous exchange of reports, manuscripts, and other scientific information should speed up progress and accomplishment. However, electronic communication may or may not provide historians with a long-time, accessible record analogous to a "paper trail." How much of history will be preserved if documents are not printed out?

For many years, molecular biology was confined to research with bacteria and viruses and their interactions. While teaching Genetics of Host-Parasite Interactions, I bemoaned to my students that very little progress was made in applying molecular biology to plant pathology; especially in the area of host resistance to pathogens. In retrospect, plant pathologists and plant breeders were poorly trained in biotechnology. Until a generation trained in biotechnology began to utilize host-pathogen systems as research models, little progress could be expected. At V.P.I. & S.U., molecular biology was thrust upon us by administrators. The PPWS department was picked by the administration to house two molecular biologists, their research, and teaching. While George Lacy was the first in the Department that was trained in molecular biology (=biotech), his research was a furtherance of biotech in bacteria; he did not apply biotech to higher plants. Sue Tolin, being a virologist, had to think molecular about viruses, but neither did she apply biotech to higher plants. Dean of The College of Agriculture and Life Science (CALS), James R. Nichols, apparently forced the hand by requiring that vacancies in certain departments be filled by hiring persons explicitly trained in biotechnology. In PPWS, Carole Cramer was the first such candidate. Appointed on September 1, 1986, she made initial efforts to apply biotech to plant pathology. In addition, M. A. Saghai-Maroof was appointed to a similar position in the Department of Crop and Soil Environmental Sciences (formerly the Agronomy Department). He worked initially to locate genes conditioning gray leafspot resistance in maize. Elizabeth Grabau was also hired into PPWS as a member of the biotech group in 1990, but her initial work did not relate to plant pathology. The department's brick laboratory-office building on Glade Road was upgraded in 1987 to provide laboratory and office space for Cramer and her associates. Thus, Cramer joined Sue Tolin, George Lacy, and Kriton Hatzios, already housed there, and the building was christened The Plant Molecular Biology Building.

Coincident with the hiring of Cramer, and perhaps an impetus to her accepting an appointment in PPWS, was the acquisition of equipment and microbial cultures from Allied Chemical Corporation valued at over $1,300,000. It seems that management of Allied had decided to divest its biotechnology research and would have useful modern equipment to discard. George Lacy had been on the advisory panel for Allied's biotech research; he apprised Gary Hooper, Vice-Provost for Research, of the situation. Hooper, Moore's predecessor, entered into negotiations with Allied to have the equipment and cultures donated to V.P.I. & S.U. Much of the donated equipment was designated for Cramer's laboratory in the refurbished Glade Road building. Charles Hagedorn, a leader in Allied's biotech research, was offered a joint appointment with PPWS and Crop and Soil Environmental Sciences (formerly Agronomy). Subsequently, Hagedorn made significant contributions to plant pathology and Virginia agriculture. Although this development happened during Moore's headship, the actual dealings were conducted by higher administrations. Nevertheless, it was a significant event of the Moore Era.

A new laboratory building, the Fralin Biotechnology Center, provided space for Cramer and Grabau in late 1995. A cadre of graduate students and research associates soon joined them.

When Cramer moved to Fralin Hall, Ruth Alscher was moved to Cramer's emptied space. There, Alscher would have modern space and would be closer to the air pollution research facility with which she was heavily involved.

An event occurred in late 1986 in which PPWS was no way involved, but later in the Moore Era would be of great benefit to the College of Agriculture and Life Sciences. The University swapped the Horticulture Farm near Christiansburg and two other small parcels of land for a 1,900 acre farm at Whitethorne in western Montgomery County. The PPWS department would benefit by having available a considerable acreage of uniform plot land. Through the Moore Era, Erik Stromberg and Herman Warren were the principle beneficiaries in PPWS (see the section on Cereals-Corn). Ironically, the land-swap deal caused the head of the Horticulture Department to resign and may have contributed to the downfall of University President W. E. Lavery. The benefit to the University was overlooked by influential people and organizations who thought loss of their beloved Horticulture Farm was the result of underhanded dealing. They did not recognize that their farm had become obsolete; they were miffled because they had not been included in the negotiations.

A plan involving four Virginia Agricultural Experiment Station member colleges known as 'The Plan to Serve Virginia Agriculture, Human and Natural Resources" was completed in 1995 and implemented soon, thereafter. This plan allocated 20 faculty and 15 staff positions to PPWS on campus; ten were in plant pathology, five in plant physiology, and five in weed science. In addition, two positions, one in plant pathology and one in plant physiology, were located to Eastern Shore (Painter), Hampton Roads (Virginia Beach), Tidewater (Suffolk), and Winchester Agriculture Research and Educator Centers, and a plant pathology position was allocated to the Southern Piedmont station (Blackstone). Thus, 29 faculty positions were allocated to PPWS; slightly less than the number in the Couch-Foy-Hooper Eras. When the Moore Era ended, the Department had 17 plant pathologists, 5 plant physiologists, and 5 weed scientists.

Moore had reinstated the Annual Departmental Report in 1987, and saw to publication of two issues of the *Physiopath*, the departmental newsletter.

The L.I. Miller Scholarship for graduate education was established in memory of Professor Miller who died unexpectedly on March 8, 1996.

In 1988, the University changed from the quarter to the semester system of instruction. This required revision of courses and kept catalogue listings and faculty in a state of flux for several years. Details will be described in the instruction section of the Moore Era.

Changing times resulted in cross-departmental programs that brought the PPWS faculty into greater participation with faculty from other departments in other colleges. PPWS faculty also became involved in teaching biology and agricultural technology courses. It will be difficult for me to portray these changes accurately.

In 1985, the Eastern Shore Agricultural Research and Education Center became an integral part of the Virginia Agricultural Experiment Station. Thereafter, R. E. Baldwin, Plant Pathologist, and H. P. Wilson, Weed Scientist, were considered members of the PPWS faculty.

Some other noteworthy events of the Moore Era were:

Completion of a new pesticides storage building.

Renovation of greenhouses.

Third (Nov. 5 - 8, 1984) and Fourth (Dec. 1 - 4, 1992) Departmental Comprehensive Reviews. Recommendations of the two review panels relative to plant pathology are given below.

George Lacy and his co-workers, Verlyn Stromberg, Laboratory Specialist, and graduate students D. P. Roberts and Caitilyn Allen, were the first at V.P.I. & S.U. to clone DNA molecules.

The first patent relative to plant pathology issued to V.P.I. & S.U. faculty was to M. A. Saghai-Maroof, G. K. Rufener, II, Erik L. Stromberg, R. P. Mowers, A. J. Balducchi; Gray Leafspot Resistant Corn and the Production Thereof (U.S. Patent No. 5, 574, 310. Nov. 12, 1996.).

Withdrawal of USDA peanut research programs at Suffolk occurred abruptly in 1994. From 1955 to November 1994, K. H. Garren and D. M. Porter, USDA plant pathologists, held staggered appointments there.

The third and fourth Cooperative State Research, Education, and Extension Service (CSREES) comprehensive reviews of the Department resulted in the following recommendations relative to plant pathology:

1984 - "Capitalize on current strengths and projected faculty changes to provide leadership in developing integrated plant health management and in focusing on the biotechnology initiative of the University. .....Develop new courses in weed science, molecular biology, and electron microscopy. ..... Train more county personnel in clinical diagnostic skills. .....Give more attention to conservation tillage development to be better prepared to handle potential problems." Among the panelists were two plant pathologists, Kenneth R. Barker from North Carolina State University and Wiley N. Garrett from the University of Georgia.

1992 - "To help ensure the future welfare of the Department, every attempt must be made to update the skills of it's technical staff. The development of a university-wide "plant sciences" major should be considered in conjunction with the botanists of the Biology Department and other Departments in CALS (College of Agriculture and Life Sciences) having plant science faculty. CALS Departments should give serious consideration in requiring appropriate courses in Plant Pathology, Physiology, and Weed Science as part of their under-graduate curriculum requirements. Content of graduate courses should be reviewed thoroughly and appropriate changes should be made, if necessary. ..... Greater team effort on interdisciplinary approaches to plant health should be explored. More cultural management investigations were suggested in addition to chemical approaches for pest problems. ..... Greater efficiency in plant disease diagnostics and electronic transmission of results are encouraged." Among the panelists were plant pathologists Clauzell Stevens, Tuskegee University, and Anne K. Vidaver, University of Nebraska.

During the Moore Era, many of the recommendations were implemented, but budget cuts necessitating personnel cuts made them infeasible. Cooperation from other departments and colleges could not be forced, yet progress was evident. Contrary to the recommendation that instruction in plant pathology in undergraduate curricula be increased, there is pressure from some departments to reduce it. Many recommendations were directed toward administrators and were beyond the realm of PPWS faculty attention.

When Moore was appointed Interim Department head on July 1, 1984, the faculty consisted of the following:

Professors–their primary disciplines are noted:

S. W. Bingham, Weed Science, turf.
H. B. Couch, Plant Pathology, turf.
C. R. Drake, Plant Pathology, fruit.
C. L. Foy, Weed Science, herbicidal action.
R. L. Grayson, Plant Pathology, Director of Electron Microscope Laboratory.
G. J. Griffin, Plant Pathology, forests and soil microbiology.
L. D. Moore, Plant Pathology, disease physiology.
C. W. Roane, Plant Pathology, field crops.
R. J. Stipes, Plant Pathology, landscape trees.

Sue A. Tolin, Plant Pathology, virology.
W. H. Wills, Plant Pathology, ornamental plants.

Associate Professors -

S. A. Alexander, Plant Pathology, forests, Christmas trees.
M. G. Hale, Plant Physiology, plant stress.
K. Hatzios, Plant Physiology, weed science.
G. H. Lacy, Plant Pathology, phytobacteriology.
R. C. Lambe, Plant Pathology, Extension, ornamental plants, nursery crops.
D. A. Orcutt, Plant Physiology, instruction, plant stress.
P. M. Phipps, Plant Pathology, peanut.
K. S. Yoder, Plant Pathology, fruit.

Assistant Professors -

D. E. Babineau, Plant Pathology, Extension, cereals, soybeans.
A. B. A. M. Baudoin, Plant Pathology, instruction.
B. I. Chevone, Plant Pathology, air pollution.
J. F. Derr, Weed Science, Extension, ornamental and vegetable crops.
Alma P. Elliott, Plant Pathology, nematology.
E. S. Hagood, Jr., Weed Science, Extension.
D. A. Komm, Plant Pathology, Extension, tobacco.
J. J. Reilly, Plant Pathology, tobacco.
E. L. Stromberg, Plant Pathology, cereals and soybean.
M. J. Weaver, Pesticides Coordinator.
W. E. Winner, Plant Physiology, air pollution.

Adjunct Professors -

J. R. Elkins, Concord College, W. Va., chestnut restoration.
D. M. Porter, Plant Pathology, U.S.D.A., Suffolk, peanut.
Martha K. Roane, Plant Pathology and Taxonomy, Endothia, Ericaceae.

Changes in faculty during the Moore Era, including new appointments, promotions, resignations, and retirements: New appointments - The Virginia Truck and Ornamental Research and Education Centers in Virginia Beach and Accomack County became a part of the Virginia Agricultural Experiment Station in 1985. As a result, R. E. Baldwin and H. P. Wilson became professors in the department. In chronological order, those appointed to the faculty 1984 - 1995 as Assistant Professors unless otherwise noted included:

C. S. Johnson, Plant Pathology, tobacco, September 1, 1985.
J. D. Eisenback, Plant Pathology, nematology, September 1, 1985.
Carole L. Cramer, Plant Physiology, September 1, 1986.
Charles Hagedorn, Professor, Microbiology, 1986; Hagedorn was appointed 50% in Crop and Soil Environment Sciences and 50% in PPWS.
H. L. Warren, Plant Pathology, Commonwealth Visiting Professor, December 1, 1987. Appointed to faculty May 1, 1989.
Ruth Alscher, Associate Professor, Plant Physiology, 1988.
Charles Swann, Professor of Weed Science, 1988.
Elizabeth A. Grabau, Plant Physiology, 1990.

J. H. Westwood, Plant Physiology, 1994.

Resignations -

Alma P. Elliott, November 30, 1984.
J. J. Reilly, December 31, 1984.
D. A. Komm, January 31, 1985.
D. E. Babineau, February 1, 1985.
W. E. Winner, 1987.

Retirements -

M. G. Hale, April 30, 1985.
C. W. Roane, August 30, 1986.
R. C. Lambe, May 31, 1988.
C. R. Drake, September 30, 1989.
W. H. Wills, September 30, 1990.

Transfers -

J. L. Derr, July 1, 1988; transferred to the Hampton Roads Agricultural Research and Education Center, Virginia Beach.
M. J. Weaver, July 1, 1991; transferred to Chemical Pesticides Unit.
S. A. Alexander, August 1, 1995; transferred to Eastern Shore Research and Education Center to fill the position from which R. E. Baldwin would retire.

Promotions -

To Associate Professor -
1986 - B. I. Chevone, E. S. Hagood, Jr.
1987 - A.B.A.M. Baudoin, E. S. Stromberg.
1990 - Carole L. Cramer, J. F. Derr, J. D. Eisenback.
1991 - C. S. Johnson.
1996 - Elizabeth A. Grabau.

To Professor -

1988 - K. Hatzios, G. H. Lacy.
1989 - P. M. Phipps.
1991 - E. S. Hagood, Jr., D. M. Orcutt.
1994 - J. D. Eisenback, E. L. Stromberg.

All promotions were effective on July 1.

Mary Ann Hansen had been appointed Laboratory Specialist C in 1984, was named Instructor in 1993; she was supervisor of the Plant Disease Clinic for PPWS.

Jodi A. Carlson was appointed Research Associate August 1, 1991 to conduct research, extension, and instruction programs formerly conducted by S. A. Alexander. She received the Ph. D. Degree in May 1994 and resigned soon thereafter.

In 1989, the Department celebrated its 40th anniversary by hosting the annual meeting of the American Phytopathological Society in Richmond, Virginia. Erik Stromberg and Larry Moore served as Co-Chairmen of the Local Arrangements Committee and co-hosts. Several other members of the Department served on committees for the meeting (see section on Service to Societies.). Following this event, the Department held an open house in Blacksburg. Four original recipients of masters degrees, Mary Comfort McBryde Miller (1933), R. Spencer Mullin (1936), and Lawrence I. Miller (1938), and Curtis W. Roane (1944), attended the open house and banquet. Charles R. Drake was an honored guest celebrating his retirement after 33 years on the faculty. Roane outlined a history of the Department, 1888 - 1989.

Instruction

The basic mission in the teaching program of the Department has remained unchanged since the Couch Era. For undergraduate students, the Department has no undergraduate curriculum but provides service courses for students in Agronomy (= Crop and Soil Environmental Sciences), Forestry, and Horticulture. The undergraduate courses Plant Pathology, Pesticide Usage, Pest and Stress Management of Trees, and Plant Responses to Air Pollutants are sometimes included in programs of study for graduate students. Several graduate courses are taken by students in the above named departments. Until 1992, all instruction was conducted on the Blacksburg campus. In that year, an M. S. Program Horticulture/Plant Sciences was established at the Hampton Roads Agricultural Research and Extension Center in Virginia Beach. Courses in plant pathology are included in the program.

In 1995, plant pathology faculty began teaching in the Biological Sciences Initiative (BSI) which facilitates cross-departmental teaching assignments and provides the best possible learning experience to life science students. Plant pathologists assumed teaching responsibility for General Biology, Principles of Biology, Introductory Genetics, Soil Microbiology, and Soil Microbiology Laboratory. They also taught and advised students in the two-year Agricultural Technology Program offered by the College of Agriculture and Life Sciences, namely, Plant Agriculture, Pest Management, Agriculture Chemistry Principles, and Diseases of Turfgrasses. Thus, inter-disciplinary teaching in the Moore Era became somewhat on par with inter-disciplinary research which was long practiced by plant pathology faculty.

Some faculty contributions become walled off by titles and administrative hierarchies. Randy (R. L.) Grayson fell into this category. He had been hired as Professor of Plant Pathology and Director of the Electron Microscopy Laboratory during the Hooper Era. He held that position until 1997, when he was appointed Co-Director of the Minority Academic Opportunities Program (MAOP). Thereupon, his directorship at the Electron Microscopy Laboratory ended. During his tenure with the laboratory, he taught Electron Microscopy to 42 students during five academic terms. This is hidden under the title of Special Study. Several students majoring in Plant Pathology took the course and utilized the scope in their thesis/dissertation research.

During the Moore Era, the University changed its academic year from a quarter system (fall, winter, spring) to a semester system (fall, spring). Two terms were offered each summer under both systems. The change from quarters to semesters necessitated a reduction in the number of courses that could be offered, or a reduction in credit hours for courses. The course offerings under each system reflect changes. However, there was considerable rearrangement as a result of trial and error. In the end, several courses were jointly taught by two or more instructors. Team teaching was unsavory to most caught up in it.

In order to show the transition from the quarter to the semester system, the courses offered under each system are listed below.

Plant Pathology courses listed in the catalogs at the beginning of the Moore Era:

2960 Field Study - variable credits.
3010 Plant Pathology - 3H, 3C, II.
3020 Plant Pathology Laboratory - 3L, 1C, II.
4010 Plant Responses to Air Pollutants - 3H, 3C, I.
4270 Forest Pathology - 3H, 3L, 4C, II.
4311 - 4312 Integrated Plant Pest Management - 3H, 3C, II, 9L, 3C, III.
4860 Virology - 3H, 3C.
4960 Field Study
4970 Independent Study - variable credits.
4980 Special Study - variable credits.
4990 Undergraduate Research - variable credits.
5020 Principles of Plant Disease Control - 3H, 3C, II..
5030 Plant Parasitic Nematodes - 1H, 6L, 3C, II, alt.
5040 Plant Virology - 3H, 3L, 4C, II, alt.
5090 Genetics of Host - Parasite Interactions - 3H, 3C, II, alt.
5111 Seminar - 1H, 1C, I.
5120 Concepts and Practices of Pesticide Application - 2H, 3L, 3C, III.
5150 Diseases of Field Crops - 3H, 3L, 4C, I.
5170 Epidemiology of Plant Diseases - 3H, 3L, 4C, II.
5221 Clinical Plant Pathology I - 6L, 2C, II.
5222 Clinical Plant Pathology II - 6L, 2C, III.
5900 Project and Report - 1-3C, any qtr.
5970 Independent Study - variable credits.
5980 Special Study - variable credits.
5990 Research and Thesis - variable credits.
6020 Principles of Plant Disease Development - 3H, 3C, I, alt.
6040 Physiology of Pathogenesis - 3H, 3L, 4C, III.
7990 Research and Dissertation - variable credits.

All courses above were offered under the quarter system. Roman numerals I, II, III at the end of each line refer to fall, winter, and spring quarters. The courses listed below were offered under the semester system. Roman numerals I, II, II there refer to fall, spring, and summer sessions.

Plant Pathology courses listed in the catalogs at the end of the Moore Era:

2964 Field Study - variable credits.
2984 Special Study - variable credits.
3104 Plant Pathology - 3H, 3L, 4C, I. 4224 Integrated Pest Management - 2H, 3L, 3C, I.
4264 Pesticide Usage - 2H, 3L, 3C, II.
4524 Pest and Stress Management of Trees - 2H, 3L, 3C, II.
4554 Plant Responses to Air Pollution - 1H, 1C, II.

4964 Field Study - variable credits.
4974 Independent Study - variable credits.
4984 Special Study - variable credits.
4994 Undergraduate Research - variable credits.
5004 Seminar - 1H, 1C, I, II.
5014 Plant Disease Agents: I. Fungi and Prokaryotes - 3H, 6L, 5C, I, alt.
5024 II. Viruses and Nematodes - 3H, 6L, 5C, II, alt.
5034 Clinic and Field Experience - 3L, 1C, I.
5204 Principles of Plant Disease Management - 3H, 3C, I.
5214 Diseases of Crop Plants - 3L, 1C, I.
5404 Genetic and Epidemiological Principles of Plant Pathology - 3H, 3L, 4C, II, alt.
5454 Plant Disease Physiology and Development - 3H, 3C, I, alt.
5894 Final Exam (Non-thesis) - I, II, III.
5904 Project and Report - variable credits.
5974 Independent Study - variable credits.
5984 Special Study - variable credits
5994 Research and Thesis - variable credits.
6004 Advanced Topics in Plant Pathology, Physiology, and Weed Science - variable credits.
6654 Topics in Virology - 3H, 3C, II, alt.
7994 Research and Dissertation - variable credits.

Other than renumbering and changes in hours and credits, some changes can be noted. Plant Pathology and Plant Pathology Laboratory (3010, 3020) were combined in the semester system (3104). Concepts and Practices of Pesticide Application (5120) was changed to undergraduate level as Pesticide Usage (4264). Forest Pathology (4270) was changed to Pest and Stress Management of Trees (4524); it included forest insects. Virology (4680) in the quarter system was cross-listed as a Biology course and was dropped from PPWS in the semester system. A new semester course, Plant Disease Agents (5014), included the study of Fungi and Prokaryotes, and in (5024) the study of Viruses (originally Plant Virology 5040), and Nematodes (originally Plant Parasitic Nematodes, 5030). Principles of Plant Disease Control (5020) became Principles of Plant Disease Management (5204).

Genetics of Host-Parasite Interactions (5090) and Epidemiology of Plant Diseases (5170) were combined into Genetic and Epidemiological Principles of Plant Pathology (5404). Clinical Plant Pathology (5221, 5222) was reduced to Clinic and Field Experience (5034). Diseases of Field Crops (5150) was broadened to Diseases of Crop Plants (5214). Principles of Plant Disease Development (6020) and Physiology of Plant Disease (6040) were combined into Plant Disease Physiology and Development (5454).

New listings included Final Exam, Non-thesis (5894), Advanced Topics in Plant Pathology, Physiology, and Weed Science (6004), and Topics in Virology (6654).

Several of the 5000 level courses were taught by committee (team-taught), namely, 5014, 5024, 5204, 5214, 5404, and 5454. Some combinations were undesirable both to students and faculty. For example, students in Crop Science may wish to have Genetics but not Epidemiology (5404), others might want Nematology but not Virology, or vice versa (5024), or Fungi and not Prokaryotes, or vice versa (5014). In team teaching, a student might excel under one instructor and flub under another. A compromised grade would not reveal a student's interests and aptitudes. In a later era, the system was changed so one could enroll for only the subject matter in which one was interested.

Students earning advanced degrees during the Moore Era are listed below. Those completing degrees in 1984 may have done so either in the Hooper or Moore Era. Some of their theses/dissertations may be discussed in the text on various crops or subjects that follow.

Year	**Author and Title**	**Advisor**
1984	Achwanya, Oliver Stafford. Effect of ozone, sulfur dioxide and alpha and delta races of *Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. And Cav. On bean *Phaseolus vulgaris* L. Ph.D.	Moore
1984	Grant, Carrol Earl. Interactions of a tobacco cyst nematode and the black shank fungus with flue-cured tobacco. Ph.D.	Reilly
1984	Hsia, Amos C. Y. Studies on host-parasite interactions of plant-parasitic nematodes in strawberry fields of Virginia. M.S.	Elliott
1984	Kularatine, W. W. P. Sarananda. Effects of root media and control agents on propagule formations and survival of *Phytophthora cinnamomi* Rands and root rot of azalea caused by *Phytophthora cinnamomi*. M.S.	Wills
1984	Niles, Robert Kenneth. Extraction procedures and population dynamics of plant-parasitic nematodes associated with non-bearing apple. M.S.	Elliott
1984	Schmidt, Peter Raymond. Influence of non-oomycete active systemic fungicides on the severity of *Pythium* blight of bentgrass. M.S.	Couch
1985	Agrizonis, Nester Bedardo. M.S. Non-thesis	Alexander
1985	Horner, Elliott W. Etiologic studies of *Verticicladiella procera* Kendr in pine Christmas trees. Ph.D.	Alexander
1985	Lewis, Katherine Joann. Studies on the spread of *Verticicladiella procera* by soil-borne and insect-borne propagules. M.S.	Alexander
1985	Micales, Jessie Ann. The chemotaxonomy of the fungal genus *Endothia* Fr. Ph.D.	Stipes
1985	Mojdehi, Hamidreza. Head scab of wheat. M.S., Non-thesis.	Stromberg
1985	Roberts, Daniel Paul. Molecular mechanisms of pathogenesis incited by *Erwinia carotovora* subsp. *carotovora*. Ph.D.	Lacy
1985	Specht, Laurence Paul. Inoculum densities of *Thielaviopsis basicola* in tobacco fields in Virginia, and the relationship of inoculum density to the severity of black root rot and growth of tobacco. Ph.D.	Griffin
1985	Tuskan, Robert G. Comparison of nucleoproteins and nucleic acids of five isolates of tomato ringspot virus. M.S.	Tolin

1985	Wickramabaskaran, Kandasam. Genetics of reaction to peanut mottle virus in four soybean cultivars. M.S., Non-thesis.	Roane
1986	Brenneman, Timothy Banner. Sensitivity and resistance of *Sclerotinia minor* to fungicides for control of *Sclerotinia* of peanut. Ph.D.	Phipps/Stipes
1986	Overton, Santford Vance. Physiological and ultrastructural effects of sterol-inhibiting fungicides on apple leaves and the scab fungus. Ph.D.	Moore
1986	Rechcigl, Nancy Ann. Ultrastructural cytology of peanut infected with peanut stripe virus. M.S.	Hooper/Tolin
1986	Tomimatsu, Gail S. Quantitative investigations of infection colonization of peanut roots by *Cylindrocladium crotalariae*. Ph.D.	Griffin
1987	Allen, Caitilyn. Evolution of a gene for pathogenicity: Endopectate lyase. Ph.D.	Lacy
1987	Farias, Graciella M. Quantitative investigations of *Fusarium oxysporum* and *F. solani* colonization and rot of *Glycine max* cv. Essex seedlings. M.S.	Griffin
1987	Gates, Melinda Mulesky. Biological control studies ofWills *Phytophthora parasitica* root rot of boxwood using multiple antagonists. M.S.	
1987	Gunyuzlu, Paul L. The nucleotide sequence of the 3' terminus of soybean mosaic virus. M.S.	Tolin
1987	Jewell, Elspeth Lea. Correlation of early leafspot disease in peanut with a weather-dependent infection index. M.S.	Phipps/Stromberg
1987	Reed, Karen Kynne. The influence of meteorological events and cultural practices on *Sclerotinia* crown and stem rot of alfalfa, caused by *Sclerotinia trifoliorum*. M.S.	Stromberg
1988	Pooranampillai, Christina D. Evaluation of resistance to crown and stem rot caused by *Sclerotinia trifoliorum*. M.S.	Stromberg
1989	Botha, Amanda Scheffler. The assessment of air pollution impacts on plants in South Africa. Ph.D.	Moore
1989	Donahue, Patrick J. The inheritance of reaction to gray leaf spot and maize dwarf mosaic virus in maize and their association with physiological traits. Ph.D.	Stromberg
1989	Mayes, Mary Sue. An ultrastructural and immunocytochemical study of the wheat soil-borne mosaic virus-*Polymyxa graminis* relationship. M.S.	Grayson
1989	Reaver, Diane M. The effects of foliar applications of seaweed extracts on plant growth and pest resistance. M.S.	Baudoin/Luma
1989	Smith, Brian Donald. The influence of high temperature stress and herbicides on susceptibility of creeping bentgrass (*Agrostis palustris*) to *Curvularia lunata*. M.S.	Couch
1990	Johnson, David Alan. Infection and development of *Ustilago syntherismae* in *Digitaria ciliaris*. M.S.	Baudoin
1990	Kyostio, Sirkka R. M. *Erwinia carotovora* extracellular	Lacy

	proteases: Characterization and role in soft rot. Ph.D.	
1990	Smith, Frisby Davis "Tad". Evaluation of fungicide resistance in *Sclerontinia minor* and strategies for chemical control of *Sclerotinia* blight in peanut, Ph.D.	Phipps/Stipes
1990	Yang, Zenbiao. Gene regulation in a pathogen-plant interaction: *Erwinia* versus potato tubers. Ph.D.	Lacy/Cramer
1991	Choi, Chang, Won. Soybean mosaic virus-soybean interactions: Molecular, biochemical, physiological and immunological analysis of resistance responses of soybean to soybean mosaic virus. Ph.D.	Tolin
1991	Cu, Ramon M. Development and evaluation of a computerized leafspot advisory program for effective use of cultivar resistance, fungicide, and spray adjuvant to control early leafspot of peanut. Ph.D.	Phipps/Stipes
1991	Nevill, Ralph John Leslie. The association and transmission of *Leptographium procerum* (Kender.) Wing., by root feeding insects in Christmas tree plantations. Ph.D.	Alexander
1991	Scamack, Anita Marie. Apple Powdery mildew: Literature and research overview. M.S., Non-thesis.	Yoder/Stipes
1992	Carter, Michele R. Gray leafspot of corn: Yield loss evaluation of germplasm for resistance. M.S.	Stromberg
1992	Farias, Graciella M. Roles of tannase and hydrolyzable tannins in chestnut blight. Ph.D.	Griffin
1992	Martinez, Natalia. Relationships among spreader-sticker application, blossom cap retention, berry scarring thrip populations, and botrytis bunch rot in 'Chardonnay' grapes and a survey of pesticides use and pest severity in Virginia vineyards in 1990 and 1991. M.S.	Baudoin/Weaver
1992	Mota, Manuel M. Morphological characterization of tobacco cyst nematode complex, *Globodera tabacum* sspp. Ph.D.	Eisenback
1992	Srinivasan, Indira. Isolation and detection of bean yellow mosaic, clover yellow vein and peanut stunt viruses from *Trifolium* spp. M.S.	Tolin
1993	Guevara, Gonzalo G. Biological studies of shiitake logs and associated mycoflora in the Virginia highlands. M.S.	Stipes
1993	Traut, Eduardo J. *Bipolaris zeicola*: physiological races morphology and resistance on maize. (*Zea mays* L.). Ph.D.	Warren
1994	Carlson, Jodi Ann. Procerum root disease physiology and disease interaction with ozone. Ph.D.	Alexander
1994	Crozier, James Brooks. Abiotic stressors in the dogwood anthracnose complex. M.S.	Stipes
1994	Gera, Tarun. Tracking soybean mosaic virus movement in soybean by leaf imprint immunoassay. M.S.	Tolin
1994	Zimmerman, Kris K. Evaluation of selected bacterial strains for control of dollar spot on creeping bentgrass and brown patch on tall fescue. M.S.	Hagedorn
1995	Dorrance, Anne E. Inheritance of resistance to diplodia ear	Warren

	rot and an assessment of the genetic variability of *Stenocarpella maydis* through isozyme analysis. Ph.D.	
1995	Mulesky, Melinda Anne. Rhizosphere competence, antibiotic and siderophore biosynthesis in *Pseudomonas chlororaphis*: implications for the biological control of cotton seeding disease pathogens. Ph.D.	Hagedorn
1996	Wang, Jia. Characterizing resistance in flue-cured tobacco to *Globodera solanacearum tabacum*. Ph.D.	Johnson/Eisenback
1997	Flora, Jonathan P. The effect of temperature on the durabilityTolin of resistance of soybean to soybean mosaic virus. M.S.	
1997	Kilic, Ozlem. Effect on dsRNA-contining and dsRNA-freeGriffin hypovirulent isolates of *Fusarium oxysporum* on severity of fusarium seedling disease of Essex soybean. M.S.	
1997	McBane, Scott J. Algae control in bentgrass (*Agrostis palustris*) with DC5772® and Profile™. M.S., Non-thesis	Couch
1997	Qusus, Saba J. Molecular studies on soybean mosaic virus-soybean interactions. Ph.D.	Tolin
1997	Robbins, Nancy E. Spread of hypovirulent strains of *Cryphonectria parasitica* among American chestnut trees at Lesesne State Forest. M.S.	Griffin

Fruit Pathology

Research in fruit pathology was conducted both at Blacksburg and Winchester during the Moore Era. At Blacksburg, Charles R. Drake investigated diseases of apple, peach, and nectarine until his retirement on September 30, 1989. No one was appointed to replace him, and tree fruit pathology at Blacksburg died with his retirement. Thereupon, Keith S. Yoder at Winchester assumed responsibility for tree fruit pathology in the entire state. Anton Baudoin and Sue Tolin of Blacksburg developed some special programs on grape pathology. Extension programs in fruit pathology which were jointly executed by Drake and Yoder until 1989 were managed only by Yoder, thereafter.

For years, research and extension in fruit pathology have been highly integrated. In fact, the end-point of most research was to provide growers with the latest pesticide advisories via extension publications. That Drake and Yoder were on similar tracks may be ascertained by comparing their statements in the Department of Plant Pathology and Weed Science Annual Report of 1989. The first two statements are in regard to extension programs; the third is for research:

"TREE AND SMALL FRUITS DISEASES - Delineate the nature of diseases that attack tree and small fruits, work out practical, economical and safe methods for their control and to educate the fruit grower clientele of findings through effective media that they fully understand; thus, help to improve their profits. Provide Virginia's fruit growers with the latest information on pest management and control through timely, well-planned publications, orchard demonstrations and practical non-credit schools. Educate growers on the relationship of maximum net profit ratio and its dependency on the percent of US Extra Fancy pack-out fruit/acre. Advise growers of changes concerning fruit pesticide regulations by the Environmental Protection Agency that would influence their production. Alert growers to potential troublesome diseases that can be introduced into their operation on young trees or propagation materials." (C. R. Drake)

"MANAGEMENT OF TREE FRUIT DISEASE - Provides the Virginia fruit industry with economical disease management recommendations necessary to maintain production; to advise growers of changes in fruit pesticide regulations that affect their operations; to alert growers to unusual disease conditions or problems that can be avoided by prompt precautionary measures." (K. S. Yoder)

"BIOLOGY OF PATHOGENIC ORGANISMS RELATED TO FRUIT TREE DISEASES - Investigation of the biology of pathogenic organisms as related to fruit tree diseases and the search for effective and economical control measures for the diseases affecting the fruit industry in Virginia include: 1) improving the prediction of disease outbreaks, 2) developing an integrated approach to reduce problems affecting tree longevity, 3) comparing effectiveness and safety of experimental and standard disease control chemicals, including disease control spectrum and fruit finish effects, to provide data for registration or re-registration of useful materials, 4) determining ways to optimize fungicide performance, 5) developing control programs for new disease problems such as fungicide-resistant fungal strains and for older disease for which control measures are deficient." (K. S. Yoder)

Note that Drake combines research and extension objectives, while Yoder separates them.

For the 1992 Comprehensive Review of the Department, Yoder made the following statement (pp. 185 - 186.):

"A research-extension appointment at a field station in the leading fruit county in the state must include extensive field research. Research and extension activities are closely integrated and many activities cannot be categorized as solely research or extension. Research objectives are: To compare effectiveness and safety of experimental and standard disease control chemicals, including control spectrum and fruit finish effects, to provide data for registration or re-registration of useful materials; to determine ways to optimize fungicide performance with spray additives and cultivar disease resistance; to develop control programs for new disease problems; to develop integrated approaches to control problems affecting tree longevity. Most current tree fruit disease research falls under the department program areas of disease monitoring and prediction, impact/loss assessment, and management strategy development using chemical, genetic, and biological approaches. Tree fruit disease extension objectives include department program areas of disease identification, monitoring, prediction, and management. General extension program objectives are: To provide the Virginia fruit industry with economical disease control recommendations necessary to maintain production; to alert growers to unusual disease conditions or problems that can be avoided by prompt precautionary measures; to advise growers of changes in fruit pesticide regulations that affect their operations.

Research Focus - The needs of the tree fruit industry for reliable control measures have changed rapidly over the past four years because of resistance to preferred fungicides, the withdrawal of registration and need for re-registration support of several useful, older materials and growers' recognition of the need to reduce pesticide usage because of economic, environmental and food safety concerns. In some cases, partial re-registration has allowed continued usage but only at reduced, less effective rates, lengthened pre-harvest intervals or lengthened worker re-entry times, and per acre per year restrictions.

The sudden withdrawal of the EBDC fungicides (mancozeb, metiram and zineb) in 1989 resulted in shortages and higher prices for alternative materials to use as companion fungicides for benzimidazole and SI fungicides and for broad spectrum summer disease control. Efforts to find replacements for the EBDC fungicides for early and late season apple disease control zeroed in on captan and ziram. Residue tests conducted in cooperation with the EBDC/ETU Task Force in 1990 permitted partial re-registration of mancozeb and metiram, but only at half rates no closer than 77 days to harvest. Ongoing research focuses on how best to supplement half rates of EBDC's with other fungicides to give the economical control expected from full rates of EBDC's. In spite of the weaknesses of remaining fungicides, we are trying to improve disease management by utilizing spray adjuvant "extenders' such as pinolene and latex derivatives. Another area with potential for reduced fungicide usage is in host resistance. Approximately 25 scab-resistant apple cultivars are now available commercially. In cooperation with horticulturists at Winchester and Blacksburg, we are selecting scab-resistant cultivars which have potential processing quality and screening them for susceptibility to other major diseases. Fruit evaluations will begin next year.

Postharvest apple and peach disease control remains a serious concern because the registrations of two preferred benzimidazole fungicides have been withdrawn for all postharvest food uses and the only non-benzimidazole is captan. Iprodione applied as a post harvest dip treatment gave good experimental control of Penicillium blue mold and brown rot which have developed resistance to the benzimidazole fungicides. Several other potential post harvest treatments will be tested. Chlorine has disinfectant properties, but because of possible phytotoxicity, would add logistical complications to the current practices. Calcium treatments increase fruit resistance to decay, but storage operators are concerned about corrosion of equipment. Biological suppression of fungal decay holds interest because this method could reduce reliance on chemical control. Biological treatments will be tested if stable formulations of organisms become available.

In a cooperative study with NYSAES virologists to test viral cross-protection, pre-inoculation of red Delicious/MM 106 trees with an avirulent Tomato Ring Spot Virus isolate appears to have delayed the onset of severe graft union necrosis symptoms. These trees will be observed for several more years.

Extension Focus - Disease control recommendations are provided through fruit schools, extension bulletins, newsletters, and personal communication with county agents, grower and grower service organizations, and individual grower contacts. Answers to numerous grower questions regarding fungicide effectiveness, and expansion or retention of the registration status of useful materials have been facilitated through laboratory, greenhouse, and field research with fungicides and spray additives. Such questions concern new fungicides, new formulations, or older compounds and alternatives to the EBDC and benzimidazole fungicides and ones more likely to receive adverse publicity. Since Dr. Charles Drake's retirement in 1989, I have participated in several additional meetings in the southern Virginia fruit areas, and there are more frequent phone calls from these areas. Our weekly newsletter is distributed electronically to all counties in Virginia. To improve growers' abilities to identify orchard pest and disease problems, we are working cooperatively within the region (VA, WV, MD, PA, and NJ) on production of a Mid-Atlantic Orchard Monitoring Guide.

Fruit fungicide testing has not been conducted in southern Virginia since Dr. Drake's retirement. Summer disease pressure in the central and southern Virginia areas has exposed some weaknesses of apple disease management programs. A new disease, Alternaria leaf blotch, as appeared in some southern Virginia orchards, stressing the need for improved controls. Variable weather conditions from region to region have exposed the difficulty in making state-wide control recommendations based only on fruit fungicide tests conducted in the Winchester area, but present staffing limitations preclude routine testing in other areas."

The following statements were prepared by Yoder for the 2000 Comprehensive Review (pp. 359 - 361.).

"Issue: the needs of the tree fruit industry for reliable disease control measures are continually changing because of resistance to preferred fungicides, potential withdrawal of registrations due to the Food Quality Protection Act (FQPA) and the recognition of the need to reduce pesticide usage because of economic, environmental and food safety concerns. Ten or more apple diseases and several peach diseases can have an economic impact on commercial production in Virginia each year. Research programs must be flexible for pathogen spectrum changes, development of resistance to fungicides, changes in material registration, or discovery of a new disease.

What Has Been Done: *Compare effectiveness and safety of new and registered disease management chemicals*. Our research has addressed the changing needs of the tree fruit industry for reliable disease control measures. For example, we identified captan and ziram as replacements for the ethylene bis dithiocarbamate (EBDC) fungicides for apple disease control in 1990. The EBDC's represented about 60% of the fungicides used on apples before they were suddenly withdrawn in 1989. They had been widely used as companion fungicides for benzimidazole and sterol-inhibiting (SI) fungicides and for broad-spectrum summer disease control. Our discovery of suitable replacements helped to reduce fungicide shortages and stabilize prices for alternative materials through the 1990's. Our research has also provided a database upon which to draw when emergencies appear, such as resistance to fungicides, changes in material registration, or discovery of a new disease.

Our research has aided in the registration of newer fungicides such as the SI's, fenarimol and myclobutanil, for broad-spectrum early season apple disease control. These fungicides give the apple grower more options because their control spectrum includes mildew and rusts, and their unique mode of action on scab became particularly significant with the onset of resistance to the benzimidazole fungicides in the apple scab fungus in much of the region's apple acreage. Since 1995, our research has determined the useful broad-spectrum nature of kresoxim-methyl (Sovran) and trifloxystrobin (Flint), low-risk, low-use-rate strobilurin fungicides registered for apples in 1999.

Integrate management practices. In addition to facilitating replacement of older fungicides with new, low-use rate compounds, we have found ways to incorporate cultivar disease resistance into orchard planting and disease management schemes. Our research has determined mildew threshold levels for the unique cultivar, Ginger Gold, and elucidated the economic parameters on which treatment selection should be based. Commercial adoption of new cultivars broadens consumer options in the market place, and disease-resistant cultivars reduce long-term reliance on fungicides.

Manage fireblight. Our research in the 1990's has provided several answers to control of potentially devastating fireblight which has become a major concern for the highly susceptible apple rootstocks and cultivars now being planted. Based on our background research, most growers are now applying copper materials to processing market cultivars at apple green tip stage to help reduce fireblight potential and to offset development of resistance to the only other registered control, streptomycin. Also, many growers and consultants are monitoring weather and bloom conditions and use a predictive system on which to base need for protective streptomycin. Finally, our novel research on the reduction of tree susceptibility by the growth regulator, prohexadione-calcium, initiated in 1994, may revolutionize fireblight management recommendations world-wide. Discussions about this material with EPA in 1998 helped facilitate its reduced-risk status and subsequent commercial registration as *Apogee* in April, 2000.

Impact: We have generated economical and environmentally sound disease management recommendations for growers and fruit crop production advisors in Virginia and the mid-Atlantic region. Our discovery of suitable replacements helped to reduce fungicide shortages and stabilize prices for alternative materials through the 1990's. Our research over the past five years revealed the useful broad-spectrum nature of kresoxim-methyl and trifloxystrobin, strobilurin fungicides that gained registration for apples in 1999. These low-risk, low use rate material will help to offset some of the impact of FQPA on tree fruit production. We were the first to try the approach of using a plant growth regulator to suppress apple shoot susceptibility to fireblight. Prohexadione-calcium now being tested world-wide wherever fireblight is a problem on apples and pears, particularly in Europe where other options are limited. Adoption of this practice will reduce excessive use of streptomycin and will help to maintain its effectiveness in the mid-Atlantic region.

We emphasize orchard monitoring for diseases and timely, efficient use of management measure to reduce overall chemical inputs. We have determined ways to incorporate cultivar disease resistance into orchard planting and disease management schemes. Our research has determined mildew threshold levels for the unique cultivar, Ginger Gold, and elucidated the economic parameters on which treatment selection should be based. Commercial adoption of new cultivars broads consumer options in the market place, and disease-resistant cultivars reduce long-term reliance on fungicides.

We transmit information through presentations at fruit schools, regional extension and research meetings. Specific information is provided in the areas of varietal resistance susceptibility to diseases, disease management, fungicide effectiveness and management decisions related to fungicide usage, proper utilization of fungicides to avoid resistance to fungicides, and effects of weather on disease development.

Adoption of these management practices increases grower profitability and helps to assure a safe supply of fruits to the consumer. In addition to conventional methods of information delivery such as area fruit schools and extension publications, we have utilized the Mid-Atlantic tree fruit web site with Dr. Alan Biggs, WVU and the Fruit Loop site with Dr. Doug Pfeiffer at Virginia Tech. We posted 11 tables of varietal disease resistance/susceptibility information and 17 disease fact sheets on the WVU Mid-Atlantic tree fruit web site. During the bloom period, we display graphics showing fireblight disease forecast information. In 1998-99, materials that I authored or co-authored and posted at the WVU and Va. Tech sites were accessed 39,059 times (page view or download data). 1999 site usage nearly tripled over 1998 because of the increasing popularity of these sites."

Although these statements were prepared in 2000, most of the research was completed in the Moore Era. These statements also highlight the increasing dependence on electronic communication. The fungicide testing is documented in the American Phytopathological Society annual publications *Fungicide and Nematicide Tests* vols. 40 through 53, 1985 - 1998 and *Biological and Cultural Tests* vols. 9, 11, 12. 1994, 1996, 1997. Information for fruit growers was updated and published annually in:

(1) Pest Management Guide for Horticultural and Forest Crops. Va. Coop. Ext. Pub. 456 - 017.
(2) Pest Management Guide for Home Grounds and Animals. Ibid. 456 - 018.
(3) Spray Bulletin for Commercial Tree Fruit Growers. Ibid. 456 - 419. (This bulletin is prepared and issued jointly by extension services of Virginia, Maryland, and West Virginia.)

In (1) above, sections were devoted to (a) commercial small fruits and (b) grapes. Yoder prepared (a) and Baudoin (b). In (a) subsections were diseases of strawberry, brambles, and blueberry.

Baudoin gave special attention to the fungus disease control needs of grape growers. Starting in 1989, he studied interactions among fungicides that were available for control of black rot and other important diseases with the aim of identifying antagonistic and synergistic combinations. Such combinations were found in laboratory studies, but they were of little value in vineyards. He also made a field study of spreader-sticker application on flower cap retention and Botrytis rot, a survey for *Botrytis cinerea* strains resistant to two fungicides recommended for it's control, and field tests to determine the optimum timing of applications. Results from these experiments were incorporated when feasible into the grape diseases section of Va. Coop. Ext. Pub. 456 - 017.

Baudoin's report that iprodione-resistant strains of *B. cinerea* existed in several vineyards in northern Virginia was the first for the United States. Benomyl-resistant strains were also reported (Plant Dis. 78: 102 - 1994.). Baudoin et al. found that floral debris could be removed from young fruit clusters with a leaf blower; however, the procedure only slightly reduced the incidence of *B. cinerea* bunch rot. The control gained was deemed not economically feasible (Vitis 36: 27 - 33. 1997.).

Sue Tolin investigated the occurrence of virus diseases in a nursery planting of grape rootstock cultivars and found several of over 400 vines examined to be infected with tomato ringspot virus (TmRSV). Infected plants were removed and destroyed. She was assisted by Dr. David Bays, a former graduate student who majored in plant virology as an advisee of Tolin. The work aided in refining Virginia's grapevine certification program. As a member of Virginia's Viticulture Technical Advisory Committee, Tolin had assisted in developing the State's grapevine certification program. The program was transferred to Mike Likens, Plant Pathologist, Virginia Department of Agriculture and Consumer Services, where it remains a function of the state's nursery stock certification program.

Much of the fruit virus research was in collaboration with Yoder and was a contribution to NE-14, Northeast Regional Research Project, Virus and Mycoplasma Diseases of Deciduous Tree Fruits and Grapevines. Yoder was a member of NE-14 Technical Committee and was its Chairman in 1993. The research was, also, a contribution to IR-2/NRSP-5, Inter-regional Project to Derive, Preserve, and Distribute Virus-free Germplasm. Yoder was a member of its Technical Committee, Chairman in 1994.

In 1990, the American Phytopathological Society published the Compendium of Apple and Pear Diseases (A. L. Jones and H. S. Aldwinckle, eds.). Drake and Yoder contributed write-ups on several diseases.

Yoder authored or co-authored the following:

> Powdery mildew - K. D. Hickey and Yoder; brooks fruit spot, blotch, black pox of apple and blister canker of pear, x-spot, all by Yoder. Yoder also contributed two illustrations.

Drake contributed the following:

> Black root rot, Armillaria and Clitocybe root rots, southern blight, white root rot and Phymatotrichum root rot (with R. D. Hine).

Both Drake and Yoder contributed many other publications useful to the fruit industry. Yoder's work has continued well beyond the Moore Era.

Two thesis bearing on fruit pathology were completed during the Moore Era:

> Scamack, Anita M. 1991. Apple powdery mildew: Literature and research overview. M. S. Thesis. V.P.I. & S.U.
>
> Martinez, Natalia. 1992. Relationship among spreader-sticker application, blossom cap retention, berry scarring, thrips populations, and Botrytis bunch rot in Chardonnay grapes, and a survey of pesticide use and pest severity in Virginia vineyards in 1990 and 1991. M. S. Thesis. V.P.I. & S.U.

Scamack found that fungicides, host resistance, and epidemiology had received most research attention. Lacking attention were roles of cleistothecia, ascospores, hetero- versus homothallism, growth of *Podosphaera leucotricha* on artificial media. Yoder served as her committee chairman.

Martinez found that the spreader-sticker product, Nu-Film 17, increased flower debris retention slightly, and removal of flower caps had no effect on berry scarring, but reduced Botrytis bunch rot slightly. Thrips control with methomyl reduced berry scarring, but did not affect the incidence of rot. Black rot, Japanese beetle, and annual grasses were considered by growers to be the most important pests. These were most frequently controlled with captan, carbaryl, and glyphosate. Anton Baudoin and M. J. Weaver were co-chairmen of her committee.

Soybeans

In the Moore Era, research emphasis was on breeding disease-resistant cultivars, genetic analysis of soybean-virus interactions, analysis of a Fusarium-induced disease that occurred most frequently in the cv. Essex, hence, named the Essex disease. The Essex disease studies will be related first.

In the late 1970's when Essex was the predominant soybean cv., complaints were received from a number of growers about the inability of the cv. To produce the expected growth and seed yield on certain sandy soils. Graduate student C. Earl Grant studied the disease for his M. S. Project. With Roane and Phipps as co-advisors and Griffin as committeeman, Grant produced a project and report entitled "Etiology and control of a damping-off disease of soybeans in Virginia", (M. S. Proj. and Rept., V.P.I. & S.U., 1980.), in which he reported that *Fusarium oxysporum* and *F. solani* caused the disease to different degrees in Essex, 'McNair 500,' and 'Lee 68.' Grant treated the disease as a damping-off problem which he could control with several seed-treatment fungicides.

Griffin, being interested in soil fungus plant interactions, studied the disease for several years and guided two students through thesis projects pertaining to the problem that became known as the "Essex disease". Graciela M. Farias titled her thesis, "Quantitative investigations of *Fusarium oxysporum* and *F. solani* colonization and rot of *Glycine max* cv. Essex seedlings." (M. S. Thesis, V.P.I. & S.U., 1987.) In addition to *Fusarium* spp., Farias identified *Rhizoctonia solani* as contributing to the Essex disease syndrome especially at higher temperatures. (See, also, Farias, G. M., and G. J. Griffin. Plant Dis. 73: 38 - 42, 1989. Plant and Soil 123: 59 - 65, 1990.).

Pathogenic and non-pathogenic isolates were found and Ozlem Kilic made a study of these under the title, "Effect of dsRNA - containing and dsRNA-free hypovirulent isolates of *Fusarium oxysporum* on severity of fusarium seedling disease of Essex soybean." (M. S. Thesis, V.P.I. & S.U., 1997.). Kilic found no correlation between presence or absence of dsRNA and virulence or hypovirulence of *F. oxysporum*. (Kilic and Griffin, Plant and Soil 201: 125 - 135, 1998.).

Griffin recognized that *Pythium ultimum* played a role in the damping-off phase of the Essex disease and later by colonizing rootlets thereby contributing to the late phase. This was discovered when he observed that metalaxyl seed treatment reduced the impact of the disease (Griffin, Canad. J. Pl. Path. 12: 135 - 140, 1990.). Metalaxyl is specific for controlling Phycomycete diseases. 1990.). Thus, the Essex disease was shown to be a complex disease caused by two *Fusarium* spp. and a *Pythium*.

Stromberg tested a number of seed-treatment fungicides. The results of these tests led to recommendations published in the Pest Management Guide (Va. Coop. Ext. Publ. 456 - 016, rev. annually.). Criteria for treating soybean seed were based on germination percentages of seed lots and soil temperature at planting time. In general, seed germinating 85% or better did not require treatment unless the soil temperature was below 85° F. If germination was 75 - 85%, seed should be treated, and if below 75%, should not be used for seed. Several fungicides were recommended singly or in combination with other fungicides. None was universally effective. Thiram was the best general fungicide; carboxin was best against *Rhizoctonia*; metalaxyl and related compounds were best against *Pythium* and *Phytophthora*.

According to John D. Eisenback, PPWS nematologist, root knot and cyst nematodes are the most damaging of the various nematodes in Virginia soybean soils. In the Pest Management Guide are lists of cultivar reactions to *Meloidogyne incognita*, *M. arenaria*, and *Heterodera glycines* for maturity groups III to VI which might be grown in the Middle Atlantic region. No resistance occurs in the publicly released cvs. from Virginia. Abundant resistance is available for races 3, 9, and 14 of the soybean cyst nematode (*H. glycines*) but little is available for root knot nematodes. Thus, root knot must be managed by cultural means and nematicides. The nematode Advisory Program developed in Virginia (see section on Peanut) is applicable to and available for soybean production.

Soybean viruses have been the subject of intensive investigation in Virginia. Soybean mosaic virus (SMV) is destructive worldwide and is easily disseminated through seeds. In the peanut area in particular, peanut mottle virus (PMV) and peanut stunt virus (PSV) are most prevalent. Resistance to these three viruses has been found and deployed in the triply resistant soybean cvs. Toano and Hutcheson. Bean pod mottle virus (BPMV) resistance has not been found in Virginia; it would be useful because it seems to be very common adjacent to crimson or red clover fields. Several other viruses occur occasionally in Virginia, but their frequency does not warrant breeding for resistance to them. Since SMV is seed-borne, continued breeding for resistance is warranted not only to prevent damage in production fields, but also to block seed transmission.

Roane, Tolin, and G. R. Buss initiated inheritance studies with soybean viruses during the Foy Era. They prepared a manuscript describing the results of a cross of 'York' x 'Lee 68,' York being resistant to SMV and PMV susceptible to PSV; and Lee 68 being resistant to PSV, but susceptible to SMV and PMV. Thus, an inheritance of reaction to three viruses was studied simultaneously. The paper was submitted to the Journal of Heredity, but since the data were "not clean" for PSV the editors would accept only the SMV and PMV data. Single dominant genes for the two virus resistances were linked by 3.7% recombination (J. Heredity 74:289 - 291, 1983.). The inheritance of reactions to three viruses was reported in the *Soybean Newsletter* (7:100 - 102, 1980.) and an abstract in *Phytopathology* (70:692, 1980.). This work is reviewed because it laid the ground work for breeding soybean cvs. with triple virus resistance.

Once resistance genes were identified and the routine of obtaining reactions of soybean lines and cvs. to viruses was established, the breeding of virus-resistant cvs. became a major objective of Buss' breeding program. Toano was released in September 1985 from lines tested in the virus inoculation program (Crop Sci. 27: 1092, 1987.). In addition to viruses, it was resistant to downy mildew (*Peronospora manshurica*) and purple stain (*Cercospora kikuchii*). With like virus resistance, Hutcheson was released in 1987 by the Virginia, Alabama, Georgia, Kansas, Missouri, and Tennessee Experiment Stations. It, also, was resistant to bacterial pustule

(*Xanthomonas campestris* pv. *phaseoli*), downy mildew, and purple stain (Crop Sci. 1024 - 1025, 1988.). It became the most widely grown cv. in the Southeast.

After it was demonstrated that York carried linked monogenes for SMV and PMV and Shipe found a second gene for PMV resistance (Crop Sci. 19: 656 - 658, 1979.), Buss, Roane, Tolin, and graduate student T. Vinardi determined that 'CNS' has resistance for PMV at a locus different from that of 'Dorman' (and York). Thus, three genes were labeled, *Rpv1* in Dorman, *Rpv2* in 'Peking', and *Rpv*? in CNS. Since no allelism tests have been conducted involving all three genes, the exact relationships have not been established and all labels are tentative (Crop Sci. 25: 314 - 316, 1985.). No further genetic tests were executed in the soybean-PMV realm.

With Tolin and Roane as co-advisors, D. C. Bays prepared a dissertation entitled, "Variability of the peanut mottle virus reaction in soybean" (*Glycine max*) (Ph. D. Diss., V.P.I. & S.U., 1983.) and later published a paper summarizing it. From inoculation experiments with five strains of PMV, he demonstrated five patterns of reactions typified by Lee 68, 'Cumberland', 'Virginia', Dorman, and Peking. Peking and CNS fell in the same reaction class which suggested they might have identical genes (Phytopathology 76:764 - 768, 1986.). Thus, the genetics of PMV reactions in soybean remains unclear; efforts were turned toward unraveling the genetics of the SMV-soybean interactions.

Until 1989, no additional journal publications were issued from V.P.I. & S.U. on genetics of soybean-virus reactions, although two unreviewed papers were published in the 1986 Soybean Genetics Newsletter (SGN 13: 136 - 138, 139 - 143.) In the first, 'Marshall' and 'Kwanggyo' were shown to be monogenic at a common locus; P.I. 96983 was digenic in reaction to SMV strain G1. The genes in P.I. 96983 were not tested for allelism with the other two genes.

In the second SGN paper, a gene-for-gene hypothesis was proposed for the soybean-SMV interactions. From the tabular information, it can be seen that Kwanggyo and Marshall reacted differently to SMV strains G2, -3, and -5; thus, they must have different alleles at the same locus. After some refinements of the data (identifying viruses in susceptible plants of mostly resistant rows as not being SMV), the paper was published by Buss, Roane, Tolin, and P. Chen (Crop Sci. 29: 1439 - 1441, 1989.). This was Chen's introductory work with genetics of virus reactions in soybean. As a graduate student in plant breeding, he would make significant contributions to the soybean-virus genetics.

At two World Soybean Research Conferences (III: 433 - 438, 1985; IV: 1144 - 1154, 1989.), Buss presented papers in behalf of the V.P.I. & S.U. soybean research team (Buss, Roane, Tolin, and Chen) describing the work on soybean-virus genetics and breeding virus resistant soybeans; SMV was emphasized, PMV was included, but PSV was not. On a world basis, SMV deserved center stage.

P. Y. Chen as Buss' advisee prepared a dissertation entitled, "Genetics of reactions of soybean mosaic virus in soybean," (Ph. D. Diss., V.P.I. & S.U., 1989.). In a published version, he reported that even though there were differences in reaction among five cvs., they did not produce segregating F_2 and F_3 when crossed and tested with SMV strain G1. Thus, all genes were at a common locus and were considered alleles. The symbols assigned in the respective cvs. Were: P.I. 96983, *Rsv1*; Ogden, *Rsv1*^{t}; York,
y m k

Rsv1 ; Marshall, *Rsv1* ; and Kwanggyo, *Rsv1* . Having these genes all at one locus created a road-block for pyramiding genes in a single cv. (Chen, Buss, Roane, and Tolin, Crop Sci. 31: 305 - 309, 1991.).

In the genetics of reaction to viruses, three responses were recognized: resistant, necrotic, and susceptible. In the past, if a plant responded to virus inoculation, it was considered susceptible by virologists. However, from the outset, Virginia workers grouped plants in progenies as non-susceptible or susceptible. The non-susceptible class included resistant (R) and necrotic (N) segregants. Such a grouping would usually provide acceptable F_2 fits to monogenic and digenic ratios with resistance dominant. Grouping N and susceptible (S) plants together would usually give acceptable 1:3 ratios, but resistance would be recessive. Necrosis was observed to occur mostly in segregating populations; thus, it was thought to be a response of heterozygous plants. In F_2, the frequency of N plants was often high enough to give a 1:2:1, R:N:S; thus, workers who did not classify F_3 chose to group N with either R or S. Resistance then would be either dominant or recessive. In F_3, F_2, R plants would produce all three classes. However, with some SMV strains, the N reaction was typical for some cultivars. Chen made a genetic study of the N reaction as part of his dissertation project. In N X S, F_2 progenies segregated 3N :1S; no S segregants occurred in N X N and R X R F_2 progenies. In R X S F_2 progenies, R, N, and S segregants appeared in a 3 (_ + N) : 1S ratio. These events were conditioned by the choice of SMV strain. This study seemed to solve the enigma of N reactions and how to classify them in genetic studies of the soybean-SMV interactions (Crop Sci. 34 : 414 - 422, 1994.). Even so, interpreting the N class for genetic purposes may remain different from that for virology purposes.

By 1991, results from genetic experiments seemed to indicate that reaction to SMV was governed by genes at 4 loci with resistance-inducing alleles occurring at *Rsv1* and *Rsv3*. Chen et al. made excellent use of the gene-for-gene table that Roane et. al. proposed in 1986 (Soybean Genetics Newsl. 13: 139 - 143.) from which he recognized discrepancies in gene labeling. Apparently, some genes had been labeled without having been tested for allelism with previously with previously labeled genes. As a consequence of Chen's efforts, *Rsv2* was shown to be an allele at *Rsv1* and was relabeled *Rsv1*; thus, *Rsv2* disappeared.

Buss advisee Guorong Ma completed his Ph.D. research in 1995 (Ma, G., Genetic analysis of soybean reactions to soybean mosaic virus. Ph.D. Diss., V.P.I. & S.U., 1995.) in which he reported on the genetic constitution of SMV reactions in 'PI486355' (Theor. Appl. Genes 91: 904 - 907, 1995.). The two genes in PI486355 were separated and their reactions to appropriate strains of SMV observed. In resistant line1, LR1, a new allele, *Rsv1s*, was determined; in LR2 and independent gene that confers resistance to SMV strains G1 - G7 was isolated and labeled *Rsv4*.

Buss, Ma, Chen, and Tolin released a line, V94 - 5152, derived from the cross Essex X PI486355, because it carried the two genes discussed above and does not give a necrotic response to any strain of SMV (Crop. Sci. 37: 1987 - 1988, 1997.).

During the Moore Era, Buss and Tolin and their students contributed significantly to the genetics of soybean-SMV interactions. They have undertaken the breeding of a series of near isogenic lines of 'Essex', each having one of the *Rsv* alleles (Va. J. Sci, 39:92, 1988.). The entire collection of SMV genetic studies probably has had little impact on the health and production of Virginia-grown soybeans, but has been very useful to soybean breeders on a world-wide basis.

M. A. Saghai-Maroof was appointed in the Crop and Soil Environmental Sciences Department in 1989 to lead studies in molecular aspects of crop genetics. One of his advisees, Yong Yang Yu, made a "Molecular genetic analysis of host resistance to soybean mosaic virus" (Ph.D. Dissertation, V.P.I. & S.U., 1994.). By using restriction fragment length polymorphisms (RFLPs) and simple sequence repeats (SSRs), he studied the *Rsv1* locus in the cross of SMV-resistant 'P.I.96983' with 'Lee 68'; progenies were inoculated SMV-G1. He found *Rsv1* linked with SSR-HSP176L and RLP pA186 and pK6441 at distances of 0.5, and 2.1 cm, respectively. He confirmed that such tight linkages occurred in three other lines carrying *Rsv1* derived from either P.I.96983 or 'Marshall'. The same three *Rsv1*-linked markers were used to screen 67 diverse soybean types. The results agreed with available pedigree information. Thus, the method is useful in identifying gene loci for breeding purposes. The need for conventional genetic tests is obviated. Other factors not related to pathology were also found linked to *Rsv1*. Yu also established that Rsv1 is a small cluster, but no dimension was given. There was no reference to alleles at the *Rsv1* locus.

This work was the first to apply molecular technology to the genetics of the soybean-SMV interactions. Yu published with members of his Ph.D. committee two papers based on his dissertation (Yu, Saghai Maroof, Buss, Maughan, and Tolin. Phytopathology 84:60 - 64, 1994; Theor. Appl. Genet. 92:64 - 69, 1996.).

In a later study, Yu, Buss, and Saghai-Maroof reported that genes for resistance to two viral and two fungal diseases tended to occur in clusters. Such a phenomenon suggests that there is some commonality in resistance mechanisms for diseases in general, and clustering may be a conservation mechanism in the host. The diseases were soybean mosaic, peanut stunt, Phytophthora root rot, and powdery mildew (Isolation of a superfamily of candidate disease-resistance genes in soybean based on a conserved nucleotide binding site (Proc. Natl. Acad. Sci. USA 93:11751 - 11756, 1996.).

In a study employing a patented technique (Keygene, Inc.), amplified fragment length polymorphism (AFLP), P. J. Maughan, Saghai-Maroof, Buss and G. M. Huestis examined cvs. carrying *Rsv1* and *Rsv3* (SMV resistance genes). Detection of gene loci by AFLP analysis is cheaper and less time-consuming in soybean: (Species diversity inheritance, and near-isogenic line analysis, Theor. Appl. Genet. 93:392 - 401, 1996.). Thus, during the Moore Era, molecular genetics made considerable strides at Virginia Tech.

During the Moore Era, Tolin mentored five graduate students through studies on the soybean mosaic virus. The students and their thesis or dissertations were:

> Paul L. Gunyuzlu - The nucleotide sequence of the 3' terminus of soybean mosaic virus. M. S. Thesis, V.P.I. & S.U. 1987.
>
> Chang W. Choi - Soybean mosaic-soybean interactions: Molecular, biochemical, physiological, and immunological analysis of resistance of soybean to soybean mosaic virus. Ph.D. Diss. V.P.I. & S.U. 1991.

Torun Gera - Tracking soybean mosaic virus movement in soybean by leaf imprint immunoassay. M. S. Thesis. V.P.I. & S.U. 1994.

Saba J. Qusus - Molecular studies on soybean mosaic virus-soybean interactions. Ph.D. Diss. V.P.I. & S.U. 1997.

Tolin advisee, Jonathan P. Flora, completed an M.S. thesis in 1997 entitled, "The effects of temperature on the durability of resistance of soybean to soybean mosaic virus." There were reports in the literature from Tu and Buzzell in Canada that the resistance conferred by *Rsv3* broke down under high temperature. Flora tested cvs. Carrying *rsv*, *Rsv1-y*, *Rsv1-t*, and *Rsv1* alleles of *Rsv1* inoculated with SMV strains SMV-G1, -G4, and G-6 after exposure to 20° and 30° C. It was expected that after exposure to 30°, heat shock proteins would be produced which would alter cv. response to virus. No such alterations were observed. Flora concluded that alleles at the *Rvs1* locus are heat-stable.

Obviously, all of the above are more fittingly discussed in the section "Virology" than under "Soybean" where the subject is soybean pathology. It can be rightly said these theses/dissertations are etiological studies on a soybean pathogen, but their objectives, methodologies, and findings merit a section of virology.

Peanuts

Research and extension activities on peanut pathology were carried out at the Tidewater Agricultural Research and Education Center (TAREC) in Suffolk (formerly Holland, Nansemond County until the county became the city of Suffolk). During the Moore Era, Patrick M. Phipps of PPWS, V.P.I. & S.U., and D. Morris Porter, USDA, ARS, were in charge of the research. Porter's tenure at TAREC ended in 1995 when the USDA closed out its peanut projects at Suffolk and he was transferred to Maine for his final year as a federal employee. Phipps held a split appointment, 40% research and 60% extension. The two worked together on several research projects and published jointly several journal articles.

A major contribution by Porter was to serve as editor of the Compenium of Peanut Diseases published by the American Phytopathological Society (APS) Press, First Edition 1984, Second Edition 1997. For the 1984 edition, editors were Porter; D. H. Smith, Texas A & M University; and R. Rodriguez - Kabana, Auburn University. For the second edition, editors were N. Kokalis-Burelle, Auburn, Porter; Rodriguez - Kabana; Smith; and P. Subrahmanyam, Malawi. Porter also prepared the following sections: Introduction, The Peanut Plant Peanut Diseases; Fungus Diseases, Botrytis Blight, Diplodia Collar Rot (with Phipps), Neocosmospora Foot Rot, Sclerotinia Blight (with H. A. Melouk); Abiotic Diseases, Drought Stress, Frost Injury, Genetic Disorders, Hail Injury and Lightning Injury. Phipps contributed sections on Cylindrocladium Black Rot (with M. K. Beute), and Diplodia Collar Rot (with Porter). Both contributed several color photographs. The Compendium is a significant contribution to peanut pathology.

Peanut leafspot (early = *Cercospora arachidicola*; late = *Cercosporidium personatum*) holds the distinction of being the longest researched peanut disease in Virginia. Efforts to control it by L. I. Miller beginning in 1938 have been described in the Wingard, Couch, Foy, and Hooper Eras. Throughout these periods, the use of foliar applied fungicides has remained the most reliable control measure. Porter studied the effects of changing management practices and reported that conventional tillage (plowing and disking) delayed the onset of leafspot more than conservation tillage (unplowed, wheat winter cover) (Proc. Am. Peanut Res. Educ. Soc. 22:44, 1990.). Earlier planting dates, earlier harvest dates did not produce the benefits from fungicides that later dates did (Ibid. 22:60, 1990.). As little progress had been made in breeding leafspot resistant cultivars, a mechanical procedure for grading plants or plots for severity of leafspot was tested. Called "machine vision technology", results obtained by human and machine scoring were comparable and five cultivars were similarly ranked. The method could speed up plot cultivar evaluation (Ibid. 26:47, 1994.). By 1997, some exotic sources of resistance had been isolated (Ibid. 19:53, 1987; 23:21, 1991; Peanut Sci. 19:41 - 43,1991; Biol. & Cult. Tests 7:57, 1992; 9:101, 102, 1994.).

In an effort to reduce the cost of applying fungicides, the method of N. L. Powell, Porter, and Roberta Dow (Proc. Am. Peanut Res. Ed. Soc. 12:41, 1980.), i.e., the peanut leafspot advisory, was continually evaluated, revised, and modernized until it is a vital part of the extension peanut project led by Phipps; cost of leafspot control was cut in half by this innovation (Plant. Dis. 81: 236 - 244, 1997.).

"The Virginia Peanut Leafspot Advisory (VPLA) was first delivered to peanut growers in southeast Virginia in 1981, and has allowed growers to reduce the number of fungicide applications per cropping season (Phipps and N. L. Powell, Phytopathology 74:1189 - 1193, 1984.), but fungicide sprays according to the VPLA in some years allowed development of disease late in the season to levels which caused concern among growers. The need to improve the leafspot advisory program was suggested by Elspeth L. Jewell. (Correlation of early leafspot disease in peanut with a weather-dependent infection index. M.S., Thesis. V.P.I. & S.U. 1987.)." This quote is from R. S. Cu. (Development and evaluation of a computerized leafspot advisory program for effective use of cultivar resistance, fungicide, and spray adjuvant to control early leafspot of peanut. Ph.D. Diss. V.P.I. & S.U. 1991.).

As the leafspot advisory was developed and refined, getting the appropriate information to the growers became a problem. "This obstacle was overcome in 1979 with the implementation of an environmental monitoring system developed through cooperative research by Virginia Tech, the National Aeronautical and Space Administration (NASA), and the U. S. Department of Agriculture" (Phipps. Plant Dis. 77:307 - 309. 1993.). This has evolved into the Peanut/Cotton InfoNet which offers advisories daily on an electronic bulletin board. A personal computer, communications software, and a modem with phone connection are required to access the bulletin board" (Phipps, 1999 Field Crops pest Management Guide, Va. Coop. Ext. Publ. 456 - 016, 1998.).

More is said about the advisories toward the end of the section on Peanut.

Porter, with others, evaluated the effects of irrigation on peanut. Overhead irrigation caused increased severity of Sclerotinia blight, pod rot, and early leafspot; consequently, yields were reduced under sprinkler irrigation (Plant Dis. 71:512 - 515, 1987.).

Cylindrocladium black rot (CBR) was one of Porter's major research topics. He and several colleagues studied the colonization and survival of the CBR fungus in seeds. The fungus, *Cylindrocladium crotalariae*, could colonize seeds but lost viability in storage. Seed transmission was remote if discolored and shriveled seed were removed and the seed were treated with captan or carboxin (Proc. Am. Peanut Res. Educ. Soc. 21:30, 1989; 23:51, 1991; Phytopathology 81:896 - 900, 1991.).

With the introduction of isothiocyanates, particularly metam-sodium (Vapam and Metam) as preplant soil fumigants, damage from Cylindrocladium black rot was minimized.

The increasing prevalence of Sclerotinia blight in the early 1980's stimulated considerable research on its control during the Moore Era. Phipps and Porter both devoted much time and effort analyzing the environmental factors conducive to its development and containment. Phipps and R. W. Mozingo, the plant breeder at Suffolk, sought suitable resistant cultivars. Three graduate students earned Ph.D. degrees by researching the disease. They were T. B. Brenneman, may 1986; F. D. "Tad" Smith, December 1990; and D. B. Langston, April 1998.

Initially, effort was devoted to finding a fungicide that would diminish the losses from Sclerotinia blight. By 1975, dicloran and PCNB were the primary chemicals recommended, but they barely paid for their use. In 1985, iprodione was registered (Smith, T. D., Evaluation of fungicide resistance in *Sclerotinia minor* and strategies for chemical control of Sclerotinia blight of peanut. Ph.D. Diss., V.P.I. & S.U., 1990.). Although it was much more efficacious than decloran and PCNB, there were cases where it failed completely. In most cases, failure was attributed to timing and methods of application, but occasional cultures with resistance to iprodione were isolated (Smith, 1990.).

In his dissertation, T. B. Brenneman describes methods for studying fungicidal action against *Sclerotinia minor* (Brenneman, T. B. Sensitivity and resistance of *Sclerotinia minor* to fungicides for control of Sclerotinia blight of peanut. Ph.D. Diss., V.P.I. & S.U. 1986.). He demonstrated that excised peanut stems could be used "to evaluate isolate pathogenicity, cultivar resistance to the disease, susceptibility of different age peanut tissues, and fungicide persistence on peanut stems in the field. The method was also used to screen fungicides; results verified previous findings which indicated that *in vitro* resistance is not equivalent to *in vivo* resistance" (Brenneman, Ph.D. Diss.).

Since it had been demonstrated that several fungi became resistant to chemicals used to control them, Brenneman investigated the possibility that fungicides efficacious against *Sclerotinia minor*, especially iprodione, might be rendered ineffective by resistant strains. He found nine fungicide-resistant colony sectors; seven maintained resistance through three years of subculturing and two survived in microplots as well as a wild type. Thus, in due time it appeared that iprodione may be rendered ineffective by resistant populations. Several papers were published on this work (Peanut Sci. 12: 41 - 45, 1985; Phytopathology 74: 755, 815, 1984; 77:1028 - 1032, 1987; 78:863, 1988; Plant Dis. 69:143 - 146, 1985; 71: 87 - 90; 71;:546 - 548, 1987; Proc. Amer. Peanut Res. Educ. Soc. 17:43, 1985.). However, iprodione has survived to the year 2000 as the only registered fungicide for Sclerotinia blight control. In 1992, Smith, Phipps, and Stipes reported fluazinam to be a new fungicide for control of Sclerotinia blight (Peanut Sci. 19;115 - 120.), but for some reason it was not registered for commercial use. Through the Moore Era, only the fungicide iprodione (sold as Rovral) was registered for control of Sclerotinia blight (1999 Field Crops Pest Management Guide, Va. Coop. Ext. Ser. Publ. 456 - 016; 115. 1998. Note: Fluazinam was registered for blight control for the 2001 peanut crop.)

Since peanuts require considerable pesticides for quality production and they are produced in coastal plains, they are thought to contribute to chemical contamination of estuaries, bays, and sounds. Ecology-minded scientists began in the Moore Era to seek production methods that would abate the use of chemicals and reduce contamination of water. Emphasis was given by Phipps and his colleagues to use of disease resistant cultivars, biological agents and modifying the environment. Results of these approaches were recorded annually in the American Phytopathological Society publication Biological and Cultural Test (BCT) volumes 1 through 13, 1986 - 1998.

Breeding or finding cultivars resistant to Sclerotinia blight did not yield significant progress. Phipps observed in 1987 that 'Va 81b' and "AD1' expressed some resistance, and later found among six Virginia types "NC6' was most resistant, and among 11 runner types, two Texas lines and "Georgia Green' were best (BCT 3:66, 1988; 13:76, 1998.). Mozingo observed that resistance in Va 81B was highly heritable in his breeding work, and that among 8 large-seeded cvs., a line produced by him, 'Va 910954', was best. However, Langston stated that true resistance to *Sclerotinia minor* had not been found and that apparent resistance was attributed to architectural characteristics of the canopy, i.e., density and erectness (Langston, D. B., Jr. The role of host, environment, and fungicide use patterns in algorithms for improving control of Sclerotinia blight of peanut. Ph.D. Diss., V.P.I. & S.U., 1998.).

The first biological agent tested by Phipps was *Trichoderma harzianum*; no significant suppression of disease was noted (BCT 4:40, 1989.). In 1992, Phipps reported on results with several biological agents compared with Rovral and fluazinam. Biologics included *Bacillus cereus, B. megaterium, B. subtilis, Pseudomonas putida, P. fluorescens, P*. sp, an Actinomycete, *Sporidesmium* sp., and *Trichoderma* sp. Fluazinam gave best blight control and highest yield; among the biologics, *B. cereus* produced the highest yield, one *Sporidesmium* produced the best blight control and highest yield. The products tested must have been commercially formulated as there was no explanation about their preparation (BCT 7:60, 1992.). A similar trial for leafspot control compared the same bacteria against Bravo 720. No bacteria produced satisfactory control or yield increase (BCT 7:56, 1992.).

For some reason, Phipps and Langston conducted field trials in 1995 on the "nutritional enhancement" for control of Sclerotinia blight with two applications of corn meal at mid-season. Yields and blight control were slightly better for enhanced plots than for untreated plots, about equal to Rovral treatment (the only fungicide registered for blight control), but inferior to fluazinam. (BCT 11:54, 1996.). Similar results were obtained in 1996 (BCT 12:75, 76, 77, 1997.).

Phipps et al. evaluated planting dates, seeding rates, irrigation, and canopy modification in an effort to find optimum cultural management for lessening losses from Sclerotinia blight. By the end of the Moore Era, advisories were issued for pesticide application. These were aimed at control of all diseases for management of the peanut crop to achieve maximum yields with minimum pesticide input. Recommendations for pesticide applications and access to advisory information are revised annually in the "Field Crops Pest Management Guide" (Va. Coop. Ext. Publ. 456 - 016.). Phipps, S. H. Deck (USDA-ARS, Stoneville, Miss.), and D. R. Walker (Walker, Asher, and Scott, Inc., Johnstown, Pa.) published a feature article in Plant Disease 81 (3): 236 - 244, 1997, entitled "Weather-based crop and disease advisories for peanuts in Virginia." They give the details of weather analysis and crop development needed to advise fungicide applications for early leaf spot, Sclerotinia blight, and impending danger of frost at harvest time. They, also, describe weather monitoring networks and information delivery systems. The article was an excellent presentation of the status of peanut advisories at the time.

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A History of Plant Pathology in Virginia: The Moore Era (7/1/1984-3/31/1997)

Tobacco

When Moore became Interim Department Head on July 1, 1984 and Department Head on July 1, 1985, tobacco research and extension at Blacksburg ended. Thereafter, all tobacco projects were completely controlled by personnel at the Southern Piedmont Agricultural Research and Education Station at Blackstone. Plant pathology research was managed by John J. Reilly; extension by D. A. Komm. However, during Moore's interim tenure, Reilly and Komm resigned; Reilly on December 31, 1984, and Komm on January 31, 1985. Hiring a replacement became the joint function of the Station Director, James L. Jones, and Moore.

At a tobacco station, much of the extension activity occurs in mid-winter when growers and County Agents are appraised of new technologies and implored to implement disease control practices on schedule. Field research activities begin early in the calendar year, especially planning experiments, lining up grower-cooperators, and fumigating seed beds. Thus, it was essential to hire replacements as soon as possible. However, hiring procedures for state employees is not a speedy matter. Meanwhile, the decision was made to eliminate one position in plant pathology, to combine into one appointment the duties of both the extension and research position, *and* to add to the position research and extension in weed science. The position was not filled until September 1, 1985, when Charles S. Johnson was appointed Assistant Professor. It appears that plant pathology research and extension had been squeezed down to the early Reilly period before the hiring of Komm. Actually, plant pathology had been further rendered trivial because the plant pathologist also needed to be a weed scientist. Thus, it may be said that Johnson had to fill two shoes, create two more, and fill them, also. Johnson was capable of doing so and has done a credible job. The 1992 Comprehensive Review gives his assigned distribution as 60% research and 40% extension.

Johnson earned a B.S. degree at the University of North Carolina, 1979; M.S., 1982; and Ph.D. 1985, both the latter at North Carolina State University. His thesis and dissertation were entitled, TMV crop loss methodology in flue-cured tobacco. M.S. Thesis, North Carolina State Univ., 1982. The role of partial resistance in the management of Cercospora leafspot of peanut in North Carolina, Ph.D. Dissertation, N.C.S.U., 1985.

On assuming his duties at Blackstone, Johnson addressed a broad array of disease problems in his extension project, but emphasized research on cyst and root knot nematodes. He did, however, devote attention to the long-standing problems of blue mold, black shank, and bacterial diseases. In the 1992 Comprehensive Review, Johnson stated his goals were to develop concepts and strategies of disease management that would maximize farm profits while minimizing harm to the environment. He would aggressively investigate alternative disease control methods to improve pest management. He listed three specific objectives:

(1) To identify an economic threshold for tobacco cyst nematodes.
(2) To develop practical systems for predicting the incidence, severity, and economic consequences of tobacco disease problems such as cyst and root knot nematodes, black shank, bacterial wilt, and blue mold.
(3) To Identify flue-cured tobacco genotypes resistant and/or tolerant to tobacco cyst nematodes.

Most of the research pertaining to these three objectives was supported by grant funds from the Virginia Bright Flue-Cured Tobacco Board.

In his extension project, Johnson focused on educating county agents to deliver timely programs to growers. He also diagnosed plant diseases, made field calls to aid agents with unusual problems, coordinated a blue mold warning and control system for Virginia, conducted small plot and on-farm test demonstrations of disease, nematode (and weed) control practices, up-dated extension publications on an annual basis, and discussed disease and nematode management at grower meetings, agribusiness training sessions, and pesticide applicator certification meetings. Johnson's research and extension objectives were essentially the same in the 2000 Comprehensive Review, but were more succinctly stated.

Several extension publications that were updated annually contained disease management information. These were:

Flue-Cured Tobacco Production Guide, Publ. 436 - 048.
Flue-Cured Tobacco Variety Information, Publ. 436 - 047.
Dark-Fired Tobacco Production Guide, Publ. 436 - 049.
Dark-Fired Tobacco Variety Information, Publ. 436 - (?).
Burley Tobacco Production Guide, Publ. 436 - 050.
Burley Tobacco Variety Information, Publ. 436 - 417.
Diseases and Nematodes of Tobacco, Pest Management Guide, Publ. 456 - 014.

The 2000 Pest Management Guide presents a 16-page guide to tobacco disease and nematode management. Sections include crop rotations, disease control for greenhouse tobacco, nematode diseases and chemical controls, plant bed diseases, foliar diseases in the field, root diseases, diseases for which there are no chemical controls, lists of disease-resistant varieties of flue-cured, burley, and dark-fired tobacco. Surprisingly noticeable is the virtual absence of Virginia-bred varieties among the flue-cured and burley lists, although there have been active breeding programs in Virginia for these types for more than 60 years. Among 32 flue-cured varieties, the only Virginia-bred variety listed is VA116. Virginia-bred varieties are well represented among dark-fired varieties, 6/11 of those listed.

One of the problems with disease-resistant varieties has been to combine good resistance with good leaf quality. Experiment stations and extension services formerly recommended crop varieties to growers after thoroughly testing available varieties. A variety was "recommended" when it was shown to produce the best yield of acceptable quality. This was fine when most varieties originated at experiment stations, but now that so many are of private origin, varieties are no longer recommended, but after testing they are thoroughly described and the growers choose those that best suit their needs. This procedure was probably brought about to avoid discrimination against any one commercial tobacco seed provider. However, not all growers are astute enough to choose appropriately from variety descriptions; they require assistance from county agents and the staff at the Blackstone station.

Much of Johnson's research effort addresses the biology and management of cyst and root-knot nematodes. This involved evaluating effects of rotations, soil fumigation, chemicals, and use of resistant cultivars on tobacco production. A brief review of some of Johnson's research publications is presented below.

In an attempt to maximize farm profits while minimizing damage to the environment, Johnson, Komm, and Jones explored the effects of rotating resistant and susceptible tobacco cultivars (cvs.) and alternating these rotations with nematicide treatments. They pointed out cyst-nematode-resistant cvs. are difficult to cure and not as productive, therefore, not as profitable to grow as were susceptible cvs. As the population of nematodes increased, resistance became less effective and because the resistance mechanism was hypersensitivity. This means at low nematode populations, a few infection sites resulted in minor damage to the root system. A plant could overcome the root loss by initiating new roots above the infection site. In essence, resistant cvs. were actually tolerant of nematodes. At high populations, however, numerous hypersensitive reactions were so destructive that root regeneration was overwhelmed and leaf production was reduced. Thus, a nematicide was needed at high populations because resistant cvs. were not profitable. Johnson et al. observed that rotation with non-susceptible (insusceptible) hosts reduced tobacco cyst nematode populations, but was not as profitable as continuous tobacco. They obtained the most profitable level of production by growing resistant cvs. For 2 years and fumigating concurrently with fenamiphos, followed by one year of a susceptible cv. with no nematicide (J. Nematol. 21:16 - 23, 1989.).

Johnson, in a paper entitled "Managing root-knot on tobacco in the Southeastern United States" (J. Nemat. Suppl. 21 (4S):604 - 608, 1989.), reviewed the research that had led to the current (1989) procedures for controlling root-knot. Management was dependent upon several practices utilized annually, namely, crop rotations, destruction of crop debris (esp. roots), growing resistant cvs., and applying nematicides. In addition, nematode advisory programs (which assess the potential for damage by determining the population level) may enhance profitability through wiser, conservative use of nematicides. Most of the research forming the basis of this review had been conducted in North Carolina prior to 1984.

Johnson extended the research on rotating cyst nematode resistant and susceptible cvs. of tobacco to show in the first year resistant cvs. reduced the population of *Globodera tabacum solanacearum* and it was feasible to grow a susceptible cv. in the second year. The population built up so rapidly in the second year that it was necessary to return to a resistant cv. in the third year. If fenamiphos were applied in the second year, a susceptible cv. would be more profitable in the third year (J. Nematol Suppl. 22 (4S):700 - 706, 1990.).

In an experiment which three nematicide treatments (fenamiphos alone, fenamiphos + chlorpyrifos, and fenamiphos + ethoprop) were applied broadcast at two locations to control tobacco cyst nematodes, fenamiphos alone reduce egg numbers, but other treatments did not. Although all increased yield at both locations, the return was not economically significant (Phytopathology 80:671 - 672, 1990.).

At low levels, tobacco cyst nematodes were reported by Johnson to stimulate the yield of flue-cured tobacco. Correlations for cyst eggs per 500 cm^3 of soil were negative for plant height, leaf number, and leaf area. Regression analyses indicated that at low levels there were 5.95 and 7.5 kg/ha gains for yield in 1990 and 1991 (Phytopathology 82:1095, 1992.). This could be a dangerous procedure for increasing profits from growing tobacco.

A graduate student, Jie Wang, completed a dissertation in 1996 entitled, "Characterizing resistance in flue-cured tobacco to *Globodera tabacum solanacearum*." Johnson and J. D. Eisenback were his co-advisors. Wang reported root exudates from both resistant and susceptible plants had similar effects as stimulants of nematode hatching. Tests conducted at several temperatures indicated an optimum range of 25 - 30° C. Infection suppressed number of leaves, plant height, and fresh weight of leaves and feeder roots. Resistant cultivar NC 567 was not as productive as susceptible K 326 in the absence of nematodes. Infection by nematodes had similar effects on both cvs. Resistance is expressed after infection, but is a damaging process; however, since reproduction is prevented by the resistant cv., the nematode population is decreased by growing a resistant cv. in infested soil. Wang, Johnson, and Eisenback summarized this research in a pair of publications (J. Nematol. 29:484 - 490, 1997; 31:326 - 333, 1999.).

It had been reported earlier that genes conditioning resistances in flue-cured tobacco to wildfire (*Pseudomonas syringae* pv. *tabaci*) and tobacco cyst nematode (*G. tabacum solanacearum*) were closely linked, and that by conducting the simpler test for reaction to wildfire, selection for resistance to the nematode could be facilitated. A graduate student, A. J. Hayes, in Crop and Soil Environmental Sciences (formerly Agronomy Dept.) working at Blackstone, evaluated the wildfire test for effectiveness in detecting new sources of cyst nematode resistance. Hayes found high correlation of resistance to both pathogens in some tobacco accessions, but a poor correlation in others. He concluded that screening for wildfire resistance is not a reliable procedure for detecting cyst nematode resistance (Hayes, C. A. Wilkinson, and C. S. Johnson. 1997. Evaluation of tobacco accessions for resistance to tobacco cyst nematode and wildfire. Crop Sci. 37: 586 - 591.).

Johnson et. al. continued research on the tobacco cyst nematode into the Hatzios era and reported that isolates from different sources were pathogenically similar. Consequently, a single isolate would suffice to screen germplasm for resistance (S. L. Rideout, Johnson, Eisenback, and Wilkinson. 2000. Development of selected tobacco cyst nematode isolates on resistant and susceptible cultivars of flue-cured tobacco. J. Nematol. 32:62 - 69.).

Johnson published numerous reports on his work with tobacco fungicides and nematicides. These formed the basis for annual revisions of extension publications. References to these publications are listed here:

> Fungicide and Nematicide Tests. 1988. 43:173, 174, 175, 176; 1990. 45:163, 164, 165, 166; 1991. 46:194 - 195; 1992. 47:166; 1993. 48:185, 186, 187.

Additional research on various tobacco nematodes, their morphology and biology appears more fittingly in the section on Nematology.

There was a dissertation completed in 1985 by L. P. Specht entitled "Inoculum densities of *Thielaviopsis basicola* in tobacco fields in Virginia, and the relationship of inoculum density to the severity of black root rot and growth of tobacco." In order to analyze precisely the relationship between propagule density and root rot effects, Specht initially developed a new medium for isolating *T. basicola* from soil and roots. Called TB-CEN medium, it contained etridiazol and nystatin to inhibit growth of undesired fungi, and unautoclaved extract from carrot to selectively enhance the growth of *T. basicola*. Although population densities were similar in burley, flue- and sun-cured regions, burley tobacco plants were more severely affected. Imazalil completely inhibited *T. basicola* in agar media at 1.0 /micrograms a.i./ml, but failed to control black root rot when added to transplanting water in concentrations as high as 1500/micrograms a.i./ml. Specht and his advisor, G. J. Griffin, published three papers on the dissertation research (Can. J. Plant Pathol. 7:438 - 441, 1985; 10:15 - 22, 1988; Pl. Dis. 71:876 - 879, 1987.).

Cereals

Cereal pathology research underwent a change in approach during the Moore Era. Since 1947, C. W. Roane had worked with corn and small grains breeders to produce disease-resistant inbred corn lines and small grains cultivars and to study the inheritance of reactions to pathogens.

His career was winding down as was that of his cooperating small grains breeder, T.M. Starling. Corn breeding *per se* had already ceased and Roane was completing a genetic study. New faculty were appointed with directives to exploit other avenues of research. Erik Stromberg and R.E. Baldwin undertook evaluating the feasibility of chemical disease control in cereal crops, and Stromberg was to evaluate and exploit various plant disease control measures in the intensive wheat culture methods. When Roane's work with Starling ended and Starling retired in 1988, Stromberg elected, or was directed, not to cooperate in the breeding program with his replacement, C.A. Griffey. Breeding and genetic research with maize dwarf mosaic virus also ended. Stromberg devoted himself almost exclusively to control of corn gray leaf spot. In addition, since Stromberg had a 60% extension, 40% research commitment, he felt compelled to carry out a total extension-research program that would produce results quickly. The chemical approach looked most promising.

In his retirement, C.W. Roane collaborated with his wife, Martha K. Roane, to collect and identify graminicolous fungi in Virginia. Three papers were published; the first dealt with fungi associated with cereals (Va. J. Sci. 45:279-296, 1994.). Others followed in 1996 and 1997 (Va. J. Sci. 47:197-224; 48:11- 45.).

<u>Corn</u> - During the 1980's, virus diseases and gray leaf spot (GLS) of corn commanded attention. The two viruses, maize dwarf mosaic virus (MDMV) and maize chlorotic dwarf virus (MCDV) had been largely conquered by the seed corn industry. Most commercial hybrids had been bred with a high level of MDMV and MCDV resistance or tolerance. Nevertheless, the overwintering host of these viruses, johnsongrass, was spreading and its populations were intensifying. The viruses commanded continuing attention of breeders; all new hybrid releases had to be

resistant, and from various tests it appeared that they were.

At the beginning of the Moore Era, Roane was studying the genetics of reaction to MDMV. With Tolin and corn breeder C.F. Genter, he had published that monogenic resistance occurred in the inbred line Oh7B (Phytopathology 73:845-850,1983.). By then, Genter was the breeder for a commercial seed company in North Carolina. His replacement was Harold S. Aycock who wished to continue the genetics of virus reactions. Although Roane retired in August 31, 1986, he continued the work until 1989 when Roane, Tolin, and Aycock published two papers on the work. In the first, they report that reaction to MDMV was conditioned by single, allelic genes in the inbred lines B68, Oh1EP, Oh7B, and Va85. The gene was labelled *Rmd1* (Phytopathology 79:139 -1368, 1989.). In the second paper, *Rmd1* was shown to be linked with genes for endosperm color and texture, *y1* and *su2*, respectively, on chromosome 6. A map of the region was published as $rmd1^{17}y1^{40}su2$. The distances were calculated from F_2 data (Phytopathology 79:1368- 1372, 1989.). The results were corroborated by a study done at Wooster, Ohio by M.D. McMullin and R. D. Louis who used restriction fragment length polymorphism (RFLP) analysis. (Phytopathology 78:1543, 1988; Molecular Plant-Microbe Interactions 2:309 - 314, 1989.). It was very satisfying to obtain almost identical results with such diverse methods. The studies described above brought genetic research on MDMV to a halt at V.P.I. & S.U.

For the period 1965 - 1988, the corn breeders C. F. Genter and H. S. Aycock, and P. J. Donahue and pathologist Roane had cooperated to test corn inbred lines, hybrids, and promising germplasm for reaction to MDMV and MCDV. Of the two, MCDV had been determined to be the most destructive, but it was severe only in close proximity to johnsongrass. Field testing where both viruses infected corn was done on the farm of Cliff Wood at Wingina, Nelson Co. Mechanical inoculations were executed at Blacksburg. Thus, it was determined that MCDV virtually sterilized any plant it infected early and stunted plants infected during elongation. More than likely, MCDV-infected plants had been previously infected with MDMV as aphids were more efficient at spreading MDMV than leaf hoppers were at spreading MCDV. Early dual infections were very destructive. From this on-farm study, researchers were able to advise farmers which hybrids could be profitably grown in johnsongrass infested fields.

Erik Stromberg continued the work of screening corn germplasm for resistance to viruses. He relied on artificial inoculation with MDMV and depended on opportunistic occurrences of MCDV. The results from these tests were published annually in the Pest Management Guide (Va. Coop. Ext. Serv. Publ. 456 - 011, & 456 - 16, rev. ann.).

In the Agronomy Department (renamed Department of Crop and Soil Environmental Science about 1990), P. J. Donahue completed an M.S. degree; his thesis was entitled "Diallel study of stalk rot resistance in elite maize and its interaction with yield" (Donahue, P. J.; M.S. Thesis, V.P.I. & S.U., 1986.). Elite lines were defined as those in wide use in commercially available hybrid corn varieties.

Stalk rot has been a problem in corn production from the beginning. Several organisms cause it, but the most damaging in Virginia are *Diplodia maydis* (now *Stenocarpella maydis*) and *Fusarium moniliforme*. Donahue artificially inoculated plants with the two organisms by inserting infested toothpicks into the third internode above the ground. Although disease scores were significantly higher in diseased than in control stalks, yield differences were not significant. General combining ability effects were significant for stalk rot scores but not for yield. Two Virginia inbred lines Va17 and Va85 produced high yields and high levels of stalk-rot resistance. These lines were bred in the Genter-Roane era of corn breeding. Usually rotted stalks have well-filled ears; when rotted stalks break and their ears are out of reach of the combine, rot makes an impact on yield. The method used by Donahue would not reflect this because all stalks were harvestable (See also Donahue, Stromberg, and Roane, Va. J. Sci. 40:157 - 170, 1989.).

Upon completing the M.S. degree, Donahue's adviser, H.S. Aycock who was the corn breeder, resigned and Donahue was appointed Maize Project Coordinator until 1987. Then he was elevated to Extension and Research Associate and served in this position until 1989. He and Stromberg collaborated on MDMV and GLS projects until his departure in 1989. Donahue was the last true corn breeder at V.P.I. & S.U. He functioned as such while completing a Ph.D. program.

Stromberg joined with Donahue to evaluate the resistance to MDMV (and GLS) of 14 "elite" inbred corn lines in a diallel cross. Plants were scored for reaction to virus at anthesis and afterward. Various statistical procedures were applied to the scores and agronomic traits. Resistance to MDMV was found to be additive and highly heritable. However, yield and virus scores were negatively correlated ($r = -0.179^*$), albeit with low significance. The results were based on a two-year study in Montgomery Co., 1987 and 1988, and they became the basis of Donahue's Ph.D. dissertation. Surprisingly, no attention was paid to the fact that Roane, Tolin, and Aycock (Phytopathology 79:1364-1368, 1989.) had reported two lines, B68 and Va85, to have monogenetic dominance for MDMV resistance. How would this affect a diallel study and the conclusions therefrom?

Gray leaf spot (GLS) of corn caused by *Cercospora zeae-maydis* became a subject of intensive research during the Moore Era. Roane and plant breeders earlier had sought to identify hybrids and inbred lines with high resistance to GLS, but had found only moderate resistance. Moderate resistance did not function well in nurseries where surrounding suscepts produced outpourings of spores which overwhelmed moderate resistance. As a consequence, no satisfactory resistance was identified by Roane and the breeders.

Stromberg had joined with Donahue to evaluate resistance to GLS, and over a period of years they had identified a number of inbred lines that produced resistant hybrids. In a diallel cross study combining reaction to MDMV and GLS, the same 14 "elite" inbred lines in the MDMV study and the same plots and plants were used for the GLS study. The lines were a mixture from corn belt and eastern states breeding programs. Virtually all lines contributing resistance originated in eastern states where disease pressure by GLS had facilitated selection. Only B68 was of Corn Belt origin; this line and NC250, Pa875, Va14, Va17, and Va85 were considered contributors of GLS resistance in the diallel study.

As previously stated, Donahue used the same plots in the MDMV study for a GLS study. He found as for MDMV, GLS resistance was highly heritable and controlled by additive genes. (It is difficult for me, the writer, to deduce how the effects of GLS and MDMV could be separated in this experiment.). The correlation coefficient for

GLS and yield was r = +0.472. There should have been a high correlation coefficient for total disease and yield, but no such coefficient was calculated (Donahue, Stromberg, and S.L. Myers, Crop Sci. 31:926-931, 1991.).

Weed scientists made contributions to the control of maize virus diseases by quantifying the effect of post-emergence application of herbicides on severity of virus diseases. John W. Eberwine earned a Ph.D. degree while making such a study (J.W. Eberwine. 1996. Effect of postemergence johnsongrass control on MCDV and MDMV incidence and severity in field corn. Ph.D. Diss, V.P.I. & S.U.). In essence, herbicide-killed johnsongrass as it died became less palatable to aphids and leafhoppers causing them to move to corn. The effect was greater on MCDV than on MDMV because aphids were much more efficient in spreading MDMV and would spread the virus irrespective of herbicides. Leafhoppers, being much less numerous, tended to remain in place until disturbed or until host plants became unpalatable. Thus, MCDV was more severe after herbicide application than in untreated areas (Weed Tech. 12:121-127, 1998.).

Research on GLS resistance took a step into the molecular biology world when M.A. Saghai-Maroof (of the Department of Crop and Soil Environmental Sciences) and Stromberg and others collaborated to use RFLP analysis for 78 marker loci scattered through all 10 maize chromosomes. They studied F_2 and F_3 of the cross of B73 (susc.) X Va14 (res.). Quantitative trait loci conditioning resistance were found in chromosomes 1, 4, & 8 (large effects) and chromosome 2 (smaller effect). All resistance loci originated from Va14 (Theor. Appl. Genet. 93:539-546, 1996.). This was the first application of molecular procedures to disease-resistance studies at V.P.I. & S.U.

There is always in plant pathology a need to know the economic impact of a disease on a crop. Stromberg, M.R. Carter (a graduate student), and L.E. Flinchum (Research Supervisor) conducted a series of experiments to determine the effect of GLS on yield and other agronomic traits. They applied several different fungicides two or four times. In different treatments, yields were increased 24 to 69% by fungicides. It was shown that reduced number kernels per ear and reduced kernel weight were components most affected (Fungicide & Nematicide Tests 45:200, 46:241, 48:207, 53:143-144; Carter included these studies in her M.S. Thesis titled "Gray leaf spot of corn: Yield loss and evaluation of germplasm for resistance, 1992. 1990-1998). This was valuable information for convincing growers to plant the most resistant hybrids and convincing administrators or granting agencies to support research on GLS.

On December 1, 1987, Herman L. Warren, a U.S.D.A. corn pathologist on the Purdue University faculty, was appointed Commonwealth Visiting Professor in PPWS. During his year-long stay, he prepared publications on his research at Purdue. The work emphasized anthracnose (*Colletotrichum graminicola*) on corn and sorghum, gray leaf spot (GLS = *Cercospora zeae-maydis*) and southern leaf blight (*Bipolaris maydis*) of corn. Warren was courted for employment at V.P.I. & S.U. and on May 1, 1989 was appointed Professor of Plant Pathology. He was assigned 60% extension and 40% research time. During the Moore Era, his extension efforts were on vegetable crops (see section on vegetable pathology); his corn research was largely related to breeding germplasm for resistance to GLS and supervising three students through Ph.D. programs on corn diseases. Interestingly, the students researched three diverse problems.

Edvardo J. Traut, a native of Buenos Aires, Argentina, studied variation in *Bipolaris zeicola* and resistance to the fungus. With six inbred lines, Traut distinguished 11 races of *B. zeicola*. He pointed out that the three lines used in prior race determinations were too limiting as differentials. This is a reasonable conclusion since genes in corn conditioning reaction are known at two loci, *Hm* and Hm_2 ; in addition, two alleles, Hm^A and Hm^B, may occur at the *Hm* locus. If the gene-for-gene hypothesis were invoked, several additional races should be recognized. *B. zeicola*, unlike other fungi, produces a toxin which changes the basic symptoms; the ability to produce or not to produce the toxin must be included in race determinations of *B. zeicola* (Traut, E. J., Ph.D. Diss., V.P.I. & S.U., 1993.).

Anne E. Dorrence studied the inheritance of resistance to diplodia ear rot and variability in *Stenocarpella maydis* through isozyme analysis (Dorrence, A. E., Ph.D. Diss., V.P.I. & S.U., 1995.). The fungus was formerly named *Diplodia maydis* and *D. Zeae*; hence, the disease is called diplodia ear rot. From a diallel study of nine inbred lines, she found general combining ability effects were significant, indicating that dominance or epistatic effects were important. Inbred lines B37, H111, B68, and M5 consistently contributed greatest resistance among the nine lines studied. In the isozyme study, 47 isolates were examined and isozyme polymorphisms occurred at a low level. This is more characteristic of biotrophs than of autotrophs such as *S. maydis*.

In 1998, Symon F. M. Mwangi completed a dissertation on maize diseases in Kenya. Most of the research was conducted during the Moore Era. He surveyed Kenyan maize fields and concluded diseases caused by *Exserohilum turcicum*, *Phaeosphaeria maydis*, *Bipolaris maydis*, *Puccinia polysora*, *P. sorghi*, and maize streak virus were the most common and most destructive Nineteen *E. turcicum* isolates from Kenya were classified into 5 races of the Leonard et al. scheme (Leonard, Levy, & Smith, Plant Dis. 79:776-777, 1989.), and 3 races which did not fit the Leonard et al. scheme (Mwangi, S. F.M., Ph.D. Diss., V.P.I. & S.U., 1998.).

Although not published until the Hatzios Era (1997 - 2000), a review article on GLS was prepared by J.M. Ward, South Africa; Stromberg; D.C. Nowell, South Africa; and F. W. Nutter, Jr., Iowa. The article, "Gray leaf spot, a disease of global importance in maize production" (Plant Dis. 83:884-895, 1999.), reviewed the history of GLS through 1998. Until the 1990-91 growing season in South Africa, GLS was only known from the western hemisphere, primarily the United States (Latterell and Rossi, Plant Dis. 67:842-847, 1983.). It caused economic losses in the 1990-91 growing season of South Africa; it now occurs destructively in most East African countries north to Ethiopia. Surprisingly, Mwangi did not detect it in Kenya. Both Stromberg and Warren have established research and consulting connections in Africa regarding GlS.

It is amazing that a disease that first sprang into prominence in Virginia in 1971 has become a damaging disease in the U.S. Corn Belt and much of Africa. Even though its presence in the U.S. was discovered in 1924, it was relatively unimportant until farmers adopted reduced tillage and continuous corn cropping systems with susceptible hybrids.

<u>Small Grains</u> - From 1948 to 1988, plant breeder T. M. Starling and plant pathologist C. W. Roane cooperated to breed disease-resistant small grain cultivars for Virginia

and surrounding states. Their aim was to breed stiff-strawed, high-yielding, high quality, disease-resistant cultivars. They were joined in this endeavor by loyal, conscientious assistants, A. M. Price at Blacksburg and W. Sisson at Warsaw, both of the Agronomy Department and most recently, L. E. Flinchum of Plant Pathology, Physiology and Weed Science at Blacksburg. They were also assisted by several graduate students and agricultural technicians. They are indebted to H. M. Camper, Jr., Superintendent of the Eastern Virginia Research Station at Warsaw, who was greatly interested in cereal improvement and who provided land, labor, chemical, and machinery needs. Indeed, Camper was considered a co-developer of all released cultivars. Whereas the two departments bore most of the expense of the cereal improvement project, the program was enhanced by grant funds primarily from the Virginia Agricultural Foundation (later Va. Agri. Council).

Roane retired August 31, 1986 after 39 years and two months of service. However, he continued in emeritus status to be the plant pathologist cooperating with Starling until his retirement in December 31, 1988. Thereupon, C.A. Griffey took charge of the breeding program, sans cooperation of a plant pathologist. During the Starling-Roane era, 10 barley, 9 wheat, and 2 oat cultivars were released. Each possessed resistance to one or more diseases.

Barley diseases emphasized were leaf rust, powdery mildew, spot blotch-net blotch complex, scald and barley yellow dwarf.

Oat diseases emphasized were crown rust, stem rust, red leaf (= yellow dwarf), victoria blight, and soil-borne mosaic.

Wheat diseases emphasized were powdery mildew, leaf rust, stem rust, soil-borne virus diseases, and septoria leaf and glume blotch.

Stromberg took on programs designed to improve yield through management of diseases, but he did not participate in the breeding project. Thus, early in the Moore Era, small grain pathology underwent marked changes.

During the period 1984 -1988, when Starling retired and Roane stopped post-retirement work on the small grains project, two aspects of research were followed. The breeding program was continued (and handed over to C. A. Griffey in 1989) and special studies were carried out on virus-infested land (the W.D. Edwards farm near Lyells in Westmoreland Co.) to determine the mode of inheritance of reaction to wheat spindle streak mosaic virus (WSSMV) and to select breeding lines and cultivars resistant to WSSMV (Wheat Newsl. 35:197-199, 1989.). Although cultivars in drill-rows were readily classifiable as resistant (non-symptomatic) or susceptible (symptomatic), when space planted they behaved erratically. Because cultivars used as resistant parents in crosses were unstable, F1 and F2 data did not provide sensible hypotheses for number of genes conditioning reaction. It appeared that susceptibility was dominant. Data also suggested that selection for resistance could only be efficiently executed on infested soil.

In diseases incited by "soilborne" viruses wherein the virus survives in soil or on the vector, in this case, *Polymyxa graminis*, factors affecting the epidemiology of the vector must be considered. Conditions sometimes are not favorable for the fungus to vector the virus. In the 1984-85 and 1986-87 seasons, nurseries on infested soil were very useful for selecting resistant germplasm; the 1985-86 season was not

(Roane & Starling, Reports to the Va. Agri. Council, 1985-1988.).

Assessing the effect of WSBMV and WSSMV on yield proved difficult. It was almost impossible to obtain side-by-side data from diseased and disease-free plots. The best that could be done was to compare yields from nurseries on virus infested and virus-free fields. In the Roane-Starling studies, yields at Lyelle and the research station were compared. There were indications that virus depressed yields of susceptible cultivars, but the data were not clearcut. High-yielding cultivars in virus-free nurseries tended to be high yielding on infested land, regardless of their reaction to virus. Studies on "soilborne" virus diseases proved to be both frustrating and intriguing.

The precise mechanism of vectoring by *Polymyxa graminis* of wheat viruses has not been understood. R. L. Grayson applied his expertise with the electron microscope to the problem. An anomaly emerged immediately. S.A. Tolin, departmental virologist and consequently an expert electron microscopist since the late 1960's, had only been able to find the long flexuous rods of WSSMV in wheat tissues. Grayson examined infected tissues of wheat from soils thought from symptoms in wheat to have WSBMV. Samples were obtained mostly from symptomatic wheat in Orange County, an area not sampled in Tolin's studies. Tolin verified that WSBMV was present in Grayson's samples. Although this was not the point of Grayson's studies, he had shown that the Orange area had WSBMV, and Tolin had shown that the Warsaw area had WSSMV.

Continuing with Grayson's objective to establish through electron microscopy the physical relationship between WSBMV and *Polymyxa graminis*, graduate student Mary Sue Mayes as Grayson's advisee selected the topic for her M.S. thesis. Mayes found that the fixatives then in use (glutaraldehyde or osmium oxide) caused WSSMV particles to deteriorate rapidly, whereas paraformaldehyde kept the particles intact. This revelation did not totally resolve the electron microscope studies of thin root sections for establishing the wheat-fungus-virus relationships. Mayes observed virus projecting from the surface of *P. graminis* but not attached parallel to the surface. No virus was observed within the fungus. Up to 15 virus particles were observed associated with cross-sections of the fungus, perpendicular to the surface of plasmodia. Since a section represents only a minute portion of a *P. graminis* plasmodium, it is difficult to estimate how many viruses might be attached to a single plasmodium. Mayes obtained evidence that the virus replicates in the fungus, and for this reason she thought the virus spreads rapidly through the host roots. It is then translocated and replicates in the foliage. Mayes never demonstrated that WSSMV survives dormant (summer) periods in cystosori and cysts. Even though she was the first to demonstrate clear-cut physical association between WSSMV and *P. graminis*, sad to say no journal publications were issued from her electron microscope work (Mary S. Mayes, 1989. An ultrastructural and immunocytochemical study of the wheat soil-borne mosaic virus/*Polymyxa graminis* relationship. M.S. Thesis. V.P.I. & S.U.). Two papers on the effects of chemical and physical environments on WSBMV were presented at American Phytopathology Society meetings (Phytopathology 79:1989; 81:1155, 1991.). Neither Grayson nor other students pursued the topic further.

As mentioned before, the small grains breeding program was under the leadership of C.A. Griffey beginning in the spring of 1989. Griffey mechanized the planting and harvesting procedures. For a while, he evaluated the germplasm that had been generated in the Starling-Roane era. In 1990, 'Wakefield' and 'Madison' were released; both were being tested for possible release beginning in 1986, three years before Griffey's appointment (Crop Sci. 31:1705; 1705-1706, 1991.). In the release notice, Wakefield was described as having the *Pm1* gene for powdery mildew resistance, but as being susceptible to powdery mildew in Virginia; the *Lr10* gene for leaf rust resistance; and *Sr15* and possibly *Sr10* for stem rust resistance. Madison was moderately resistant to powdery mildew; possessed *Lr10* and *Lr11* genes for leaf rust resistance and Sr6, Sr17, and Sr36 for stem rust resistance; was resistant to wheat spindle streak mosaic virus; and the Great Plains biotype of Hessian fly. Madison, incidentally, was named for Thomas *Madison* Starling; the name Starling was not available for wheat.

In 1990, there began a period when wheat lines were released to private seed companies. The disease reactions of these releases were not described in journals as were those of public releases. In the Moore Era, eleven private (or exclusive) and five public releases were made. Public cvs. in addition to those previously described were 'Jackson', 1993; 'Pocahontas', 1997; and 'Roane', 1999.

Jackson was released in June 1993 from a cross made by Starling in 1982 (Crop Sci. 36:1074-1975; 1996.). When released, it was moderately resistant to powdery mildew, carried *Lr11* plus unidentified genes for leaf rust resistance but was only moderately resistant, was resistant to stem rust, moderately tolerant of septoria leaf blotch and glume blotch, and moderately susceptible to wheat spindle streak mosaic.

Pocahontas was released in February 1997 (Crop Sci. 41:1361-1362; 2001.). It was described as resistant to powdery mildew and several prevalent races of the stem rust fungus and moderately resistant to glume blotch. However, it was susceptible to leaf rust (*Lr11* was not effective), moderately susceptible to barley yellow dwarf virus, and susceptible to wheat spindle streak mosaic virus.

Roane, although released in 1999, resulted from a cross made by Starling in 1984 (Crop Sci. 41:1359; 2001.). When released, Roane was resistant to barley yellow dwarf virus and powdery mildew; it probably possesses *Pm4a* and *Pm3a*. Adult plants are moderately resistant to leaf rust, septoria leaf blotch and glume blotch, and scab. It was susceptible to stem rust and both soil-borne virus diseases. Roane was the final publicly released wheat cv. originating from crosses made by Starling and tested and released by Griffey. Roane "was named in honor of Curtis W. Roane, Professor Emeritus....for his contributions toward the development of disease and insect resistant small grain cultivars."

Griffey also released four barley cvs. from crosses made by Starling; 'Callao', 'Nomini', 'Pamunkey', and 'Starling'. All have multiple disease resistances.

Nomini, released in 1992, resulted from a cross made by Starling in 1977 (Crop Sci. 34:300; 1994.). It was described as resistant to barley yellow dwarf virus, net and spot blotch, powdery mildew, scald, and septoria leaf blotch. It was susceptible to leaf rust.

Starling, released in 1993, resulted from a cross made by Starling in 1977 (Crop Sci. 36:1076-1077; 1996.). When released, it was resistant to barley yellow dwarf virus, net and spot blotch, scald and septoria leaf blotch; it was susceptible in seedling stages, but moderately resistant as adult plants to leaf rust and powdery mildew. Obviously, Starling was named in honor of Thomas M. Starling, Professor Emeritus, in recognition of contributions made to small grains breeding and genetics.

Callao, released in March 1994, resulted from a cross made by Starling in 1981 (Crop Sci. 36:1077; 1996.). When released, it was moderately resistant to powdery mildew, net blotch, scald, spot blotch, septoria leaf blotch, barley yellow dwarf virus, and leaf rust.

Pamunkey, released in 1997, resulted from a cross made by Starling in 1977. When released, Pamunkey was moderately resistant to barley yellow dwarf virus, net and spot blotch, powdery mildew, scald, and septoria leaf blotch, but susceptible to leaf rust.

In addition to leading the barley and wheat breeding programs, Griffey, with colleagues and graduate students, has actively investigated the inheritance of disease reactions and the impact of diseases on various cultivars. The genetic studies may be reviewed in more detail than is necessary for this history, but the author (Roane) also made contributions on these subjects and they still remain dear to his heart. Studies by Griffey et al. relative to wheat powdery mildew and barley leaf rust resistance are continuations of those initiated by Roane and Starling.

The terms "slow mildewing", "partial resistance", and "adult-plant resistance" had been utilized to describe resistance that did not seem to fit resistance conditioned by specific, generally dominant, major genes. Adult plant resistance (APR) apparently was first recognized in the U.S.A. by Shaner et al. at Purdue University in 'Knox' wheat (Phytopathology 63:867-872, 1307-1311; 1973.). In Virginia, APR had been recognized in the cv. 'Massy' as field resistance', which according to the release notice had no specific *Pm* genes (Crop Sci. 24:1000, 1984.). However, the term APR was first applied to Massey by Griffey, Das, and Stromberg (Plant Dis. 77:618-622; 1993.). They reported that in tests where fungicides were applied for powdery mildew control, compared to untreated plots, little or no grain yield was gained among cvs. having APR, i.e., 'Houser', 'Knox62', 'Massey', and 'Redcoat'; susceptible, unprotected 'Saluda' averaged a 13.4% loss. Griffey and M. K. Das studied the inheritance of APR in the cvs. Massey and Knox62 (Crop Sci. 34:641-646, 1994.) by both qualitative and quantitative means. The qualitative analysis indicated two recessive genes conditional APR in each cv. No Massey X Knox62 populations were examined. In the quantitative analysis, two or three genes were indicated to condition APR in each cvs. This time the study of Massey X Knox62 showed at least one gene in common since no susceptible segregates were observed.

Das and Griffey studied the heritability of powdery mildew in five cvs. with APR, including Virginia-bred Massey. They found general combining ability, GCA, to be more important than specific CA and that APR was quite heritable. All cvs. were promising sources of APR for breeding protection from powdery mildew induced losses (Das and Griffey, Phytopathology 84:406-409, 1994; Crop Sci. 34:948-952, 1994: Genome 38:277-282, 1995.).

The use of specific, major genes for powdery mildew resistance was very frustrating. Time after time, resistant cvs. were soon overcome by mildew races with matching virulence, yet interest and hope remained high that some *Pm* gene would be deployed that could stabilize resistance. For this reason, the research for new genes continued. When new sources of resistance were introduced, it was necessary to show that they carried new genes or alleles. Consequently, genetic studies were always under way. Y. S. Chung, under Griffey's guidance, conducted dissertation research on 10 winter wheat lines that had been previously studied in an M.S. project by Starling's advisee G. Jeyandran (M.S. thesis, V.P.I. & S.U., 1984.). Since Jeyandran's results produced questionable conclusions, Chung crossed the 10 lines with susceptible 'Chancellor' and with 13 powdery mildew differential lines, each of a different genotype. Although six genes were found among the 10 lines (Chung and Griffey, Crop Sci. 35:378-382, 383-388; 1995.) studied, none was new. Only two of the existing genes (*Pm4a* and *Pm17*) are individually effective against powdery mildew in southeastern U.S.A., but these had not been deployed by 1995. Should they be, mostly likely single mutations would provide virulence, and specific gene powdery mildew resistance would once again succumb. Thus, deployment of APR may be the more dependable route.

Griffey and his students took an interest in the genetics of barley leaf rust resistance. Except for 'James' (having *Rph2* and possibly *Rph6*), all barley varieties released in Virginia possessed *Rph7*, a gene from 'Cebada Cepa' which provided leaf rust resistance for over 20 years. In 1990, virulence for *Rph7* was detected in *Puccinia hordei* collections from Virginia, California, and Pennsylvania. Although virulence for *Rph7* was known from Israel (1978) and Morocco (1981), until 1990 none had been detected in the Western Hemisphere (Steffenson, Jin, & Griffey, Plant Dis. 77:867-869, 1993.). Thus, all Virginia barley cvs became susceptible to leaf rust. Griffey et al. showed from tests with 21 entries at Painter in 1991 and 1992, and at Warsaw in 1992 that leaf rust caused a grain loss averaging 16% (Plant Dis. 78:256-260, 1993.). Brian Steffenson, Y. Jin, and Griffey observed that pathotypes virulent for *Rph7* were avirulent for *Rph3*, *-5*, and *-9*. None of these genes have been deployed in North America. In regard to their future deployment, they warned, "The continued use of single *Rph* genes in barley cvs. will likely result in ephemeral resistance, because virulence for all described leaf rust resistance genes is known in the global population of *P. hordei*" (Plant Dis. 77:867-869, 1993.). The alternative seems to be in utilizing APR as shown to occur in Massey wheat, but has not been observed in Virginia-bred barley germplasm. Fungicides are available for controlling rusts, but their application to barley would not be economically feasible.

In the early 1980's there was a team effort to develop intensive management practices for small grains. Mark Alley and Dan Brann from Crop and Soil Environmental Sciences spearheaded the project. Breeders, soil and weed scientists, pathologists, entomologists, seed farm personnel, agricultural engineers, county agricultural agents, and several farmers cooperated. The information and prescribed practices from this project have resulted in an increase of wheat yields (state average from 42 to 68 bu/ac (nearly 65% increase) from circa 1985 to 1995. The increases were attributed to narrower drill-row spacing, higher rates of nitrogen application, better pest control, better cultivars, and stricter attention to rotation and planting dates. Plant pathologists Babineau (early in the program), Stromberg, and Baldwin contributed. They evaluated the effects of crop sanitation, rotations, planting date, balanced fertility, disease-free seed, resistant cultivars, and seed and foliar fungicides and insecticides on the severity of powdery mildew, leaf rust, leaf and glume blotch, tan spot, loose smut, head scab, barley yellow dwarf virus, wheat soil-borne viruses (WSBMV and WSSMV) and wheat streak mosaic. Although several journal papers were published on particular phases of the project, recommendations were published annually in the Pest Management Guide: Field Crops (Va. Coop. Ext. Publ. 456-016, rev. ann.). Detailed descriptions of circumstances and environments are given for control of barley yellow dwarf, and the foliar diseases powdery mildew, leaf rust, and leaf blotch. Resistances of cultivars and details for applying fungicides are tabulated. Both wheat and barley diseases are addressed. Most of the small gains section of the Guide was prepared by Stromberg. Much of his work is documented in the American Phytopathological Society annual publication *Fungicide and Nematicide Tests* vols. 40-52; 1986-1988.

With Stromberg evaluating seed treatment and foliar fungicides and Griffey turning out resistant cultivars, small grain farming should be economically sound well into the 21st century.

Saghai-Maroof also made contributions to barley genetics by making use of restriction fragment length polymorphisms (RFLP's). In cooperation with researchers at Washington State University (A. Killian and A. Kleinhofs) and North Dakota State University (B.J. Steffenson), results were obtained showing the gene for stem rust resistance, *Rpg1*, to be in the extreme subteleomeric region of chromosome 1P. A map of the region was provided (Molecular/Plant Microbe Interactions 7:298-301, 1993.).

With students R.M. Biyashev and Q. Zhang, Saghai-Maroof also made a study of a single qualitative gene for barley powdery mildew resistance, *Mla12*, and quantitative differences affecting mildew reactions. In their words, "Quantitative differences are likely to exist among alleles even at loci which are considered to carry major genes for resistance, and minor effects may be prevalent in cultivars that are not known to carry major genes for resistance" (Theor. Appl. Genet. 88:733-740, 1994.).

Stromberg took an interest in wheat take-all that became more prevalent about 1990 as a result of intensive management. Intensive management involved very high seeding and fertilizer rates, with nitrogen applications conducive to take-all. The problem was eventually addressed by two doctoral graduate students. Their research was reported in dissertations: James G. Crozier.1999. Evaluation of agents for suppression of take-all of wheat in Virginia in greenhouse and field studies and characterization of isolates of *Gaeumannomyces graminis* varieties. Ph.D. Diss. V.P.I. & S.U.

Sansanalak Rachdawong. 1999. PCR based test for differentiating *Gaeumannomyces graminis* varieties. Ph. D. Diss. V.P.I. & S.U.

From Crozier's work, only an abstract was published. This covered greenhouse work; using cone-shaped containers and soil infested with *G. graminis* var. *tritici*, Crozier suppressed take-all with NH_4 fertilizer and enhanced it with NO_3; Mn^{2+} did not suppress take-all. These findings merely agreed with previous determinations (Phytopathology 86:5124, 1996.).

Rachdawong developed a diagnostic test for *G. g. avenae*, *G.g. graminis*, and *G.g. tritici* which could be executed in a single polymersase chain reaction (PCR) tube. She further showed that ability to oxidize Mn from $MnSO_4$. In general, *G.g. tritici* was a strong oxidizer, *G.g. graminis* was moderate, *G.g. avenae* was a non-oxidizer. However, the test was not as precise as the PCR procedure. Only an abstract was published (Phytopathology 86:S124, 1996.).

Forest Pathology

Two conspicuous changes involving trees occurred in the Twentieth Century; the chestnut trees were destroyed and Christmas trees became commonplace in our mountain landscapes. Early in the chestnut blight epiphytotic, many scientific man hours were devoted to stemming advance of the blight down the Appalachians, yet the chestnuts were destroyed. Efforts by pathologists and others subsided until about the 1970's when a cadre of curious scientists began to wonder if new discoveries and technologies might make it possible to reintroduce the chestnut into the forest canopy. Initially, the "restore the chestnut" pioneers in Virginia were John R. Elkins of Concord College, Athens, West Virginia, on educational leave working with R. J. Stipes. Soon, G. J. Griffin and Martha K. Roane were involved in different aspects of chestnut blight and their joint efforts culminated in an American Phytopathological Society Monograph "Chestnut Blight, Other Endothia Diseases, and the Genus *Endothia*" (1986). This publication summarized the literature on chestnut blight through early 1984. More will be said about the Monograph later.

Forest pathology at V.P.I. & S.U. came into being with the hiring of J. M. Skelly in the Couch Era. His primary interests were pine root diseases and air pollution effects on vegetation. When Skelly resigned, one of his proteges, S.A. Alexander, became forest pathologist and B. I. Chevone inherited the air pollution research. In 1991, Alexander was awarded a leave of absence to work on an Environmental Monitoring and Assessment Program for the Environmental Monitoring and Assessment Program for the Environmental Protection Agency. Upon returning in 1995, he was appointed to fill a vacancy at the Eastern Shore Agricultural Research and Extension Center. Thus, his career in forest pathology ended. During Alexander's leave period, Jodi A. Carlson, as Research Associate, Sr., assumed the duties of forest pathologist. When Carlson resigned in 1995, no forest pathologist was appointed. Griffin continued research on chestnut blight, and Stipes worked with tree diseases mostly in landscape situations. Several graduate students earned degrees by investigating tree diseases. Gradually, chestnut blight became the premier subject of forest pathology. It was also a primary topic for employees of the Virginia Division of Forestry headquartered in Charlottesville.

Up to the beginning of the Moore Era, *Heterobasidion annosum* root rot of pine trees had been emphasized by Skelly and then Alexander. However, during the Moore Era attention to this problem waned and was over-shadowed by emphasis on *Verticicladiella proceera* (later *Leptographium procerum*), the cause of a root disease of pine. Procerum root diseases, (PRD) as it came to be known, was very destructive to pine in Virginia's Christmas tree plantations; it became epidemic in 1990, causing a $6 million loss. This loss, plus the fact that Christmas tree plantations were more conveniently located to V.P.I. & S.U. than were forest seedling and tree plantations, contributed to waning interest in annosum root rot and intensification of study on PRD.

In the Moore Era under the direction of Alexander, one thesis and three dissertations were devoted to research on PRD:

Katherine J. Lewis. Studies on the spread of *Verticicladiella procera* by soil-borne and insect-borne propagules. M.S. Thesis, V.P.I. & S.U. 1985.

W. E. Horner. Etiologic studies of *Verticicladiella procera* Kendr. in pine Christmas trees. Ph.D. Diss. V.P.I. & S.U. 1985.

R.J.L. Nevill. The association of *Leptographium procerum* (Kendr.) Wing. by root feeding insects in Christmas tree plantations. Ph.D. Diss. V.P.I. & S.U. 1990.

Jodi A. Carlson. Procerum root disease physiology and disease interaction with ozone. Ph.D. Diss. V.P.I. & S.U. 1994.

With Alexander's transfer to Eastern Shore and Carlson's resignation, both in 1995, research on PRD ended. Lewis presented evidence that insect vectors (bark beetles and especially weevils) were the primary sources of effective inoculum for PRD. Soil contaminated with *V. procera* propagules was not a source of effective inoculum. Horner found the collar zone to be the initial point of colonization, the fungus "progressing acropetally in both directions" (? Meaning toward the shoot and root apices?). He also found the fungus could exist in resinous lesions for 22 months without inducing symptoms. Analysis of moisture content indicated the lesions induced stem drying, and as drying progressed foliar symptoms intensified. Nevill focused on weevils as vectors of the PRD fungus. *Hylobius pales* and *Pissodes nemorensis* were found to be the primary vectors and were nearly equally efficient. (Note: The name of the fungus had been changed in 1985 to *Leptographium procerum*.) Carlson prepared the final dissertation on PRD in the Moore Era. She undertook the examination of six physiological variables as they affected disease severity. The variables were pre-dawn water potential, change in pre-dawn to mid-day water potential, stomatal conductance, photosynthetic rate, transpiration rate, and exposure to ozone. The linear response to these variables was highly significant. From her long-time study of PRD, Carlson concluded that seedlings were infected, but trees did not become symptomatic for several years. Ozone injury occurring sometime after seedling infection may predispose trees to more rapid development of PRD and, consequently, a more rapid decline. Defense of Carlson's dissertation appears to have ended research of PRD at V.P.I. & S.U. in the Twentieth Century.

Before the book is closed on PRD, the results and usefulness of knowledge gained through the years needed to be transmitted to Christmas tree growers. Alexander's appointment as Extension Forest Pathologist necessitated that he carry out this function. He prepared a hand-out entitled, "Procerum Root Disease in Christmas Tree Plantations" (Undated but about 1992.). He described the symptoms and conditions favoring PRD, listed the suscepts of *L. procerum*, and made the following management recommendations:

1. Plant trees on proper site for the species; avoid wet or dry sites.
2. Remove pine slash from in and around the plantation.
3. Keep weeds under control by mowing or with herbicides.
4. Control weevils and bark beetles with insecticides. (Directions were given for stump and tree sprays and for plantations where PRD was either present or absent.)

In 1995, Alexander ended his leave as Technical Director of the Environmental Monitoring and Assessment Program for Forest Ecosystems, but instead of returning to Blacksburg he was appointed vegetable pathologist at the Eastern Shore Research and Extension Center in Painter. It is apparent but not stated that support for forest pathology in Virginia was withering. Although research on chestnut blight was increasing, internal support for it did not accrue. People dedicated to the belief that the chestnut could be restored to the forests fervently sought to sustain promising projects. Thus, some background information may be inserted on the discussion of chestnut blight research in the Moore Era.

Note: Much of the discussion on chestnut blight is condensed from the following publication: Martha K. Roane, Gary J. Griffin, and John Rush Elkins. Chestnut Blight, Other Endothia Diseases, and the Genus *Endothia*. Monograph Series, Amer. Phytopathol. Soc. Press. St. Paul, Minn. 1986.

Chapters and authors are:

Chestnut blight - G. J. Griffin and J. R. Elkins.
Other diseases caused by *Endothia* species - Martha. K. Roane.
Taxonomy of the genus *Endothia* - Martha K. Roane.
In the text, citations will appear as Monograph 1986.

There is an interesting anecdote regarding the approval of the monograph. I (C. W. Roane) was chairman of the A.P.S. Monograph Committee at the time my colleague R .J. Stipes presented the proposal for it. Since my wife, Martha, would be an author, I had to be neutral in the discussion of the proposal and votes pertaining thereto. G. W. Bruehl, an A.P.S. past-president who commanded considerable respect and clout in society affairs, was vehemently opposed to approval. He summarized his arguments with, "Why beat a dead horse?" This was the prevailing attitude of those not familiar with the status of chestnut and chestnut blight research. I submit that the horse was merely 'playing possum'. Needless to say, publication was approved.

Interest in chestnut blight had its roots in R. J. Stipes' laboratory. The occurrence of pin oak blight (caused by *Endothia gyrosa*) resulted in two dissertations (P.P. Hunter, 1977; D. N. Appel, 1980.) on the effects of environment and stresses on the disease. Stipes invited J. R. Elkins, an organic chemist from Concord College, to spend his sabbatical leave investigating longevity in soil and movement in trees of methyl-2-benzimidozolecarbamate (MBC.)., the breakdown product of the systemic fungicide benomyl (Mono. 1986, p. 25.). Elkins was already a fervent believer that the chestnut could be restored, but he had no idea how it would come about. However, his avidness inspired Stipes, Griffin, and M.K. Roane to become involved in various aspects of chestnut research. Thus, Stipes began shifting his interest from *E. gyrosa* to the genus *Endothia* and *E. parasitica* in particular.

Several discoveries were prequisite to present-day approaches to blight control, the most notable of which was the discovery of hypovirulence in *Endothia* (now *Cryphonectria*) *parasitica*. In essence, hypovirulence is low virulence generally induced by cytoplasmically-borne dsRNA. The determinant is transmissible through hyphal anastomosis. The first discovery of hypovirulent *E. parasitica* was made in Italy. The value of hypovirulence as a biocontrol for *E. parasitica* was soon recognized and exploited. Hypovirulent cultures were first isolated in Virginia in 1977 and have been the subject of experiments by Griffin and his students ever since (Griffin et al. Proc. Amer. Phytopath. Soc. 4:108. 1977.).

Soon after hypovirulence was found in *E. parasitica* on large surviving chestnut trees (*Castanea dentata*), it was determined that those large trees possessed a low level of resistance to the fungus. This opened additional approaches to breeding blight resistant chestnut. Previous breeding schemes involved crossing *C. dentata* with oriental sources of resistance, *C. crenata* (Japanese) and *C. mollissima* (Chinese). There were some backcrosses to oriental trees but none to *C. dentata* (Monograph, 1986. pp. 19, 25.). Because Chinese X American crosses in F1 were intermediate in resistance, C. R. Burnham and P. A. Rutter concluded resistance was incompletely dominant. They also concluded that linkage between resistance and poor tree growth was unproven, because F_2 populations demonstrating this hypothesis were non-existant (Mono. 1986. p.19.). Burnham proposed backcrossing American X Chinese F_1 to American chestnut three times, then intercrossing the most resistant progeny to pool genes and bring resistance up to Chinese level. This will take years and Burnham who was 75 years old when he became involved with chestnut genetics and breeding was teased about his life-span optimism. His genetic and breeding proposals inspired an interested group to establish in 1983 the American Chestnut Foundation for raising money to support chestnut breeding. A farm was established in 1989 in Meadowview, Washington Co., Virginia to facilitate breeding. Fred Hebard, who had earned the Ph.D. degree under Griffin, was appointed scientist-superintendent.

I had taken Advanced Genetics and Cytogenetics from Burnham at the University of Minnesota in 1944-1946 and had used some of his translocation stocks to study linkage in barley. Through the years we had become good friends. In 1988, he prevailed on me to make some backcrosses on some F_1 Chinese X American trees that were on the Horticulture Farm near Christiansburg (Trees are gone; Farm is a shopping area.). I used corn pollinating shoot and tassel bags to facilitate crosses. In 1988, I sent Burnham 56 nuts; in 1989, I sent Hebard 35 nuts of (C A) A genotype. All were planted at Meadowview, but Hebard did not foresee impending disaster. Deer found the seedlings and only one escaped. He has since taken necessary measures to safe-guard seedlings.

Returning to the breeding schemes, the discovery of low level resistance opened two additional avenues of breeding. First, American chestnuts could be intercrossed to pool unlike genes and perhaps raise the resistance in purely American stock. Second, low level resistance could be crossed with stock carrying Chinese resistance, perhaps leading to superior resistance. Both of these schemes are being exploited (Griffin, Jour. Forestry 98 (2):22-27. 2000.).

It may appear from above that all the chestnut blight research in Virginia was centerd at V.P.I. & S.U. However, T. Dierauf and J. Artman of the Virginia Department of Forestry, Charlottesville, Virginia, have been involved at least since 1969. Under their leadership and in the cooperation with the Connecticut Agricultural Experiment Station, 12,000 seedlings of hybrid origin with American and Chinese or Japanese chestnut ancestry have been grown under exposure to wild *E. parasitica* at Lesesne State Forest in Nelson Co. One seedling in particular emerged with resistance and good form and it has been used in the backcrossing program (thus far to the BC_2).

Experiments were started whereby scions from large surviving American chestnut trees were grafted onto American rootstocks in 1980. The plants were at Lesesne

State Forest in an area surrounded by blight-infected stump sprouts. After 3 years, the scions had cankers of virulent *E. parasitica* and they were inoculated with hypovirulent strains. In 1996, these trees were 60 feet or more tall with 15-inch boles. Apparently, hypovirulence and low level of resistance combined to increase longevity of these specimens (Dierauf et al., Jour. Arboriculture 23:87-88, 1997; Griffin, Jour. Forestry 98(2):22-27, 2000.).

It had been determined that site conditions affected survivability of chestnut. High elevation, above 2500 feet, competition from other hardwood species, and xeric sites favored blight development even in hypovirulent-low resistance combinations. Thus, reforestation with chestnut is more apt to succeed in mesic, low elevation, low competition sites (Griffin et al. Canad. J. Pl. Pathology 15:159-167, 1993; Canad. J. Bot. 69:1804-1809, 1991.). Utilizing resistance, hypovirulence, and site management appear to favor success in re-introducing chestnut.

In the foregoing, much is written about hypovirulence, a complex biological phenomenon. There is much literature on developing understanding and utilizing it all over the world's chestnut habitat. Although Griffin, his students, colleagues, and even his wife, Lucille, have been major contributors, only a small fraction of the total effort is expended in Virginia. Yet, some of the most important contributions have been made here. Student projects have addressed hypovirulence by finding, isolating, cultivating, characterizing cultures, evaluating effectiveness in the forest, and many other aspects of a complex biosystem. Students and their theses/dissertations are listed here. To establish continuity, those before and during the Moore Era are listed chronologically:

> Wendt, R.W. 1981. Presence of hypovirulent *Endothia parasitica* (Murr.) P. J. & H. W. Anderson in the general population of American chestnut, *Cartanea dentata* (Marsh.) Borkh.,. stump sprouts. M.S. Thesis, V.P.I. & S.U.
>
> Hebard, F.V. 1982. Biology of virulent and hypovirulent *Endothia parasitica* on American chestnut (*Castanea dentata*). Ph.D. Diss. V.P.I. & S.U.
>
> Micales, Jessie Ann. 1985. The chemotaxonomy of the fungal genus *Endothia* Fr. Ph.D. Diss. V.P.I. & S.U.
>
> Frias, Graciella M. 1992. Roles of tannase and hydrolyzable tannins in chestnut blight. Ph.D. Diss. V.P.I. & S.U.
>
> Robbins, Nancy E. 1997. Spread of hypovirulent strains of *Cryphonectria parasitica* among American chestnut trees at Lesesne State Forest. M.S. Thesis. V.P.I. & S.U.

Some of the contributions by the authors listed above are discussed below.

Micales gave a thorough review of the taxonomy of *Endothia*. The integrity of the genus had been questioned in 1978 when Margaret E. Barr published a paper entitled, "The Diaporthales of North America with emphasis on *Gnomonia* and its segregates" (Mycologia Mem. 7. J. Cramer, Lehre, Germany, 1978. 232 pp.). She retained in *Endothia* those fungi having, "Brightly colored, pseudo-parenchymatous stromata, a diatrypoid configuration and one-celled, allantoid ascospores..... The majority of the fungi that were traditionally included in *Endothia* were transferred to the genus *Cryphonectria* Sacc. of the family Valsaceae. These fungi are distinguished by prosenchymatous stromata, a valsoid configuration and two-celled, ellipsoid or ovoid ascospores" (Micales, 1985, p. 8.). Micales examined the morphology of 12 species assigned to *Endothia* before 1978, and "Applied polyacrylamide gel electrophoresis and fungicide sensitivity assays to establish additional biochemical relationships among," the fungi. She concluded that, "Barr's classification system is technically correct. ..... Its adoption is recommended with some hesitation since the influence of host on stromal development is not fully understood" (Micales 1985, p. 9.).

Martha Roane, on the other hand, because of long-time use of E. parasitica attempted to have *E. parasitica* retained under *nomen conservandum* of the International Rules of Botanical Nomenclature. She ignored Micales results with chemotaxonomy, but stressed that prosenchymatous stroma could be compressed into pseudoparenchymatous stroma as stroma aged. She illustrated this hypothesis in an effort to refute Barr's classification scheme (Mono., 1986, pp. 31-33.). She ignored Micale's dissertation which supported Barr in favor of questioning the conclusiveness of the morphologic evidence which might have conserved the name *Endothia parasitica*. (I always thought her reason was sentimental rather than scientific; quite uncharacteristic of Martha Roane. - CWR).

In her study of tannase and tannins, Farias found *E. parasitica* tannase activity greater in American than in Chinese extracts. "Differences in tannase activity....may be used as a tool to identify sources of resistance" (Farias, Ph.D. Diss. 1992.).

Robbins assayed the spread of hypovirulent strains of *E. parasitica* (*Cryphonectria parasitica*) in inoculated trees and from such trees to stump sprouts in the surrounding forest. Limited spread occurred within inoculated trees but no spread from these to stump sprouts was detected (Robbins, M.S. thesis, V.P.I. & S.U. 1997.). Use of hypovirulent strains seems limited because no efficient means of dissemination has been developed.

In 1984, a group interested in restoring the American chestnut organized The American Chestnut Cooperator's Foundation (ACCF), a non-profit scientific and educational foundation; ACCF is attempting to restore American chestnut by interbreeding trees of low resistance to accumulate genes, by cloning resistant scions on existing sprouts, and by selecting and managing sites optimum for growth. The ACCF directors are G. J. and Lucille Griffin and J. R. Elkins. They solicit funds used strictly to fulfill the objectives; no salaries are involved. It is a noble effort. Would that the ACCF should succeed.

Other aspects of tree diseases are included in sections on air pollution, ornamentals, and new diseases.

Addendum

Note: White pine blister rust was not mentioned in previous Eras because I could find no literature on it for Virginia. Early in 2002, Mr. Kenny May of the U.S. Forest Service, Edinburg, Virginia, provided me with a history white pine blister rust control in the U.S. The comments below are prompted by this material. I am grateful to Mr. May for his interest and help. -- C. W. Roane

White pine blister rust was probably present in North America in 1898, but its discovery in a nursery at Geneva, N.Y. in 1906 stirred interest. (W. V. Benedict. 1981. History of white pine blister rust control - A personal account. U.S.D.A. Forest Service. Wash., D.C.). *Cronartium ribicola* is a heteroecius rust of 5-needled pines (spermagonial and aecial stages) and *Ribes* spp. (uredinial and telial stages). In Virginia, *R. cynosbati* (prickly gooseberry), and *R. americanum* (wild black current), coincide commonly with the range of *Pinus strobus*, eastern white pine. White pine blister rust (WPBR) was perceived to be a threat to our forests. It precipitated the first federal plant quarantine in 1912. An Office of Blister Rust Control was established some time after 1915. Five regions for WPBR were established . Virginia was in the Southern Appalachian Region (with Ga., Ky., S.C., N.C., Md., Del, Tenn., and W.Va. The regional administrative office was in Richmond, Va., from 1931 to 1938 and in Harrisonburg, thereafter. The records are skimpy as to who was in charge, but it is believed that H. E. Yost served from 1938 to 1953 when the office was closed and Yost retired; afterward WPBR control was probably administered from Edinburg, Virginia.

From a paper prepared by C. E. Cordell, U.S. Forest Service, Ashville, N.C. (An evaluation of white pine blister rust in the George Washington National Forest, Virginia. Rept. 68:1-29, June 1968), the following facts have been gleaned:

Ribes eradication was conducted in Virginia for about 40 years (up to 1968).

The highest incidence of WPBR occurred in Highland Co.

It was assumed that *Ribes* eradication had effectively confined WPBR to that area.

Future eradication work should cease for 10 years (= 1977).

Surveys afterward should be based upon pine infection data instead of *Ribes* occurrence.

Infection centers should be under surveillance and no further action should be taken unless disease activity warrants it.

This is a quiet little corner in the history of plant pathology in Virginia. So far as I know, barberry eradication and WPBR control are the only federal plant pathology activities conducted in the State.

Vegetable Pathology

Originally, the Virginia Truck Experiment Station (VTES) was established in Princess Anne Co., near Little Creek, to study diseases plaguing producers of crops for the fresh market. Most products were sold to wholesalers in Norfolk, but a considerable volume was shipped to Baltimore, Washington, Philadelphia, and New York. The production area was concentrated in Norfolk Co. (now Chesapeake), Princess Anne Co. (now Virginia Beach), and the Eastern Shore counties of Accomack and

Northampton. Gradually, as Chesapeake and Virginia Beach became almost totally urbanized, vegetable production was concentrated on Eastern Shore, and VTES became an ornamentals crop research and extension center serving nurserymen and home gardeners. Its name change reflected its subject matter, Virginia Truck and Ornamentals Experiment Station. For many years the center at Painter in Accomack Co. was a substation of VTES, but as it became almost the sole center for vegetable crop research it was made independent of the Virginia Beach center and both locations were renamed, e.i., Hampton Roads Agricultural Research and Education Center (HRAREC) and Eastern Shore AREC. Both were incorporated into the Virginia Agricultural Experiment Station and Extension Service. A plant pathologist had been assigned to each location, but when the Moore Era began there was no plant pathologist at HRAREC; R.E. Baldwin was at ESAREC. There would be no pathologist at HRAREC until Chuanxue Hong was appointed Assistant Professor in 1999.

During the Moore Era, R.E. Baldwin retired from the ESAREC on December 31, 1995. In anticipation of this, S.A. Alexander was moved from Blacksburg to Painter on August 1, 1995 and became solely responsible for vegetable pathology research and extension on January 1,1996. While not meaning to disparage Alexander, it did not seem to be a wise administrative decision to appoint a career forest pathologist to such a responsible vegetable pathology position.

Although vegetable pathology research and extension had by tradition been centered at Virginia Beach and Painter, R. C. Lambe, G. H. Lacy, and H. L. Warren at Blacksburg devoted some time to vegetable pathology, Lacy primarily in vegetable bacteriological research, Warren and Lambe in vegetable pathology extension. The role of each at Blacksburg and Painter and their contributions will be reviewed below.

Baldwin was the principal researcher in vegetable pathology. He repetitiously tested new products for disease control on the leading crops of Eastern Shore. Most of his research is reported in *Fungicide and Nematicide Tests*. Attention was given to fruit and foliage diseases of tomato, cucumber, squash, snap beans and strawberry and to potato foliage, seed piece, and nematode diseases. Usually, a companion publication in lay-language appeared in the *Vegetable Growers News*, a publication of the ESAREC. Annually, these published results were incorporated into recommendations to growers and were summarized in a series of pest management guides (Pest Management Guide for - Home Vegetable Gardens, VPI. & SU Pub. 456-002 (revised annually); - for Home Grounds and Animals, Section 2, Home Vegetables, V.P.I. & S.U. Pub. 456-018.). There were also pest management guides for home ornamentals, 456-019, nursery ornamentals, 456-010, (also numbered 456-070.), and horticultural and forest crops, 456-017. Baldwin collaborated with R. C. Lambe in publishing most of these pest management guides until Lambe retired in 1988, thereafter he soloed their preparation until he also retired in 1995. Afterward, it was Alexander's responsibility to continue the vegetable pathology in these publications.

Although the aim of field stations is to serve the commodity group of the area, and as a consequence the research is very applied, occasional original experiments are conducted. A series of studies with marigold were initiated when the poultry processing industry sought ways to improve the buyer appeal of chickens by adding xanthophyll to their rations. This would change skin color from white to yellow. The source of the pigment was marigold flowers. Lambe and Baldwin collaborated to develop production procedures. In doing so, they found that a marigold-white potato rotation enhanced potato production by reducing lesion nematode injury to potato roots. Alexander continued this work and reported increased yields of potato and tomato and concurrent reduction of lesion nematodes of African marigolds (*Tagetes erecta*) were used as a green manure crop (Biol. & Cult. Tests for Control of Pl. Dis. 11:95, 1996; 12:104, 1997.). There was no indication that marigolds were used in commercial potato and tomato rotations by the end of the Moore Era.

Herman Warren was a corn pathologist who was appointed Professor of Plant Pathology on May 1, 1989. Since he had been a federal employee at Purdue University, he wanted an appointment that would continue his federal retirement program. As Lambe had retired, it was arranged that he would be a part-time Extension Specialist in vegetable pathology. As such, he stressed a search of sweet corn, tomato, crucifer and cucurbit hybrids and cultivars for resistance to common diseases plaguing Virginia growers. The aim was integrated pest management of chemical and disease resistance in order to reduce chemical usage. His results were incorporated into various pest management guides. In essence, this was the type of Extension activity conducted by his predecessor, Lambe.

George Lacy, his colleagues, and graduate students made genetic modifications of the soft rot bacterium, *Erwinia carotovora*, such that modified strains were less virulent than wildtypes. Although the accomplishments were of high caliber, they have not yet been applied in agriculture.

Theses related to vegetable pathology:

D. P. Roberts. - Molecular mechanisms of pathogenesis incited by *Erwinia carotovora* subsp. carotovora. Ph.D., 1985. Lacy, advisor.

Caitilyn Allen. - Evolution of a gene for pathogenicity: Endopectate lyase. Ph.D., 1987. Lacy, advisor.

Sirkka R.M. Kyostio. - *Erwinia carotovora* extracellular proteases: Characterization and role in soft rot. Ph.D., 1990. Lacy, advisor.

Zenbiao Yang. - Gene regulation in a pathogen-plant interaction: *Erwinia* versus potato tubers. Ph.D., 1991. Lacy, advisor.

These theses would best be discussed in a section on molecular biology in plant pathology (not covered in this history).

Ornamental Crops

Included in this section are the usual decorative plant species plus trees used in landscape situations. Faculty who held assignments in extension, instruction, and research on ornamental plant diseases were Robert C. Lambe who served nurserymen and home gardeners, Wirt H. Wills who studied diseases of shrubs, and R. J. Stipes who worked with trees. During the Moore Era, Lambe took a leave in Mexico and graduate student Melinda Mulesky Gates was acting vegetable and ornamental crop pathologist, May 1976 to February 1987. Lambe retired on May 31, 1988 and Wills on September 30, 1990. Mary Ann Hansen, the Plant Clinician, also rendered considerable service to nurserymen and home gardeners. The retirements of Lambe and Wills brought to a virtual stop at Blacksburg the research on ornamental plants and shrubs. The work of Stipes with landscape trees has been continued, and ornamentals pathology was moved to the Hampton Roads Agricultural Research and Education Center in Virginia Beach.

During the Moore Era, retirements, position freezes, and changing commodity emphasis caused reapportionment of Stipes time on three different occasions. From 1984 to 1989, his teaching, research and extension assignment was 10, 75, 25. For 1989 to 1995, it was 25, 65, 10; for 1996, it was 30, 10, 60; and in 1997, it was 30, 0, 70. Note that research time steadily declined and extension time steadily increased. Strangely, although his primary assignment addressed landscape trees, most of his research publications were on peanut diseases. This is because he was co-chairman of student committees with Phipps, and both chairmen were accorded authorship when students published results from their dissertation research on peanut. It is apparent that Stipes functioned excellently as the on-campus chairman; it is also apparent that in doing so, his attention to landscape research may have suffered. Nevertheless, he pursued several objectives to significant results.

Stipes worked avidly to develop injection procedures and chemicals for control of Dutch elm disease and other wilts of trees. His research helped to bring about the labelling of Arbotect 20S and Alamo for use in chemotherapy of tree diseases. These are approved for control of Dutch elm disease and are being tested by Stipes for control of dogwood anthracnose.

The nature of Stipes' research and extension projects can be rendered by noting the titles of some of his talks:

> "Some famous patients I have known." Delivered to several audiences.
>
> "Trojan horses in Appalachian forests."
> Chestnut blight, Dutch elm disease, dogwood anthracnose; Appalachian Biogeography Symposium, et al.
>
> "Managing plant diseases around the home."
>
> "Basics in biology and stresses of the landscape tree." - Master Gardeners' Training.
>
> "Tree crisis on the horizon." Va. Tech Horticulture Club.
>
> "Diagnostic methodologies in tree diseases." St. Louis, Mo., Urban Tree Conf.
>
> "Tree tips on tree troubles." Roanoke City Extension Services.
>
> "What's hot in tree troubles."
>
> "Update on tree injection technology and injectables." Pesticide Applicators Training Session.
>
> "Pines pining away." Tidewater Horticulture Conference.
>
> "Use of Alamo in the management of Dutch elm disease." Arlington National Cemetary.

Stipes' topics were technical, educational, and usually entertaining. His audiences ranged from college students to kindergarten kids, from professional horticulturists to amateur gardeners and putterers. He could teach to the level of each. The technical aspects are boiled down in extension guide books for public utilization, for example. The Pest Management Guide for Home Grounds and Animals, Virginia Cooperative Extension Publ. 456-016 (revised annually), wherein management of diseases of the most commonly grown landscape trees is discussed. New technologies are introduced as soon as they become available. Much of the information on ornamental shrubs contained in Ext. Publ. 456-016 was developed by R. C. Lambe and W. H. Wills. Both worked on shrubby ornamentals early in the Moore Era (Rhododendron, azalea, boxwood, Japanese holly, *Photinia*, and *Leucothoe*.). Later, toward their retirements they emphasized fungicidal control of vegetable diseases. A significant contribution to ornamental plant pathology was a chapter on azalea diseases in a book on azaleas (R. C. Lambe, W. H. Wills, R. K. Jones, and D .M. Benson. 1985. Azalea diseases. Pp. 359-373. *In* = Azaleas. F.C. Galle, ed., Timber Press, Portland, Oreg. 486 pp.) The book predated the Compendium of Rhododendron and Azalea Diseases described below by one year.

Martha K. Roane had been inoculated with an interest in Ericaceous plants when during her graduate study years she took a special course in taxonomy. She was inspired to prepare a volume in the APS Press compendium series on her favorite topic, *Rhododendron*. Somehow, she established contact with Duane L. Coyier of the U.S.D.A. Horticultural Crops Research Laboratory at Oregon State University, Corvallis, Oregon. Martha and Duane organized a group of 17 authors to prepare the text. APS Press requires that a publishing fund be raised to defray the cost of publishing its compendia. Several organizations became financial sponsors and publication was assured. The sponsors were:

Amer. Rhododendron Soc., Middle Atlantic Chapter.
Amer. Rhod. Soc. Portland Chapter.
Amer. Rhod. Soc. Research Foundation.
Mallinckrodt, Inc.
Drs. Kenneth and Sandra MacDonald.
Oregon Association of Nurserymen.
University Faculty Book Publishing Comm., VPI&SU;
Virginia Nurserymen's Association, Inc.

It can be seen that several Virginia-based organizations were involved. The Compendium of Rhododendron and Azalea Diseases was issued in 1986. Martha's photographs adorned the covers. Of the 19 contributing authors, four were connected with our department:

Author	**Topic**
Maynard G. Hale	Mineral Nutrient Deficiencies and Toxicities, pp.46-48.
Laurence D. Moore	Air Pollution Injury, 00. 48-50. Pesticide Phytotoxicities, pp. 50-51.
G. Myron Shear	Moisture Stress, Head Injury and Winter Injury, pp.45-46.
Martha K. Roane	Introduction, p. 1. Rusts, pp. 26-28. Aid to Diagnosis, p. 53.

In addition, a Ph.D. alumnus of the Department contributed two sections:

Ronald K. Jones Botryosphaeria Dieback, pp. 10-11.
Rhizoctonia Web Blight, pp. 20-21.

Martha also prepared the index, which reminds me of an old adage: "Any fool can write a book; it takes a genius to make a good index!"

After the Compendium was published, Martha collaborated with Molly N. Cline of the Monsanto Corporation, St. Louis, Missouri, to assemble an APS Slide Set of 87 slides on Rhododendron and Azalea Diseases. No doubt Martha prevailed upon persons she had contacted while preparing the Compendium to contribute slides.

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A History of Plant Pathology in Virginia: The Moore Era (7/1/1984-3/31/1997)

Turfgrasses

During the Moore Era, turfgrass pathology and Houston B. Couch were synonymous. During the Era, Couch mentored three students through their M. S. programs and wrote and published a beautiful book entitled "Diseases of Turfgrasses" (3rd ed., Krieger Publishing Co., Malabar, Fla., 421 pp., 1995.). The book occupied most of his time during the Moore Era. He also conducted research on various aspects of turfgrass pathology. Officially, Couch was assigned 15% teaching and 85% research time in the quarter system and 70% research and 30% teaching time in the semester system.

Couch's teaching program changed in 1985; before then he taught introductory plant pathology (PPWS 3104), a graduate course on principles and concepts in plant pathology (PPWS 6020) and an undergraduate course on the nature and control of turfgrasses (PPWS 4980). After 1985, and especially after the University changed from the quarter to semester system, he taught only PPWS 4980, Diseases of Turfgrasses but the course was not listed in plant pathology; it was variously listed under Agricultural Technology (AT) and Special Study. In the 1992 Comprehensive Review of the Department the following description appeared:

"The lectures cover the total syndromes of the major turfgrass diseases, the epidemiological factors involved in the infection and colonization processes of foliar pathogens and recent developments in the configuration of spray equipment, dilution rates of specific fungicide formulations, and additive, synergistic, and antagonistic interactions among tank mixtures of turfgrass fungicides."

Couch also taught short courses in turfgrass pathology in the University's continuing education program to landscape and turfgrass management specialists and to members of the Golf Course Superintendents Association of America.

Students completing degrees (and their subjects) under Couch's tutorship were:

> P. R. Schmidt - Influence of non-oomycete active systemic fungicides on the severity of Pythium blight of bentgrass. M. S., 1984.
>
> B. D. Smith - The influence of high temperature stress and herbicides on susceptibility of creeping bentgrass (*Agrostis palustris*) to *Curvularia lunata*. M. S., 1989.
>
> S. J. McBane - Algae control in bentgrass (*Agrostis palustris*) with DC5772® and Profile™. M. S. Non-thesis, 1997.

Schmidt reported on the interactive effects of fertility levels and non-oomycete active fungicides on *Pythium aphanidermatum/Agrostis palustris* pathogen/host systems. Some fungicides depressed disease in all environments, but some depressed disease only at low nutrient levels.

Smith addressed the problem of *Curvularia lunata* as a grass pathogen. It appears from his research that the fungus is best regarded as a pathogen of senenscing tissue. This is in support of the conclusions by Muchovej (1984 Dissertation) that *C. lunata* is a secondary colonizer.

McBane stepped outside of conventional plant pathology to study control of algae on golf courses. He reported that "management practices which promote a dry soil surface coupled with a preventative fungicide/algicide program are the only means available to combat surface algae as long as environmental conditions favor their development."

In the 1992 Comprehensive Review of the Department (p. 49), Couch reports his research efforts to be focused on various stress factors that affect turfgrass diseases and on developing procedures for maximizing the effectiveness of turfgrass fungicides. Although he held no appointed time in extension, he contributed to the extension program by preparing publications, training extension agents, speaking at extension-sponsored meetings and diagnosing specimens of diseased grasses for the Plant Clinic. He was in demand as a speaker at meetings and conventions of turfgrass managers because of his extensive knowledge and ability as an entertainer. His invited presentations took him to many states and Canadian provinces. Throughout the Moore Era, Couch was ably assisted in his research and extension by Phil Keating.

Air Pollution

The study of the effect of air-borne pollutants on plants began in the Couch Era. Moore, the Department Head, had been associated with the research from the outset. About the time he began his tenure as Department Head, one of his advisees, Oliver Achwanya from Kenya, completed his dissertation in 1984 on, "Effect of ozone, sulfur dioxide and alpha and delta races of *Colletotrichum lindemuthisnum* (Sacc. & Magn.) Bri. And Cov. on bean, *Phaseolus vulgaris* L." Moore advised one other student through her Ph.D. program, namely, Amanda Botha of South Africa, who in 1989 wrote on, "The assessment of air pollution impacts on plants in South Africa." Botha reported that atmospheric fluoride and sulfur dioxide were the principle pollutants in South Africa. Damage to flora was particularly noticeable in the vicinity of Cape Town. Acidic mists were a probable cause of injury to pine trees in Eastern Transvaal escarpment regions. Control strategies were not discussed.

Achwanya studied the separate effects of ozone, sulfur dioxide, and the alpha and delta races of *C. lindemuthianum*, the combined effects of ozone and sulfur dioxide and the interaction among the air pollutants and the fungus. Even though the co-occurrence of ozone and sulfur dioxide had not been documented in Kenya, it was expected to occur as urbanization increased. Anthracnose of bean was a common problem. In his dissertation research, Achwanya found a greater than additive (=synegistic?) effect of the two pollutants acting together and that diseased plants were more susceptible to pollution damage than healthy plants. He suggested that bean breeding for anthracnose resistance done near Thika, a major industrial city in Kenya, may lead to erroneous interpretation of disease reactions. He suggested that the breeding project should be moved to a pollution free area.

Ongoing research in air pollution has been conducted by Boris I. Chevone and Ruth G. Alscher.

Chevone's research addresses the physical and biochemical aspects of air pollution damage to forest trees and tobacco. Alscher's research follows a similar path using pea and red spruce. However, her work entails much more biochemical analysis with an attempt to understand the molecular events involved.

Further discussion of air pollution research becomes plant physiology and molecular biology which are outside the scope of this essay.

Parasitic Angiosperms

In preparing this history of plant pathology in Virginia, nothing was written previously about research on parasitic flowering plants. A complete review takes us back to the Couch Era when A.R. Saghir, Associate professor of Agronomy at the American University of Beirut, Lebanon, was appointed Visiting Associate Professor of Plant Physiology from July 1971 to June 1972. He worked with C. L. Foy on the biology and control of *orobanche ramosa*, a damaging parasite of tobacco, tomato, potato and hemp (several authors appeared on the publications from early work at V.P.I. & S.U., namely, Foy, Saghir, K. M. Hameed, C.R. Drake, and S. A Tolin. However, the primary collaborators were Foy, Saghir, and Hameed. Weed Res. 13:114-117, 1973; Proc. Eur. Weed Res. Counc. Symp. Parasitic Weeeds, Malta, pp. 106-116, 1973; Weed Sci. 21:253-258, 1973.). *Orobanche* spp. are very damaging to crops in the Middle East of Asia and Arica. (Jain and Foy. Broomrapes (*Orobanche* spp.): A potential threat to U.S. broadleaf crops. Weed Tech. 3:608-614, 1989.). K.M. Hameed, who had M.S. and Ph.D. degrees from V.P.I. &.S.U. while stressing gnotobiology, entered a post-doctoral program in January 1972 and was appointed Instructor for the calendar year. He studied the influence of root exulates on seed germination of *Orobanche* spp. (Weed Res. 13:114-117, 1973.). Saghir, at the end of his tenure, presented a seminar on his work wherein he enlightened the audience with little known facts about the structure, life cycle, and parasitism of *Orobanche*. Saghir was a very charismatic person, so much so that for his farewell party, Roane was inspired to write an "Ode to Saghirweed."

Ode To Saghirweed

There came to us a man from Beirut
With a message loud and clear:
From an exotic flowering parasite
We have so much to fear !

He studied this pest day and night,
So much that it made him cranky,
He must know all about the parasite
That taxonomists called Orobanche.

He divulged in Seminars and in person
That it grows out of sight of us
Botanists would describe this pesky one
As being radicolous.

He wrings his hands because
It makes tomatoes lean and lanky,
And defies all osmotic laws,
This herb we call Orobanche.

There is much more to dwell upon
But the time is drawing near
For him to return to Lebanon
So it is good bye, friend, Abed Saghir.

C. W. Roane, 1972

Foy continued collaboration with scientists in the Middle East who were actively studying parasitic flowering plants and seeking avenues of control. These included Reuven Jacobsohn and Y. Kleifeld of Israel. Jacobsohn, at V.P.I. & S.U for visits in 1983 and 1985, helped Foy prepare a successful proposal to the Binational Agricultural and Development Fund (an AID function). Funds from this grant sustained cooperative research between Foy and Israelis for several years.

Foy mentored three students through their graduate programs of research on *Orobanche*:

> Rakesh Jain. 1987. Physiological aspects of broomrape (*Orobanche* spp.) parasitism, host specificity and selective control by glyphosate. Ph.D. Diss. V.P.I. & S.U.
>
> Ivan V. Morozov. 1998. Egyptian broomrape (*Orobanche aegyptiaca* Pers.) and small broomrape (*Orobanche minor* Sm.) parasitism of red clover (*Trifolium pratense* L.) *in vitro*. M.S. Thesis. V.P.I. & S.U.
>
> Vijay Nandula. 1998. Nitrogen metabolism of broomrapes and selective control by glyphosate. Ph.D. Diss. V.P.I. & S.U.

Jain studied the parasitism of *O. aegyptiaca*, *O. ramosa*, and *O. crenata* on tomato, tobacco, alfalfa, peanut, and soybean. *O. aegyptiaca* showed the widest host range, and peanut was susceptible to all species. Synthetic analogs of strigol induced high rates of "suicidal germination" of broomrape seeds, ethylene moderately and gibberellic acid less effectively induced germination. Efforts to control broomrape by applying glyphosate to host shoots were partially successful but somewhat damaging to the host. Several publications were issued from Jain's research (Weed Res. 28:383-391, 1988; Weed Tech. 3:608-614, 1989; 6:269-275, 1992; Rev. Weed Sci. 4:123-152, 1989.).

Though the thesis of Morozov and dissertation of Nandula were completed after the Moore Era, most of the research was completed during that era. James H. Westwood took a post-doctoral assignment in April 1994 and was appointed Assistant Professor of Plant Physiology and Weed Science in January 1999. In the Moore Era, he contributed to research that was published after the Moore Era. During Morozov's thesis research, Westwood provided technologies for the project. The objective was to investigate a possible relationship between nodulation and broomrape parasitism of red clover. Morozov found that although "rhizobacterial nodulation is not required for parasitization, the presence of nodules facilitates small broomrape germination and attachment to red clover" (Morozov, Foy, and Westwood. Weed Tech. 14:312-320. 2000.).

In his dissertation research, V. K. Nandula studied the use of glyphosate in controlling broomrape (*O. aegyptiaca*) in a glyphosate tolerant species, common vetch (*Vicia sativa*), and a genetically engineered-to-be-glyphosate-resistant species, oilseed rape (*Brassica napus*). Glyphosate provided excellent suppression of broomrape in both hosts. About 30% of applied labelled glyphosate accumulated in attached broomrape seedlings. Glyphosate generally increased the amino acid concentrations in common vetch and oilseed rape plants, and broomrape attachments (Nandula, Foy, and D. M. Orcutt. Weed Sci. 47:486-491, 1999; Nandula, Joyce G. Foster, and Foy. J. Agri. & Food Chem. 48:3930-3934, 2000; Nandula, Westwood, Foster, and Foy. Ibid. 49:1524-1528, 2001.).

At Old Dominion University in Norfolk Virginia, Lytton J. Musselman has been a student of root-parasitic weeds, world-wide. In 1980, he published a review article entitled, "The biology of *Striga*, *Orobanche*, and other root-parasitic weeds" (Annu. Rev. Phytopathol. 18:463-489.). Since 1980, I could find his name associated only with conference proceedings and workshops where he served as an editor of resulting publications.

At the University of Virginia, studies have been conducted on *in vitro* culture of *Striga asiatica* and on morphogenesis of haustorium formation (Susan Wolfe and M.P. Timko, J. Expt. Biol. 43:1339-1348, 1992; Plant Sci. 73:233-242, 1991; M.P. Timko, Christa S. Florea, and J. L. Riopel, Germination and early morphogenesis of parasitic angiosperms *in* Advances in the Development and Germination of Seeds, Plenum, 1989; Florea and Timko, Gene 186:127-133, 1997; Wolfe and Timko, Plants 192:61-68, 1994.).

When *Striga asiatica* (witchweed) was discovered growing in corn fields of four counties each in North Carolina and South Carolina late in 1956, the Virginia Department of Agriculture and Immigration implemented surveys for witchweed in southeastern Virginia. The surveys were conducted from 1957 to the mid-1970's. A total of 2,690 acres were surveyed in the counties of Accomack, Brunswick, Greensville, Henry, Northampton, and Pittsylvania, and the cities of Chesapeake, Suffolk, and Virginia Beach. All surveys were negative for witchweed (Rept. Of Va. Dept. Agri., Imm., Plant Pest Control Section, 1975-1976.). Eradication of witchweed in North and South Carolina was apparently successful and surveys in Virginia ended.

Biological Control

Anton B.A.M. Baudoin was appointed Assistant Professor of Plant Pathology in 1981. Soon thereafter, he began collecting diseased weeds in Virginia and assessing the potential of pathogens associated with them as biological control agents. Pathogens of 16 weeds were examined but most effort was spent on kudzu, milkweed, poison ivy, hemp dogbane, and johnsongrass. He concluded that most of the pathogens had little potential. As he pursued this research, he found several organisms that had not previously been reported as pathogens, namely, *Aphelenchoides* sp. on milkweed, *Phomopsis* sp. on hemp dogbane, *Phyllosticta* sp. on kudzu, and *Dichotomophthora indica* on purslane (Va. J. Sci. 37:41. 1986.). The work was continued by graduate student D. A. Johnson, mentored by Baudoin, who isolated two *Alternaria* spp., a *Cercospora* sp., and two *Fusarium* spp. from *plumeless thistle*; a *Cercospora* sp., a *Colletotrichum* sp., a *Fusarium* sp., and a *Rhizoctonia* sp. from tall morningglory. Johnson and Baudoin intended assaying these fungi for their potential as bio-control agents (Va. J. Sci. 39:95, 1988.).

Musk thistle (*Carduus thoermeri*) has become a troublesome weed of pastures in western Virginia and was the subject of biological control studies by Entomologist L.T. Kok at V.P.I. & S.U. He had cooperated in the release of two insects that effectively reduced musk thistle populations. Additional enemies of musk thistle were being sought; since the weed was also a problem in western rangelands, workers in the U.S.D.A. at Frederick, Maryland had found *Puccinia carduorum*, an autoecious rust from the Mediterranean region, to be a potentially useful candidate. The Blacksburg area was selected for its release and evaluation (Biol. Control 3:53-60, 1993.). Baudoin became a cooperator on the project.

In the field, *P. carduorum* did not spread to other thistle species or artichokes and was deemed after two yeas to be non-hazardous to non-target species. Although little reduction in plant growth was obtained, seed production by musk thistle was reduced. It was feared that the rust would interfere with the effectiveness of herbivore insects on thistle control. Numerous experiments were conducted; no detrimental effects on insects were detected, so it was concluded that both insects and the rust could be used for bio-control of musk thistle (Biol. Control 6:123-129, 1996.).

For his M.S. Thesis, D. A. Johnson evaluated the potential of crabgrass smut as a bio-control agent (D. A. Johnson. 1990. Infection and development of *Ustilago syntherismae* in *Digitaria ciliaris*. M. S. Thesis, V.P. I. & S.U.). He found U. syntherismae to be a seedling infecting smut which could initiate infection either from soil-borne or seed-borne inoculum. However, since infection efficiency was relatively low in his experiments, he concluded the fungus was not a good candidate for biological control.

Charles Hagedorn was appointed Professor in 1986 and allotted 50% to Plant Pathology, Physiology, and Weed Science, and 50% to Crops and Soil Environmental Sciences. He was interested in utilizing bacteria to control seedling diseases especially in cotton. Under his direction, Melinda A. Mulesky completed a dissertation entitled, "Rhizosphere competence, antibiotic and siderophore biosynthesis in *Pseudomonas chlororaphis* : Implications for the biological control of cotton seedling disease pathogens" (1990) in which she demonstrated "a minimum contribution of siderophores in the biological control of cotton seedling disease and established a significant role for antibiotic biosynthesis over a range of soil physical and chemical characteristics." Thus, *P. chlororaphis* has the potential to protect cotton seedlings from damping-off organisms.

In greenhouse studies with cotton, Hagedorn et al. (1990) demonstrated a similar effect with *Pseudomonas fluorescens* against *Pythium ultimum* and *Rhizoctonia solani*. In soils where these organisms prevailed, certain placements of *P. fluorescens* reduced seedling disease symptoms and increased plant stands (Hagedorn, N. Nelson, and J. E. Skwara. 1990. Evaluation of a *Pseudomonas fluorescens* strain for repression of seedling disease in cotton. Va. J. Sci. 41:492-500.).

Nematology

When L. D. Moore became Interim Department Head on July 1, 1984, Alma P. Elliott was the nematologist, but she resigned effective November 30, 1984, to take a position in the California Experiment Station at Riverside. Jonathan D. Eisenback was hired on September 1, 1985 to replace Elliott. That same day Charles S. Johnson was appointed Assistant Plant Pathologist at the Blackstone tobacco station. Eisenback was a very proficient nematologist, well on the way to becoming a world authority on root-knot and cyst nematodes. Johnson, on the other hand, was trained in peanut pathology and control of foliar diseases. He would become an expert in the management of tobacco cyst and root-knot nematodes. Eisenback's contributions will be reviewed below; Johnson's contributions are reviewed in the section on tobacco.

On being appointed to the faculty at V.P.I. & S.U., Eisenback continued the research he had under way at North Carolina State University. Thus, his contributions have centered primarily around expanding our knowledge of *Meloidozyne* and *Globodera* spp. He has concentrated on the morphometrics of these important root pathogens and has published his work extensively in the *Journal of Nematology* and *Fundamentals of Applied Nematology*. Eisenback was an expert at utilizing the computer for publication and has placed several items on web sites and compact disks. The letter includes "A pictorial glossary of nematological terms" and "Distribution of nematodes (Cactodera, Globodera, Heterodera, and Punctodera spp.) in the United States" in which distributions by states and counties are shown.

Eisenback has sought to improve techniques available to nematode taxonomists such as describing (with A. Rammah) an alternative method of styler extractions (J. Nematol. 19:116-122, 1987.); multiple focus and exposure photomicroscopy for increased depth of field (Ibid. 20:333-334, 1988.); fixation procedures with glutaraldehyde and freeze drying (Ibid. 18:479-487, 1986; Va. J. Sci. 39:97, 1988, with M. M. Mota.). He devised a technique employing a selection of plant species and a key which growers could use to identify the root knot nematode attacking their crops (Pl. Protection Newsl. 6 (2): 20-22, 1987.). With D. A. Radin, he devised an aseptic root culture for studying the interaction of tomato and *Meloidogyne incognita* root knot. Root growth was induced from thin cell layers of peduncles of susceptible and resistant cultivars. Responses were similar to those on roots from seedlings (J. Nematol. 23:441-445, 1991.).

Eisenback mentored Manuel M. Mota through a Ph.D. project and published several papers and abstracts based upon Mota's research. Mota's dissertation completed in September 1992 was entitled, "Morphological characterization of the tobacco cyst nematode complex, *Globodera tabacum* sapp. *tabacum, virginiae*, and *solanacearum* (Nemata: Heteroderinae). Mota employed both light and scanning electron microscopy; he found the morphology of females and cysts to be most useful for separating the subspecies (J. Nematol. 25:27-33, 136-147, 148-160, 1993.). A dichotomous key using certain characters would be beneficial, but at present the three subspecies are geographically separated so a key was deemed unnecessary.

With Phipps, Johnson and others located at Research and Extension Centers, Eisenback published articles in the American Phytopathological Society annual summaries, *Biological and Cultural Tests* and *Fungicide and Nematicide Tests*. Peanut, soybean, and tobacco were the primary subjects; significant results are found in sections on these crops. However, most of this research is incorporated in the annual *Pest Management Guide: Field Crops*, Virginia Cooperative Extension Service Publication 456-16.

Eisenback presented numerous papers at meetings with nematologists world wide and has written in cooperation with others several book chapters relative to nematode morphology and taxonomy. He has also discovered an/or described domestic and exotic nematodes, especially in the genera *Meloidogyne* and *Globodera*.

While Eisenback was developing his career refining descriptions of cyst and root knot nematodes, Miller was ending his career demonstrating that several species of *Heterodera* (*H. glycines*, *H. cruciferae*, and *H. schachtii*) were interfertile. He produced hybrid populations and studied their morphology (Nematologica 41:322, 1995.). He drew no conclusions as to their taxonomic relations.

Miller studied the inheritance of virulence among five isolates of *H. schachtii* and found transgressive segregation for virulence and avirulence among the hybrid populations.

Miller presented numerous papers at professional society meetings on morphological comparisons of *Globodera* spp. pathogenic to tobacco (J. Nematology 23:540, 540-541, 1991; 24:608, 1992; Phytopathology 81:703, 1991; 82:720, 1992; Va. J. Sci. 39:96, 97, 1988; 42:173, 174, 1991; 43:219, 1992.). He also published abstracts on the morphology of three *Heterodera* spp., namely, *H. glycines*, *H. cruciferae*, and *H. schachtii* J. Nematology 20:648-649, 1988; 21:574, 1989: Nematologica 41:322, 1995; Phytopathology 78:803, 1988; 79:1183, 1989; 84:546, 1994; 85:631, 1995; Va. J. Sci. 39:97, 1988; 40:136, 1989.). He also described a new species of *Globodera* found in Mexico, Bolivia, and Venezuela (Nematropica 23:127, 1993.). This nematode was not named, but Miller thought it was similar to *G. tabacum virginiae*.

Miller ventured once into the world of bio-technology. In his final journal publication with V. R. and J. M. Ferris, ribosomal DNA comparisons provided evidence that *G. pallida*, *G. rostochiensis*, and two undescribed Mexican isolates were closely related, but *G. virginiae* was either unrelated or distantly related to the others. These findings were consistent with the thesis that Mexico is the center of origin for the potato cyst nematode (J. Nematology 27:273-283, 1995.).

Although Miller had retired January 1, 1980, he remained a diligent and productive researcher for 16 more years. He died March 8, 1995 from complications following an operation. In the final weeks before he was hospitalized, he was busy planting hosts, washing and screening roots and soil, preserving and studying specimens, and planning papers and trips to meet with nematologists throughout the world.

Virology

Although the topics in this section could very well be considered in sections on soybean, forage crops, tobacco, etc., they are separated and placed under virology because their study involves an almost unique technology. During the Moore Era, Sue A. Tolin mentored six students through graduate degree programs addressing aspects of the soybean mosaic virus (SMV). They were Paul L. Gunyuzlu, 1987; Chang W. Choi, Ph.D., 1991; Indira Srinivasan, M.S., 1992; Tarun Gera, M.S. 1994; Jonathan P. Flora, M.S., 1994; and Saba J. Qusus, Ph.D., 1997. Complete citations of their theses/dissertations are found near the end of the section on soybean.

Gunyuzlu determined the nucleotide sequence of the 3' terminus of strain G1 of SMV. He demonstrated, "That SMV capsid protein is initially expressed as a high molecular weight polyprotein. The predicted amino acid sequence shares several similarities with other potyviruses." He also concluded that, "the amino acid sequence of the N-terminus is highly variable," compared to other potyviruses and that, "SMV may encode a nuclear inclusion gene which shares some homology with other known potyvirus nuclear inclusion genes" (Thesis, p. 38.). This work pioneered a study of potyvirus by cloning a portion of a potyvirus using recombinant DNA. Gunyuzlu also demonstrated heterogeneity in the capsid protein. It was later determined that he had worked with a variant of SMV-G1.

Qusus isolated, cloned, and sequenced the coat protein (CP) genes of SMV-G1 and -G6. "The predicted 265 amino acid sequence of the CP of the G1 and G5 strains were 98.9% identical. Correlating the CP sequences of G1, G2, G6, and G7, with their virulence on resistant soybean cultivars indicated that the CP is not likely to be the R- and /or N-determinant in the SMV-soybean system." (From the Diss. Abstract.).

Qusus also used a technique developed by Gera (see below) to study the pathogenesis of SMV strains G1, G6, and G7 on inoculated leaves of resistant (R), necrotic (N), and susceptible (S) soybean cultivars by leaf imprint immunoassay. She concluded that, "*Rsv1*-mediated resistance is a multicomponent type of resistance that involved both inhibition of virus replication as well as cell-to-cell movement.

Finally, Qusus attempted to study *Rsv1*-mediated resistance at the cellular level. Protoplasts of soybean were separated. The attempts failed because the inoculation medium killed the protoplasts, or the residual virus from inoculations interfered. In any case, results were not reproducible.

Gera devised a method of transferring soybean leaf sap and infecting virus to filter paper and, analogous to photography, developing an image of exactly where virus was distributed in the leaf. The advantage of Gera's technique was that the entire leaf was assayed, not merely specified or random sections. He could track movement of the virus any number of days after inoculation. His contribution was development of a very useful, accurate method for pinpointing the location of virus. In his study, he used SMV-G4 and -G5 to inoculate York ($Rsv1^{y}$) Kwanngyo ($Rsv1^{k}$) and Lee (*rsv*).

Choi studied various aspects of the SMV-interactions occurring when 'York' soybean was inoculated with SMV-G1 and necrosis inducing G4. With G4, virus spread in a restricted manner along the veins, stems, and trifoliolate leaves which became necrotic Pathogenesis related proteins accumulated in hypersensitive and necrotic responses; they were placed in four groups two of which were identified, one as beta-1, 3-glucanoses and one as chitinases. These were further subdivided. Accumulation of certain enzymes was correlated with strain specific resistance. These studies gave molecular affirmation to Mendelian genetic studies and occurrence of an allelic series at the *Rsv1* locus.

In their various inheritance studies, plant geneticists observed variability of symptoms in soybean-SMV interactions. They attributed this to a sensitivity of resistance genes to high temperature. Flora tested this hypothesis using soybeans cvs. carrying *rsv*, *Rsv1*, *Rsv1k*, *Rsv1t* and *Rsvly*, each inoculated singly with SMV-G1, -G4, -G6, and -G7. He also tested similarly cvs. carrying *Rsv3*, *Rsv3h*, *Rsv3* + *Rsv4*, and *Rsv3*?. Symptoms normal for soybean - *Rsv1* (all allelotypes) interactions were stable in response to heat treatments, but soybean - *Rsv3* interactions varied. Thus, with genetic studies, variations were attributed to other factors in *Rsv1* genotypes, but caused variations in hosts of Rsv3 genotype (J. P. Flora, M.S. Thesis, V.P.I. & S.U., 1997.).

Tolin became involved in characterizing two exotic viruses that posed a threat to the U.S. soybean crop should they be introduced. The viruses, soybean dwarf virus (SDV) and a soybean-infecting strain of tobacco mosaic virus (TMV-S), were discovered in Japan and Yugoslavia, respectively. The team investigating SDV operated at Fort Detrick, Md., where containment facilities enabled workers to manipulate the virus without endangering domestic soybean crops. A yellow and dwarfing strain were compared and found to be very similar (Phytopathology 76:759-763, 1986; 81:131-134, 1991.). Neither strain has been found in U.S.A. The TMV-5 was studied by a different team operating at the American Type Culture Collection in Rockville, Md. The team compared TMV-S with TMV-B (bean), TMV-C (common) and TMV-SHMV (sunhemp mosaic virus). They found it most closely related to TMV-C (Indian J. Virol. 2:188-200, 1986; Plant Dis. 79:206-211, 1995.).

Tolin was also a cooperator in the Regional Research Project, Viruses Affecting Growth and Persistence of Forage Legumes in Pastures and Fields. In Virginia, white, alsike, and subterranean clovers were found infected with a soybean dwarf-like luteovirus and also with peanut stunt virus (PSV). Cultures of PSV were provided to collaborators in Kentucky who are attempting to genetically engineer virus-resistant tobacco plants.

Srinivasan in her M.S. research (1992) isolated bean yellow mosaic virus (BYMV) from red clover (*Trifolium pratense*) collected in Frederick and Montgomery Counties, clover yellow vein virus (CYVV) from white clover collected in Augusta, Richmond, and Washington Counties, and peanut stunt virus (PSV) from white clover collected in Augusta County. She claimed that these viruses, "were successfully detected for the first time from naturally infected clovers in Virginia...by tissue immunoblot assay" (Srinivasan, M.S. Thesis, p. 74.). The tissue immunoblot assay (TIBA) and indirect enzyme linked immunosorbent (i-ELISA) assay methods for virus detection were compared for efficaciousness, cost, speed, and laboriousness. The TIBA method was equal to or more expeditious than the i-ELISA method on all accounts. This thesis was more a study of laboratory technique than the pathology of forage plant viruses, but it laid the groundwork for more efficient surveys and clinical detection of viruses in forage legumes.

New Plant Diseases and Pathogens

Most of the diseases and pathogens cited below are based upon published reports. In an effort to seek out overlooked publications, several faculty were questioned. The results were surprising; no one kept a list of new or unusual pathogens they encountered. Two diseases/pathogens did attract regional attention, dogwood anthracnose and the corn cyst nematode. Except for graminicolous fungi, the diseases/pathogens are listed in chronological order of publication. Note that the order of publication and order of discovery may not coincide:

Japenese cedar (*Cryptomeria japonica*) - Cercospora blight caused by *Cercospora sequoiae*, received by the Plant Clinic from Laxena, New Kent Co., 1982. (R. L. Wick and R. C. Lambe. J. Environ. Hort. 3 (1):18-19. 1985.).

Barley (*Hordum vulgare*) - the Columbia root-knot nematode *Meloidogyne chitwoodi*, was detected in soil and barley roots from Westmoreland Co. in December 1985. Previously, it had been known from California, Colorado, Idaho, Nevada, Oregon, Utah, Washington. Thus, this is the first record of its occurrence in the eastern United States (J. D. Eisenback, E. L. Stromberg, and M. S. McCoy. Pl. Dis. 70:801. 1986.).

Siberian elm *Ulmus pulila*) - Dutch elm disease caused by *Ophiostoma ulmi* (= *Ceratocystis ulmi*), at Winchester, Frederick Co. 1987. (R. J. Stipes and K. S. Yoder. Va. J. Sci. 38:131. 1988.).

Round leaf birch (*Betula uber*) - Crown dieback caused by *Botryosphaeria dothidea*, and anthracnose caused by *Glomerella cungulata* found in the Mt. Rogers Virginia Department of Agriculture and Consumer Services (VACS) propagation plots, Washington Co., 1989. (R. J. Stipes, D. J. Schweitzer, and M. W. Trammell, Jr., last two VACS, Richmond, Va. J. Sci. 41:69. 1990.).

Soybean (*Glycine max*) - Root and stem rot, caused by *Phytophthora megasperma* f. sp. *glycines*, was first observed on 'Bay' soybean in Amelia Co., August 1988. The fungus was isolated, inoculated to 'Essex' soybean, and the disease was produced. (Hansen, Mary A., R. L. Wick, and E. L. Stromberg. Pl. Dis. 74:183. 1990.).

Shiitake (Japanese forest) mushroom, *Lentinus edodes*, is grown on logs of deciduous hardwood trees, primarily oak. To say that the mushroom is diseased may not be accurate. However, logs bearing skiitake mushrooms may be invaded by fungi regarded as weeds. These weeds soon destroy the productivity of the logs. *Eutypa spinosa* and *Graphostroma platystoma*, both pyrenomycetous Ascomycetes, and both found as invaders of various hardwoods, are among the fungi identified as causing decline of shiitake production in Virginia at various sites. (G. Guevara and R. J. Stipes. Va. J. Sci. 41:62. 1990.).

Peanut (*Arachis hypogaea*) - A ringspot disease caused by the tomato spotted wilt virus was observed on peanut foliage in Dinwiddie, Isle of Wight, and Sussex Cos., in late 1990. Identity of the virus was established by the ELISA method (enzyme linked immunosorbent assay). Isolated infected plants occurred in several fields on several cvs. (D. M. Porter, J. W. Demski, and P. M. Phipps. Pl. Dis. 75:451. 1991.).

Corn (*Zea mays*) - Crazy top caused by *Sclerophthora macrospora* (formerly *Sclerospora macrospora*) occurred in test plots on the farm of Bailey and Leedy at Crockett, Wythe Co. 1991, 1992. The disease was reported by E. L. Stromberg (unpublished) and observed by C. W. Roane. Although crazy top was observed in 1958, there are no reports of its occurrence in Virginia in the intervening years, 1958 - 1991.

Peanut leafspot fungus hyperparasite (*Cercosporidium personatum*) - *Dicyma pulvinata* was observed colonizing the causal agent of peanut leafspot during October 1991, in Suffolk. A frequency of 2.5% was determined on 8110 spots. Through 1991, this was the northernmost observation of the fungus. (D. M. Porter and R. A. Taber. Pl. Dis. 76:1185. 1992.).

Corn (*Z. mays*) - the cyst nematode, *Heterodera zeae* was first found in Virginia in October 1992 on a farm in Cumberland Co. The infested field produced 120 bu/ac in 1991 following application of a nematicide, but only 20 bu/ac without a nematicide in 1992. There were no additional sites of infestation in Virginia through the end of the Moore Era. (J. D. Eisenback, Diane Reaver, and E. L. Stromberg. Pl. Dis. 77:647. 1993.).

Corn - Eyespot caused by *Aureobasidium zeae* (syn. *Kabatiella zeae*) was found in Montgomery and Orange Cos. In the fall of 1984. (C. W. Roane and Martha K. Roane. Va. J. Sci. 45:279-296, p. 292. 1994.).

Grape (*Vitis vinifera*) - Grapevine yellows caused by a mycoplasma-like organism, MLO, was observed in 1987. By 1993, it had been recorded for 12 Chardonnay and 3 Riesling vineyards scattered around the Piedmont. The disease appears to be similar to grapevine *flavescence dor_ee* of Europe. (T. K. Wolf, Winchester Experiment Station, J. P. Prince, and R. E. Davis, USDA, Beltsville, Md., Pl. Dis. 78:208. 1994.).

For several years after his retirement on August 31, 1986, C. W. Roane collected fungi on grasses. This was a somewhat natural follow-up to his 39+ years of research on cereal crop diseases. His wife, Martha K. Roane, joined in the identification, description, and publication of the findings. Three papers were issued under the general title, "Graminicolous fungi of Virginia" (Va. J. Sci. 45:279-296, 1994; 47:197-224, 1996; 48:11-45, 1997.). It was concluded that there were 160 fungus/grass associations new to the United States, 24 new to the eastern United States (east of the Mississippi R.), and 46 new only for Virginia. Thus, 230 new associations were reported for Virginia. Since most of the collections were made in Montgomery and the surrounding counties, a few from the Piedmont, and a very few from the Coastal Plain, the authors suggested that intensive surveys in single counties, cities, ecosystems, or neighborhoods should be very productive (Va. J. Sci. 48:44.). Martha Roane died on December 31, 1996, but Curtis Roane continued the project on a limited scale and intends to report further on this work.

When a previously exotic organism is introduced for the purpose of biocontrol of a noxious weed, should it properly be considered under new diseases? Musk thistle, *Carduus thoermeri*, is an introduced weed that has become a widespread pasture and range pest in the United States. Heavy infestations occur in several counties in western Virginia. Attempts have been made to control it by introducing insects that feed upon it. Although these insects have reduced the population, a search has been made for pathogenic fungi which may further reduce the thistle population. *Puccinia carduorum*, an autoecious rust from turkey, was found by researchers at the Foreign Disease-Weed Science Research Unit, USDA-ARS, Fort Detrick, Md. to be a probable biocontrol agent for musk thistle (W. L. Bruckart et. Al. 1996. Biol. Control 6:215-221.). Anton Baudoin cooperated with Bruckart in the October 1987 release of *P. carduorum*, and in the study of its spread through 1995 (A.B.A.M. Baudoin et al. Biol. Control 3:53-60, 1993; Pl. Dis. 80:1193-1196, 1996.). From its introduction near Blacksburg in1987, by 1995 it had spread westward into Kentucky, Indiana, Tennessee, and Missouri, and southward into North Carolina, South Carolina, and Georgia. Baudoin and Bruckhart made the following cautious statement, "The fact that rust severities on young rosettes in the fall were usually low may favor the pathogen since it limits damage to the host, but it is disappointing from a biological control perspective since young seedlings are actually the most susceptible stage, and severe fall infection might have led to the reduced overwintering of thistles (Pl. Dis. 80:1196.). It is often said that nature has a way of achieving a balance. Experimenters in biological control can vouch for the veracity of this axiom.

Plant Pathology Related Service to Societies, 1984 - 97

Obviously, the American Phytopathological Society was the most important society for plant pathologists, but there were others just as important to individuals, namely, The Society of Nematology, Virginia State Horticultural Society, Virginia Academy of Science, Organization of Tropical American Nematologists, American Institute of Biological Sciences, American Peanut Research and Education Society, International Society of Arboculture. Activities in the various societies are listed below.

S. A. Alexander
- American Phytopathological Society
  - Forest Pathology Committee - 1986 - 1990.
  - Plant Disease Detection Comm. - 1990 - 1992.
  - National Forest Health Monitoring Management Comm. - 1992 - 1995.
  - Potomac Division Graduate Student Comm. - 1997 - 1998.

A. B. A. M. Baudoin
- American Phytopathological Society
  - Editorial board, *Plant Disease* - 1989- 1991.
  - Teaching Comm. - 1983 - 1988.
    - Chairman, 1986 - 1987.
  - Local Arrangements Comm. - 1989.
  - Editor, *Laboratory Exercises for Plant Pathology*, APS, 1988.
  - Potomac Division Graduate Student Paper

Judging Comm. 1985, 1988, 1994,
Secretary/Treasurer, Potomac Division - 1997 - 99.
Virginia Academy of Science
Agricultural Science Section, Chm. - 1991

Jodi A. Carlson (Gray)
American Phytopathological Society
Forest Pathology Comm. 1992 - 1995.
Potomac Division Representative to the Graduate Comm. - 1991 - 1993.

J. D. Eisenback
American Phytopathological Society
Illustrations of Plant Pathogens Comm. - 1987 - 1998.
International Liaison Comm. - 1988 - 1998.
Society of Nematologists
Secretary - 1994 - 1997.
Executive Board - 1994 - 97.
Computers in Nematology Comm. - 1991 - 1998.
Intraspecific Designations in Nematology Comm. - 1988 - 1989.
Education Comm. - 1980 - 1989; 1994 - V.-Chm. 1981 - 84, 1986 - 7.
Chm. 1984 - 85, 1985 - 86, 1987 - 89.
Program Comm. For 1988 meeting - 1986 - 88.
Systematic Resources Comm. - 1996 - 97.
Symposium Chm. - 1988, 1990.
Paper Session Chm. - 1984, 1986, 1987.
Associate Editor, *Journal of Nematology*. - 1988 - 90.
Organization of Tropical American Nematologists
Geographical Representative for North America - 1990 - 1998.
Virginia Academy of Science
Judge for Virginia Junior Academy of Science - 1991.
Editorial Board. *Nematologica Mediterranea* - 1989 - 97, 1994 - 96.
Editorial Board, *Numa CD International*. - 1996 - 97.

R. L. Grayson
American Phytopathological Society
Public Relations Comm. - 1992 - 96.

G. J. Griffin
American Phytopathological Society
Soil Microbiology and Root Disease Comm. - 1988 - 90, 1995 - 98.

C. Hagedorn
American Phytopathological Society
Biotechnology Regulation
Impact Assessment Comm. - 1991, 1994 - 96.

Mary A. Hansen
American Phytopathological Society
Plant Disease Advisory Board - 1993 - 94.
Diagnostics Comm. - 1988 - 90.

Subcomm. On Diagnostics Manual - 1988 - 95.
Placement Comm. - 1988 - 91.
Editor, "Spotlight on Diagnosis" Section of *Plant Disease*. - 1992 - 93.
Editorial Board, APS Press. - 1994.

G. R. Hooper
American Phytopathological Society
Teaching Comm. - 1980 - 85.
Cassette Tape Information Comm. - 1984 - 85.

C. S. Johnson
American Phytopathological Society
Comm. on Plant Disease Losses. - 1988 - 91.
Integrated Pest Management Comm. - 1989 - 93, V.-chm. 1990 - 91,
Chm. 1991 - 93.
Nematology Comm. - 1997 - 98.
Extension Comm. - 19933 - 96.

Dean A. Komm
American Phytopathological Society
Extension Comm. - 1984 - 85.

G. H. Lacy
American Phytopathological Society
Bacteriology Comm. - 1997 - 98.
Potomac Division Graduate Student Paper Awards Comm. - 1990.

R. C. Lambe
American Phytopathological Society
Registration Comm. - 1985.
International Cooperation Comm. - 1986 - 88.
Private Practice Comm. - 1986 - 88.

L. D. Moore
American Phytopathological Society
Potomac Division Representative on Council. - 1983 - 86.
Local Arrangements Chm., National Meeting for 1989. - 1986 - 89.
APS Representation on American Institute of Biological Sciences. - 1983 - 96.
Editor, *Phytopathology News*. - 1987 - 90.
Membership Comm. - 1983 - 86.
Meeting Site Selection Comm. - 1983 - 86.
Nominating Comm. - 1983 - 86.
Public Responsibilities Comm. - 1992 - 96. V.- Chm. 1993 - 94, Chm. 1994 - 95.
Cultural Diversity Comm. - 1994 - 97. Chm. 1996 - 97.
Women in Plant Pathology Comm. - 1995 - 98.
Potomac Division Committees
Nominations. - 1990 - 91.
Distinguish Service Award. - 1993 - 94.

Graduate Student Competition. - 1992, 1995.
American Institute of Biological Sciences.
General Council. - 1983 - 92.
Board of Directors. - 1986 - 88, 1989 - 91.

P. M. Phipps
American Phytopathological Society
Chemical Control Comm. - 1994 - 97.
Associate Editor, *Plant Disease* - 1986 - 88, 1992 - 94, 1995 - 97.
Section Editor, *Biological and Cultural Control Tests*. - 1988 - 90.
Section Editor, *Fungicide and Nematicide Tests*. - 1982 - 87.
Comm. to Draft the Extension - Technology Transfer Section of Plant Pathology 2000 Document. - 1993 - 94.
American Peanut Research and Education Society
Finance Comm. - 1997 - 99.
Fellows Comm. - 1994 - 97, chm. 1996
Local Arrangements Comm. - 1995, 1998.
Technical Program Comm. - 1986, 1989, 1991, 1992.
Graduate Student Paper Competition, Judge. - 1993 - 94.
Associate Editor, *Peanut Science*. - 1993 - 99.
Other - Southern Soybean Disease Workers, Disease Loss Estimate Comm. - 1984 - 97.
- Cotton Seedling Disease Control Comm. - 1995 - 97.
- Cotton Nematode Control Comm. - 1995 - 97.

D. M. Porter
American Phytopathological Society
Co-editor, *Compendium of Peanut Diseases*. - 1984, Sec. ed. 1997.
American Peanut Research and Education society.
Program Comm., Chm. - 1986.
Nominating Comm., Chm. - 1988.
Awards Comm. - 1988 - 89.
Fellows Comm. - 1991 - 92, Chm. 1992.
President. - 1986.
Associate Editor, *Peanut Science*, - 1982 - 84.

C. W. Roane
American Phytopathological Society
Archives Comm. - 1991 - 93.

Martha K. Roane
American Phytopathological Society
Mycology Comm.
Potomac Division, Resolutions Comm. - 1986, Chm.
Potomac Division, Graduate Student Awards Comm. - 19817, Chm.
Co-editor, *Compendium of Rhododendron and Azalea Diseases*. - 1986.
Co-author, APS Monograph *Chestnut Blight, Other Endothia Diseases, and the Genus Endothia*. - 1986.
Co-preparer, APS slide set and text, Diseases of Rhododendron and Azalea. - 1989.

Virginia Academy of Science
Flora Comm. Council
Editor, *Jeffersonia*
Local Arrangements Comm.
Chairman, Public Relations
Chairman, Accommodations
Publications Comm.
Long Range Planning Comm.
Archives Comm., Chm.
Advisory Board of Virginia Museum of Natural History. - 1985 - 87.
Treasurer.
Secretary.

R. J. Stipes
American Phytopathological Society
Monographs and Reviews Comm. -
Membership Survey Comm. -
Promotional Film Comm. -
Associate Editor, *Phytopathology*. 1989 - 91.
Potomac Division, - President - 1984
- Councilor - 1986 - 88
- Awards Comm.
- Nominations Comm.
- Resolutions Comm.
- Pianist, annual banquet.
International Society of Arborculture
Editorial Board, *Journal of Arborculture*. - 1988 - 90.
Virginia Academy of Science
Agricultural Sciences Section, Editor, Councilor. -
Botany Section, Editor, Councilor

E. L . Stromberg
American Phytopathological Society
Fungicide and Nematicide Data Comm. - 1986 - 92, V.-Chm. - 1987 - 88, Chm. - 1988 - 89, 1995 - 97.
Section Editor, *Fungicide and Nematicide Tests*, - 1990 - 91, 1992 - 96.
Editor, *Fungicide and Nematicide Tests*, - 1992 - 97.
Extension Comm. - 1988 - 92.
Regulatory and Foreign Plant Diseases Comm. - 1980 - 86, Chm. - 1984 - 86.
Integrated Pest Management Comm. - 1995
Potomac Division
Program Comm. - 1982 - 92, Chm. 1991; 1994
V.-President. - 1989 - 90, President. - 1990 - 91.
Nominations Comm., Chm. - 1991
Distinguished Service Awards Comm., Chm. - 1991.
Program Comm. - 1996

Sue A. Tolin
American Phytopathological Society

Vice-president, President Elect, President, Past President. - 1993 - 96.
Councilor-at-Large. - 1989 - 93.
Financial Advisory Comm. - 1993 - 96.
Headquarters Operations Comm. - 1993 - 96.
National Meeting Program, Comm. 1992 - 94; Chm. - 1994.
National Plant Pathology Board, - 1991 - 97.
APS Representative to Coalition for Funding Agricultural Research Missions. - 1993 - 97.
Biotechnology Regulation Impact Assessment Comm. - 1987 - 92; 1997 -
Public Responsibilities Comm. - 1984 - 88.
Committee on Committees, Chm. - 1991.
Executive Comm. - 1991.
Membership Comm. - 1991.
Potomac Division Nominating Comm. - 1993 - 94.

H. L. Warren
American Phytopathological Society
Genetics Comm. - 1986 - 89.
Collection and Germplasm Comm. - 1991 - 94.
Diversity and Cultural Comm. - 1995 - 98. V.-Chm. - 1997.

K. S. Yoder
American Phytopathological Society
New Fungicide and Nematicide Data Comm. - 1989 - 92.
Section Editor, Small Fruits, *Ibid*. 1996 - 97.
Potomac Division. Program Comm. - 1986.
Deciduous Tree Fruit Workers, Pre-meeting tour, Chm. - 1989.
Associate Editor, *Phytopathology* - 1993 - 95.
Chemical Control Comm. - 1989 - 91.

Faculty Awards and Recognitions Related to Plant Pathology, 1984 - 1997

The awards and citations listed below originated outside of the Department and show that the recipients are recognized for quality achievements by professional societies, scholarly organizations, and the agricultural industry.

S. A. Alexander.
U. S. Environmental Protection Agency, Scientific Leadership Award, 1995.
Office of Monitoring, Tribute of Appreciation, 1995.

R. E. Baldwin.
Association of Virginia Potato and Vegetable Growers, Certificate of Appreciation for Outstanding and Dedicated Service, 1994.

A.B.A. M. Baudoin.
National Association of College Teachers in Agriculture, NACTA

Teacher Fellow Award, 1987.
American Phytopathological Society, Excellence in Teaching Award, 1994.

B. I. Chevone.
U.S. Environmental Protection Agency, Certificate of Outstanding Service, Office of Exploratory Research, 1993.

H. B. Couch.
Massachusetts Turfgrass Conference, 63rd meeting dedicated to Couch, 1994.

C. R. Drake.
National Peach Council, Carroll Miller Award, for Outstanding Research and Extension Contributions to the Peach Industry, 1988.

J. D. Eisenback.
Society of Nematology Ciba.Geigy Award, for Significant Contributions to Agriculture, 1996.

G. J. Griffin.
Academia Galega De. Sciences, Spain, Elected to Membership, 1992.
U.S. Department of Agriculture / CSREES, Group Honor Award, for Innovative Research on American Chestnut, 1997.

C. Hagedorn.
U.S. Environmental Protection Agency, Distinguished Service Award, 1992.

R. C. Lambe.
Fulbright Scholarship, 1983 - 84.

L. D. Moore.
American Phytopathological Society. Potomac Division, Distinguished Service Award, 1994.
Virginia Turfgrass Council, Meritorious Service Award, 1994.
Virginia Pesticide Control Board, Certificate of Recognition, 1996.

P. M. Phipps.
American Phytopathological Society, Extension Award, 1994.
Virginia Tech Alumni Association, Excellence in Extension Award, 1994.
American Peanut Research and Education Association, Bailey Award for Outstanding Paper, 1991.

D. M. Porter.
American Peanut Research and Education Association, Fellow. 1989

C. W. Roane.
Virginia Agricultural Experiment Station, 'Roane' wheat named for

contributions to small grains breeding, 1998.
American Phytopathological Society, Fellow, 1984.
Ibid., Potomac Division, Distinguished Service Award, 1990.
Gamma Sigma Delta, Va. Tech Chapter, Outstanding Faculty Research Award, 1986.
Va. Tech Agricultural Alumni Organization Citation, for Outstanding Service to Va. Tech, Agricultural Alumni Association, the College of Agriculture and Life Sciences and the Industry of Agriculture, 1989.
Virginia Small Grains Association, Certificate of Appreciation, 1986.

M. K. Roane.
Virginia Academy of Science, Fellow, 1991.

R. J. Stipes.
American Phytopathological Society, Potomac Division, Distinguished Service Award, 1995.
Alpha Gamma Rho, Va. Tech Chapter, Commendation Certificate, 25 Years Service to Virginia Agriculture, 1993.
International Society of Arboriculture, Outstanding Research Award, 1991. Honorary Life Membership (Mid-Atlantic Division), 1990.

E. L. Stromberg.
American Society of Agronomy, Certificate of Excellence, for Development of Outstanding Educational Material, i.e., "Intensive Soft Red Winter Wheat Production-Management Guide," 1996.
National Association of Wheat Growers, Certificate of Appreciation, 1989.
Virginia Small Grains Association, Certificate of Appreciation for Contributions to Wheat Disease Control, 1996.

S. A. Tolin.
American Phytopathological Society, Fellow, 1984.
Presidential Service Award, 1996.
Potomac Division, Distinguished Service Award, 1996.
U.S.D.A., Certificate of Appreciation for Service to Science, 1993.
Purdue University, Distinguished Alumni Award, College of Agriculture, 1993.
University of Nebraska, Outstanding Alumni Award, 1995.

H. L. Warren.
Commonwealth Visiting Professor, 1988.
New York Academy of Science, Elected Member, 1996.

M. J. Weaver.
Agricultural Communicators in Education, Superior Award, for Educational Interactive Video Program, 1989.
Ibid., Superior Award, Best Innovative Use of Communication Technology, 1989.
Student Awards and Recognitions Related to Plant Pathology, 1984-

1997.

Cunningham Fellowships
Caitilyn Allen - 1983, 1985 - 86.

American Phytopathology Society, Potomac Division, Best Paper Award
Michele Carter - 1992, Co-winner
Ramon Cu - 1990.
John Eberwine - 1993.
David Langston - 1996.
Katherine J. Lewis - 1985, Co-winner.
Daniel P. Roberts - 1985, Co-winner.
F. D. "Tad" Smith - 1991.
Sandra Walker - 1992, Co-winner.

Bruce Perry Scholarship
Caitilyn Allen - 1986.
Brooks Crozier - 1991.
Graciela Farias -1990, 1991.
Jonathan Flora - 1996.
David Johnson - 1987, 1989.
Melinda Mulesky - 1989.
Symon Mwangi - 1992, 1993, 1994.
Santford V. Overton - 1984.
Nancy Robbins - 1997.

Virginia Agricultural Chemical and Soil Fertility Association Scholarship
Timothy B. Brenneman - 1985.
Michele Carter - 1991.
Brooks Crozier - 1996.
Anne Dorrance - 1992.
John Eberwine - 1992, 1993.
David Langston - 1997.
F. D. "Tad" Smith - 1989.

American Peanut Research and Education Society, best paper award.
Timothy B. Brenneman - 1985.
Ramon Cu - 1989, 1990.
David Langston - 1996.

Miscellaneous Awards and Scholarships
Anne Dorrance.
Teaching Excellence Award from our College - 1995; Graduate Student Scholarship; Graduate Research Development Project Grant - 1994.
Elspeth Jewell.
Kocide Chemical Corp., Agricultural Scholarship 1984, 1985.
Mike Johnson.
Virginia State golf Association Fellowship - 1994.
Manuel Mota.
Junta Nacional de. Investigaco Cientificae Technologica

Scholarship - 1990.

Melinda Muleskey.

American Association of University Women Scholarship - 1993.

Sigma Xi Grant-in-aid Research Award - 1993.

Symon Mwangi.

Rockefeller Foundation Research Grant - 1995.

Sirkka Kyostio.

Research Grant, Graduate Student Assembly - 1990.

Sigma Xi Graduate Research Award - 1989.

Diane Reaver.

David R. Spence Research Award from our College - 1986.

Paul Zama.

Graduate Research Development Award - 1985.

Epilogue

This History of Plant Pathology in Virginia was originally undertaken as a hobby. At the time of my retirement, August 31, 1986, I could not visualize myself as disconnecting from plant pathology. Since I was interested in the history of plant pathology and had known all of Virginia's pathologists from 1930 on, writing about plant pathology in Virginia seemed like a way to stay connected. It has kept me connected for over 15 years.

This History is totally my own. No one else has specified its length or content. I have not relied on editors nor have I had to contend with them. Thus, all errors, misconceptions, and omissions are mine alone. Conversely, there may be some first-time observations and proclamations for which I may be proud. To those who may have contributed substantially to Virginia plant pathology and whose contributions were not cited, I deeply regret the omission and apologize sincerely.

As to the style of the History, I recognize inconsistencies in citations and format. I did whatever the mood of the moment dictated, and there were many moods over the 15+ years. The History is not meant to be a literary piece, but more a chronicle, a tabulation in prose. It does not deal with personalities, people, or clashes. Having done so, the history might have been hilarious or at times, reeking of scandal. A more talented author in doing so may have created a more interesting, readable history. It may have also been necessary to seal the history and label it, "Do not open until 2050." Thus, the History is only archival 'stuff' destined to fill a few more inches on library shelves, shelves already overstuffed with print nobody ever reads; for now it must be on a web site or the internet, or it will never be seen.

C. W. Roane
April 2003

Acknowledgements

It would seem that one could assemble a history of plant pathology simply by consulting published papers, books, reports, etc. Try it. You will find that you become dependent upon the kindness of others for all sorts of favors. Thus, many of my plant pathology colleagues provided me with notes, reprints, and conversational tidbits which enhanced the completeness of this history. Although the list is probably incomplete, I would like to thank my wife, Martha K. Roane (deceased), and my friend Lawrence S. Miller (deceased), who played significant roles in editing and steering me to sources of information. Others provided dossiers, documents, and biographical files: R. E. Baldwin, A.B.A.M. Baudoin, H. B. Couch, C. R. Drake, J. D. Eisenback, C. L. Foy, K. H. Garren, G. J. Griffin, L. D. Moore, R. S. Mullin, T. J. Nugent, J. A. Pinckard, D. M. Porter, Peter B. Schultz, J. M. Skelly, R. J. Stipes, E. L. Stromberg, Sue A. Tolin, and K. S. Yoder.

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I remain eternally grateful to all those mentioned and to those who through human oversight were not mentioned, but also contributed.

C. W. Roane
April 2003

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