SCIENCE NEWS

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SPECTRAL LINES

A SUBSTANCE impossible on this earth, but lying in the vast stretches of so-called "empty" space between the stars, partly clears up an astronomical mystery of long standing. It accounts for three of four spectral lines that have puzzled astronomers. The fourth is still unexplained.

The substance is hydrogen carbide or carbon hydride, whichever you prefer to call it. But astronomers simply call it CH, for the molecule is composed of one atom of carbon and one of hydrogen. The final step in the proof was accomplished by two Canadian physicists who looked not at the sky but through the eyepiece of a spectrometer in the laboratory. The physicists are Dr. A. E. Douglas, of the National Research Laboratories in Ottawa, and Professor G. Herzberg, physicist at the University of Saskatchewan.

The spectrometer is the instrument that spreads light out in a rainbow and tells what things are made of here and in the skies, provided the spectrum "lines" are identified with similar lines given by a known substance. Each line corresponds to a particular wavelength of light. A good instrument will measure this to a 25-billionth of an inch. Astronomers examining the stars with this instrument have noted four sharp lines which did not correspond to those of any known substance. On theoretical grounds and as a result of mathematical calculations they attributed them to CH, existing in the space between the stars. Much of this work was done by Dr. Theodore Dunham, Jr., and Dr. Walter S. Adams, of the Mount Wilson Observatory in California, and Dr. Andrew McKellar, of the Dominion Astrophysical Observatory, B. C.

But the astronomers could not be sure of their conclusion, because since CH does not exist on the earth, its "lines" had never been seen. All this has now been remedied, for Dr. Douglas and Dr. Herzberg have produced three of the lines in the laboratory and positively identified them as belonging to CH. The fourth line which did not appear, they gave good reasons for believing does not belong to CH. Hence the fourth line still remains a mystery.

The reason why CH, and we may add CH_2 and CH_3, are "impossible" compounds on this earth is that the normal quota of the carbon atom is four atoms of hydrogen. If it has a less number, it is unsatisfied or "unsaturated," and immediately sets out to fill its quota. It may accept other atoms than hydrogen or it may join with other unsaturated hydrocarbons to form the large groups or the long chains that compose the molecules of petroleum, rubber and other organic compounds.

The carbon atom has no difficulty here in filling its quota, with plenty of materials close at hand, 500 billion billion molecules to a cubic inch of air. But out there in "empty space" it is believed that there is about one atom or molecule to a cubic yard. If the carbon atom were magnified to the size of a pea, and the cubic yard were similarly magnified, there would not be another atom of any sort within a million miles. The carbon atom would be lucky to get even one hydrogen atom to share its loneliness, and however much it might yearn for more, it would be a long time before it got any. CH can therefore very well exist for prolonged periods in "empty" space.

The manner in which the CH lines were produced in the laboratory was by admitting a small amount of benzene to an atmosphere of inert helium gas and passing an electric discharge. Apparently the discharge broke up the hydrocarbon molecules of the benzene and CH existed momentarily while the carbon atoms were filling their quotas. How short this time is may be gathered from the fact that CH_3, which would be the most stable of the three compounds, had previously been produced in the laboratory, but half of it disappears in 1/1,000 to 1/10,000 second. The lines obtained were very faint. Exposures of one to ten hours were required to photograph them.

Twice before have mysterious spectral lines puzzled astronomers. They were then attributed to new elements not yet discovered on the earth, but in both cases they turned out to be very common earthly substances, but in a peculiar state. They were the mysterious green lines seen in the spectra of nebulae, which were attributed to an unknown element, which was called "nebulium." But in 1927, Dr. I. S. Bowen, of the California Institute of Technology, showed that it was simply oxygen and nitrogen emitting "forbidden" lines, possible only when the gases are extremely attenuated. Again, a conspicuous green line and others in the spectrum of the sun's corona were attributed to an unearthly element and named "coronium." But in 1941, the Swedish astronomer, Dr. Bengt Edlen, showed that these lines were probably due to atoms of iron and calcium stripped of most of their electrons by some powerful agency that had not been duplicated on the earth. Finally, 1942, the Indian scientist, M. N. Saha, proposed that the highly damaged atoms were produced by "fission," the famous process by which physicists are seeking atomic power.

In any case it is believed that all possible elements have now been discovered. No new ones will be found in the sky.—MORTON MOTT-SMITH.

THE GROWTH OF PLANTS

WHAT plants want for growth, reduced to simplest possible terms by experimenting with separated bits of plant tissue, was described at North Truro, Mass., at the annual symposium of the Society for the Study of Growth, by Dr. Philip R. White, of the Rockefeller Institute for Medical Research at Princeton, N. J.

Dr. White used three kinds of plant tissue cultures, similar to the chick heart and other animal tissue cultures made famous by the classic studies of Dr. Alexis Carrel. They were detached root-pieces of tomato and other plants, fragments of abnormal tumor-like growths

produced by a hybrid tobacco whose parent strains "disagreed with each other" and pieces of crown-gall growth provoked on sunflower stems by bacterial attack.

Plant tissues, it was found, need eleven mineral salts (containing sixteen elements), a supply of carbohydrate, three vitamins and one amino acid. Omission of some, like magnesium, calcium or sugar, causes immediate stopping of growth. Lack of others results in slowed-down or abnormal growth.

In the case of the masses of tissue from the tumor-like formations Dr. White found that the oxygen supply had a great deal to do with the kind of growth that would occur. As long as there was plenty of oxygen, they kept on producing cells that were practically all alike growing in no particular direction. But when any of these irregular lumps happened to sink beneath the surface of the nutrient fluid, thus reducing the oxygen supply, it would begin to develop stems and leaves. Brought up to the air again, it would revert to its original formless condition.

Dr. White expressed the belief that there must be other kinds of plant material that would lend themselves equally well to experiments on growth control, leading eventually to information of value in such widely separated fields of research as the growth of diseased tissue and the growth of crops.—FRANK THONE.

COLCHICINE

COLCHICINE, known nowadays primarily for its use in originating new plant varieties, is used by Professor Edgar Allen and his co-workers at the Yale Medical School as a key to new knowledge on animal reproduction, and, incidentally, on the ever-present problem of cancer. He told of some of his researches at the North Truro meeting of the Society for the Study of Growth.

Colchicine is of value in this work, Professor Allen explained, because it "freezes" dividing cells in exactly the condition in which it finds them. Thus he is able to give supplemental doses of sex hormones to female rats and other small laboratory animals, follow that with injections of colchicine, and then kill and dissect his specimens at various time intervals, getting a series of clear pictures of just what has been going on.

One of the things he has found out is that the female sex gland at each reproductive cycle starts to develop several times as many eggs as it finally discharges. As many as four fifths of those that start never finish. The colchicine technique shows up the unsuccessful ones, some growing abnormally inside, others developing abnormally outside; the few that are "chosen" maintaining an even developmental balance throughout. Nobody knows as yet why this happens. If the secret is eventually discovered it will obviously help in giving an understanding of comparative fertility in animals, and thus be of importance in both medicine and farm animal production.

Another discovery made with the aid of colchicine settles the old question of what happens during gestation to the muscles of the uterus, which cradle the young during the pre-birth period. Professor Allen has definitely demonstrated that these muscles undergo great cell multiplication and growth. After birth, there must be a great dying off and resorption of this emergency tissue, returning the muscles to their ordinary size.

Warning has often been issued by physicians against too free use of female sex hormones in medicine, lest their highly active growth-promoting compounds run growth out of bounds into the wild, anarchic growth that is cancer. Professor Allen and his colleague, Dr. William Gardner, have found just that, as a result of long-continued stimulation of growth in the sex organs with hormones. He has slides showing the first experimentally induced cases of cervical cancer in animals. Such cancers can not be induced in all his animals, but they do arise in from fifty to sixty-two per cent. of the mice that survive hormone treatment for more than one year. Susceptibility seems to be partly a matter of heredity.

MUSCLE FIBERS

RUSSIANS are aiding American efforts in other fields than those of war. Basic research in life science, carried out at the Academy of Sciences in Moscow while Nazi bombers were nightly roaring over the city, has thrown new light on a problem under investigation by a biochemist working in New York. Dr. Kurt G. Stern, of the Overly Biochemical Research Foundation, at the annual symposium of the Society for the Study of Growth, reviewed present knowledge of how molecules grow and multiply.

Academician W. A. Engelhardt and his Moscow colleagues were trying to find out how muscle fibers used food energy in the contraction. The picture they got was one of a complex phosphorus compound, adenylpyrophosphate, being split by the contractile muscle protein. When they made an artificial model of muscle by spinning threads of muscle protein, much as artificial silk is spun, and immersed it in a solution of the energy rich phosphorus compound, the fibers lengthened. They see a muscle as a spring put under tension in this way. When a suitable stimulus is applied the coil snaps back, the muscle contracts.

This picture, said Dr. Stern, helped him considerably in his efforts to understand the growth and reproduction of the protein-like molecules of disease-causing viruses, those ultramicroscopic particles about which there is at present much dispute as to whether or not they are alive. Whether they are alive or not, Dr. Stern believes, is of less importance than a determination of the means by which they grow at the expense of their host cells.

One of the things that probably happens when virus particles multiply is a piracy of energy from the same kind of phosphorus compound in the host cell by the parasitic virus particles. It is suggested therefore that virus growth depends on the appropriation of the host cell's energy supply as well as its building material. This would explain, among other things, why viruses are always parasitic, feeding only on living cells of plants and animals, and are never found as scavengers, feeding on the dead. Dead things might yield them building materials, but could offer no substances actively engaged in the transfer of life energy.—FRANK THONE.

PUBLICATION OF A "LOST" BOOK

A GREAT encyclopedic work on the wonders of the New World, written by Fray Antonio Vásquez de Espinosa, long reckoned as one of the most famous of "lost books," has finally been published by the Smithsonian Institution. It really was lost for a long time—lost where it is hardest of all to find any particular book because it is surrounded by thousands of other books: lost in a great library. In this particular case it was the Vatican Library, where an American scholar, Dr. Charles Upson Clark, finally discovered the manuscript and the partially printed sections. It is at last available, in English translation, for anthropologists, historians, geographers and scholars of all angles of interest.

Fray Antonio, a very energetic, inquiring sort of person, spent the greater part of his adult life in South and Central America. He recorded everything he saw, quizzed missionaries, soldiers, officials, traders, and made judicious notes of all he learned. At last growing old, he went back home to write up and publish his tremendous accumulation of information. Unfortunately he died before much of his work got into print, and for three centuries scholars have known of his writings mainly through quotations by his contemporaries.

Fray Antonio made some mistakes in his accounts, especially where he was depending on the testimony of others. Like everyone else of his time, he describes California (which means Lower California) as an island. He also speculates on the location of the fabulous El Dorado, which has never achieved actual location on a map.

The book gives a rather good description of the American buffalo or bison, as "woolly, humpbacked cattle with two short horns twisted backward. . . . They are very ugly and wild. The wool on their chests in front is long and curly. They make excellent rugs from their hides." He also had a good word to say for the Indians of what is now the southwestern United States, speaking of them as "very intelligent and well-governed. They wear cotton clothing and antelope skins which are well decorated. As jewelry they wear turquoises."

ITEMS

CONTOUR plowing, following the natural levels of the land to conserve moisture and check soil erosion, is becoming increasingly popular on American farms. Until now, however, the old straight-line fences of the old square-shaped fields have remained, in many instances interfering with the curved path of the cultivating machinery and increasing the number of troublesome "point rows" necessary. Some farmers, according to the U. S. Department of Agriculture, have recently begun to reset their fences, so that field boundaries go with the contour plow lines. This not only abates the "point-row" difficulty, but furnishes a permanent guide to cultivation. Plant growth in the fence row also serves as a further water conserver and soil anchor.

NAVIGATION charts of the U. S. Navy will now appear in new colors. Studies conducted by the Navy show that the man who steps from a dark deck to a chart room illuminated by white or blue light will require from ten minutes to half an hour after he returns to the darkness before his eyes again become dark-adapted. This time required before he is able to see well in the dark is reduced to only a few seconds if the light used is red instead of blue. But when red lights and red goggles were introduced as a result of this study, it was found that the old colors on the navigation charts could no longer be distinguished. The buff color used for land, the orange which indicated navigational lights, and the red lines are all invisible under red lighting. So in future charts, the land areas will be gray, the lights will be magenta, and purple will be substituted for red.

AN all-time low record for smallpox in the United States was set in 1941, but health authorities of the Metropolitan Life Insurance Company warn against overconfidence about the smallpox situation. An increase in smallpox cases can confidently be predicted, they point out, if people generally get the false notion that vaccination against smallpox can be dispensed with. In that case the growing number of unprotected persons will provide a new fertile field for a resurgence of the disease. The shift, because of the war, of thousands of families of war workers from smallpox areas to cities previously free of smallpox may lead to outbreaks in these cities. The best protection against this danger is a wide-spread and vigorous campaign for vaccination, including revaccination of adults.

THE electron microscope now promises to show what happens to an individual disease germ when it is attacked by a germ-killing agent such as bichloride of mercury. The first studies along this line are reported by Dr. Stuart Mudd, of the University of Pennsylvania, and Dr. Thomas F. Anderson, of the RCA Manufacturing Company, in the *Journal of Experimental Medicine* for July. They find that when a typhoid fever germ is mixed with silver nitrate, the flagella which serve the germ as propellers are completely destroyed. The protoplasm, which is the very life of the cell, is stained black, but the wall of the cell is apparently unaffected. The entire germ is very much smaller, as if shrunken. When the typhoid fever germ is mixed with lead acetate, however, the flagella, though darkened, are not destroyed. The germ swells and its protoplasm escapes its wall to form a halo around it. Differences in action of lead, silver, nickel and mercury salts were also observed on cholera and dysentery germs and on a microorganism called Fusobacterium.

CHEMICAL magic with plants, written so that the ordinary garden variety of gardener can work it, is described by two U. S. Department of Agriculture plant physiologists, Dr. John W. Mitchell and Ruby R. Rice, in a new department publication, "Plant-Growth Regulators." It tells how growth-promoting substances, indole acetic acid and related chemical compounds, can be used to insure the rooting of slips and cuttings, to keep trees from dropping their fruit before it is ripe, to make holly berries form from unpollinated flowers, to induce the production of seedless tomatoes, and a number of other useful things that plants are unlikely to do if left to their own devices.

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