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WILLIAM WEBER COBLENTZ

1873—1962

A Biographical Memoir by

WILLIAM F. MEGGERS

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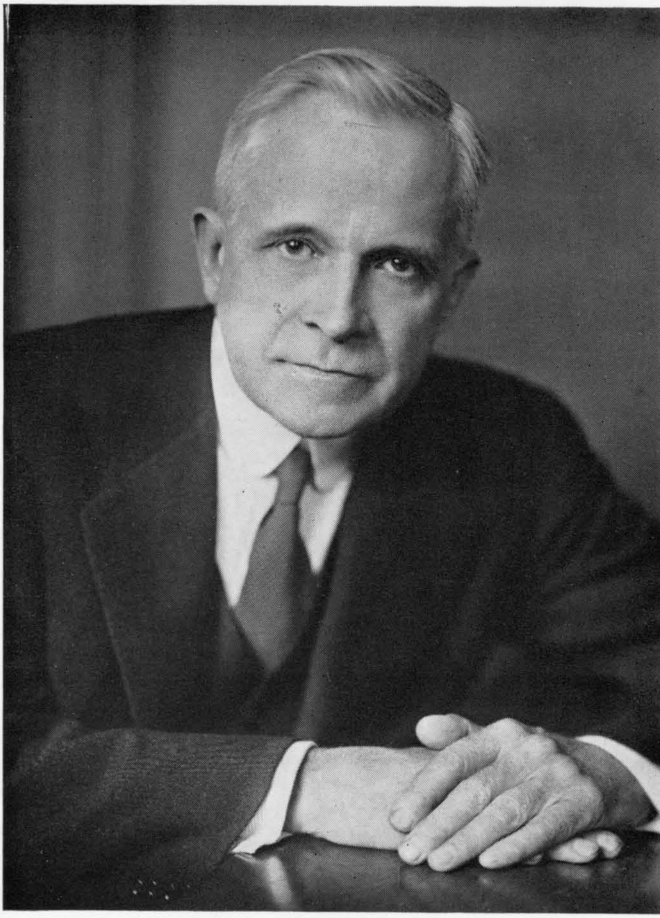
Biographical Memoir



W. W. Coblentz

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November 20, 1873–September 15, 1962

BY WILLIAM F. MEGGERS

WILLIAM WEBER COBLENTZ was born on a farm about three miles southeast of North Lima, Mahoning County, Ohio, on November 20, 1873; he died in Washington, D.C., on September 15, 1962.

Coblentz was one of the few scientists who undertook the task of writing and publishing an autobiography.[1] He explained that this autobiography was the result of a requirement of every Academician to place on file in the National Academy of Sciences, to which he was elected a member in 1930, a detailed description of his ancestry, education, and work.

In addition to his autobiography, Coblentz gave the Academy a separate report on family history in greater detail and a complete list of his publications. These documents served as a basis for this brief biographical memoir of a distinguished, departed fellow Academician, but I have added a few items based upon my personal acquaintance and association with Dr. Coblentz from 1913 until 1962. From 1914 to 1945 we both had laboratories in the "South Building" of the National Bureau of Standards.

Readers who wish more dates, details, facts, figures, anecdotes, episodes, and examples of human strength or weakness will be rewarded by reading two revealing books that uniquely

[1] *From the Life of a Researcher* (New York, Philosophical Library, 1951). 238 pp. Quotations from this work used by permission of the publisher.

characterize a diligent, dedicated scientist, viz., *From the Life of a Researcher,* referred to above, and *Man's Place in a Superphysical World.*[2]

According to tradition and hearsay, the paternal side of the Coblentz family came from Coblentz on the Rhine, probably during the eighteenth century. The first definite information concerning his ancestors is that William's great-grandfather, John Coblentz, in 1804 migrated from Maryland to Ohio, where he built a log house on a section of land near North Lima. John Coblentz had seven children, including Jacob (1792-1871), William's grandfather, who became a part-time carpenter and cabinetmaker. William's second name came from his grandmother, Susanna Weber (Coblentz) (1806-1894), who was born in Switzerland and came to America with her parents in 1817. In due time Jacob and Susanna had ten children, including David (1843-1894), who became the father of our Academician.

Little is known about his maternal ancestors, except that the Goods originally came from Germany, and his maternal grandfather, Christian Good, built a small house in North Lima, Ohio, in which William's mother, Catherine (M. Good) Coblentz (1852-1876), was born. Finally the union of Catherine M. Good and David Coblentz produced two boys, William Weber (1873-1962) and Oscar Oliver (1875-1941), who entered this world amid surroundings that were decidedly primitive. Unfortunately, Catherine died of tuberculosis before William was three years old; this left David, with two infant boys, to run a farm of 145 acres with one hired man and a hired girl. After twenty-one months, David married Amelia Schillinger (1851-1934), who became an ideal second mother to the Coblentz boys. "I wish to record my highest regard for

[2] William Weber Coblentz, *Man's Place in a Superphysical World* (New York, Sabian Publishing Society, 1954). 233 pp.

my second mother. No more careful, hardworking person ever lived. True, she scolded a little sometimes, but she always had our interest at heart."[3]

In his early years, William Weber Coblentz lived on a farm in a small log house with frame addition, with his father, second mother, and younger brother. As a young boy, he learned the routines of pioneer farming: clearing land, cutting wood, sowing and reaping crops, flailing grain, weaning calves, killing potato bugs, breeding cows and pigs. (Fifteen years later I learned the same routines on a farm in Wisconsin.) Being unusually observant, he noticed how the women made candles and soap, spun woolen yarn, knitted socks and mittens, spun flax and wove it into cloth for towels, churned butter, baked bread, etc. When he was free, he apparently exploited the country in all directions, searching for arrowheads (he found more than 400) in the cultivated fields after the rains, picking blackberries and raspberries along the fences, gathering hickory nuts in season, gunning for squirrels, trapping mink, muskrat, and skunk for furs, and frequently offending his schoolmates with his odor of skunk.

Before he reached the age of ten, Coblentz began to collect in a barrel the roots of trees that had naturally grown into the form of capital letters of the alphabet. This hobby continued many years until he completed the alphabet and a set of numerals to show what curious formations occur in nature without intervention of the hand of man. At the age of eleven, Coblentz devoted some spare time to the construction of wooden models of pioneer farm machinery, including wagons, hayrake, road scraper, and threshing machine. This exhibition of mechanical ability was encouraged by his father who bought, for ten cents, a dry-goods box of pine boards which the boy used in 1885 to build a "real" threshing machine, illustrated

[3] *From the Life of a Researcher,* p. 13.

on page 51 of his autobiography published sixty-six years later.

About 1885, a book agent sold to William's father a good-sized book called *The World's Wonders.* This book cost $3.00 which was an immense outlay in those days, but for William it was probably the best investment his father ever made.

Since David Coblentz was relatively meek and poor, he never owned a farm; he worked on farms for a share of the crop, much of which he hauled twelve miles to Youngstown and sold on the streets as a huckster. Because of these circumstances, William conceived several schemes for increasing the cash income of the family. For example, in the spring of 1884 he earned 15 cents for a day's work picking stones from the field of a neighbor, and during the winter of 1888-1889 he caught a number of muskrats, some skunks, and several minks; he sold the pelts for $12.20 but, after donating $10 to the family exchequer and paying brother Oscar for holding the carcasses while he skinned them, there was precious little left for William. Also, at age sixteen, William experimented with stock breeding as a source of cash income; he kept a fine Chester white boar and the next summer a fine white bull. "Although business was good, payment for service was slow, or evaded on some pretext or another, and I terminated my efforts as a stock breeder."[4]

As a boy, William enjoyed assisting a neighboring aunt and grandmother who cultivated many herbs and flowers; he thus acquired a love for plants that lasted all his life, resulting, during World War I, in a "Victory Garden" (including flowers) on the grounds of the National Bureau of Standards in Washington, D.C., and in systematic beautification of the yard surrounding his home at 2737 Macomb Street N.W. Shortly after I built a house at 2904 Brandywine Street N.W.,

[4] *Ibid.,* p. 73.

Coblentz gave me two small shoots of the star magnolia and two of holly (male and female) to decorate my yard; these have developed into large trees that constantly remind me of a considerate and generous friend.

Coblentz grew up in Ohio among immigrants who spoke more German than English, and his autobiography contains many examples of aphorisms, maxims, or remarks in German dialects, mostly German-American. Since I later encountered a similar environment in Wisconsin, I pleasantly recall that during the thirty-one years we occupied laboratories in the Bureau of Standards, Coblentz would often come after 5 P.M. to remind me that it was "Zeit anzufangen aufzuhören!"

In the spring of 1880, William's formal education began in Webster Hall, the district school a mile south of the farm. Beginning with McGuffey's "First Reader" and a spelling book, the student was not overworked in the district school and at the age of seventeen he had scarcely a grammar school preparation —at least as regards book knowledge. At age ten, William had acquired several "mouth organs" on which he learned to "blow" popular tunes, and at fourteen he bought a violin (for $7) on which he taught himself to play some dance tunes. During social activities as a teenager, he experienced his first contacts with tobacco and liquor; he decided to abjure both the rest of his life. Because he had no time or patience for frivolities, he never learned to play cards or participate in popular sports. However, he never pretended to be a saint.[5]

In 1891 William broke his home ties by going to Poland, Ohio, to pursue his education at the Poland Union Seminary where he earned his tuition by serving as janitor while his father strained every means to pay $3.00 a week for board and lodging. The following year his father said he could no longer support him in school so William lived with a physician's

[5] *Ibid.*, p. 81.

family in Poland and earned his keep by doing various chores and extra jobs such as caring for a horse, tending a furnace, mowing lawns, and hoeing gardens. In 1892 William was diligently whitewashing the cellar in the home of Isaac P. Sexton when the latter's wife (Carrie Lee Sexton, daughter of Bernard F. Lee, founder and supporter of the Poland Seminary) became interested in the ambitious young student and asked him to live with them. This was an inspiring experience for the student.

As he progressed in education and craftsmanship, there was much comment and discussion as to what Coblentz should do for a vocation. Some thought he should go to the Normal School at Canfield, Ohio, to train for teaching in the district school. Because of his mechanical and inventive traits, others urged him to learn a trade. In particular, his cousin, Elmer E. Helman, then a pension examiner and attorney in Washington, D.C., suggested that he become an electrical engineer, and this novelty is what he aimed at for several years.

At the Poland Seminary he cleaned and repaired a friction electric machine with the aid of Avery's *Physics*, and because that book said the electric machine had to be "well grounded," he lugged a coal bucket full of wet ground up two flights of stairs to the machine. During this period, his cousin sent him Mendenhall's *Century of Electricity*, which he studied intensively, and for his graduation piece, in June 1894, he "read an impressive (!) disquisition extracted from this book; concluding by telling the good people from the countryside how the time was sure to come when the farmer would plow his garden, cook his food, and fry his potatoes—all by means of electricity."[6]

After finishing the Poland Seminary, he found that two years at Rayen High School in Youngstown would give him sufficient credits to enter the freshman class in the department

[6] *Ibid.*, p. 97.

of electrical engineering in Cornell University. Accordingly, the school years 1894-1896 were spent at Rayen taking courses in chemistry, physics, mechanical drawing, pattern making, French, and German; he rode daily twelve miles, to Youngstown and return to Poland, in a two-wheeled cart, or on a bicycle, over gravel roads. The summers were devoted to earning money in the Sextons' garden by raising sweet corn, cucumbers, and potatoes, as well as chickens, all of which were sold to a huckster.

After all plans and preparations had been made, "financial reverses" for the Sextons in the summer of 1896 canceled the Cornell venture, and Coblentz, in September of that year, entered the Case School of Applied Science (in 1941 named Case Institute of Technology) in Cleveland, because of lower railroad fares and tuition fees. Successful passing of a scholarship examination reduced his tuition from $100 to $25 per year, and he selected a course of study leading to the degree of "B.S. in E.E." At that time, the studies in the first two years of all courses in Case were practically identical, excepting the course in E.E., which did not include astronomy. Because astronomy had a special fascination for him, Coblentz, at the end of his second year at Case, applied for a transfer of course from E.E. to Physics, and two years later, in June 1900, he was graduated "B.S. majoring in Physics." It appears that Coblentz was a diligent student of all sciences and a lover of literature. At Case he continued to attend lectures in E.E. and devoured numerous courses in astronomy, biology, botany, geology, and zoology, in addition to physics, chemistry, and mathematics. According to a notebook that he kept from 1896 to 1900, he also read twenty-six volumes of history. His graduation thesis at Case reported some measurements with a Michelson interferometer on the expansivity of metal bars; it went into the files of the Department of Physics.

Professor Dayton C. Miller, the famous physicist at Case, advised Coblentz to acquire a postgraduate degree, which he did by entering Cornell University in September 1900. There he majored in theoretical physics under Professor Ernest G. Merritt. Professor Edward L. Nichols, then head of the department, suggested that Coblentz work on infrared absorption spectra. At that time, only a few crude observations of infrared absorption spectra (to 5 microns) had been made. For his purposes, William built a radiometer to detect radiation behind a small mirror spectrometer provided with a prism of rock salt, and soon won acclaim by extending such observations to wavelengths of 15 microns. On the basis of this work, the degree of M.S. was granted in June 1901, and the degree of Ph.D. in June 1903, his thesis for the latter being "Some Optical Properties of Iodine"—the first of a long series of scientific publications resulting from more than a half century of research. Because the quantitative measurement of infrared spectra of pure molecular compounds was then in a primitive state and appeared to be a fruitful field of research, Professor Nichols recommended that Coblentz be appointed Research Associate of the Carnegie Institution of Washington at $1000 per year, to work two years (1903-1905) as Honorary Fellow at Cornell. During those two years, and subsequently, Coblentz systematically mapped the infrared spectra of thousands of molecular substances and observed that selective absorption, in many cases, occurred in regularly recurring "harmonic" bands.

Part of the financial burden of his first year at Cornell was assumed by Mrs. Sexton. During his second and third years, he had a scholarship that paid $300 per year, which was sufficient for his style of living. After 1903, in spite of his munificent income of $1000 per year as Carnegie Research Associate, Coblentz continued to live on $300 per year and paid back what he owed for his education. His appreciation of this aid went far beyond financial reimbursement. "Luckily for me, the climax of adversity did not come to the one who had befriended me until after I had begun to earn money. Bent low from arthritis, continually suffering from spinal pain, with both hands crooked and almost helpless from improper setting after double fractures of the wrists (caused by falling on ice in 1904), but still as active as ever in mind, in the fall of 1905 I took my former benefactress to Washington, where in the winter of 1923, after weeks of torture from a fractured hip, she was relieved of her suffering and I felt free to live the life that would have been possible sooner by shirking my responsibilities."[7]

In the spring of 1904, Professor Nichols urged Coblentz to devote his life to research and told him about the newly organized National Bureau of Standards in Washington, D.C., "where scientific work will go on uninterrupted by change of faculty or students; and where work can be done in big projects."[8] Thereupon, Coblentz took a Civil Service qualifying examination and on May 1, 1905, became a Laboratory Assistant (at $900 per year) to Dr. Samuel W. Stratton, the first Director of the National Bureau of Standards. At that time, the Bureau consisted of three buildings (one housing a power plant and shops, a small Cryogenic Laboratory, and a Physics Building containing laboratories, offices, and a library) located in a then uninhabited section of Washington about seven miles northwest of the Capitol.

Coblentz occupied a corner room on the ground floor of the Physics ("South") Building for forty years. Here he founded a radiometry laboratory and resumed his investigations of infrared spectra and radiation. In addition to organic compounds, he investigated also the absorption, transmittance, and/or

[7] *Ibid.*, pp. 121-22.
[8] *Ibid.*, p. 129.

reflectance of numerous inorganic materials and metals. During most of this period he had one assistant, but sometimes two. First he made a thorough intercomparison of various devices (radiomicrometer, Nichols radiometer, metal-strip bolometer, thermopile) for measuring radiant energy; this resulted in improvements and new designs, his first contribution being "A new form of radiometer," reported at a meeting of the American Physical Society on April 21, 1906.

On returning from a tour of European laboratories, Dr. Stratton asked Coblentz to concentrate on a determination of the constants of radiation of a "black body"; he first reported on this subject in 1909 to the American Physical Society and more fully in 1921 to the Optical Society of America. This work was handicapped by dependence upon others for indexes of refraction of prism materials.

"While I enjoyed the unusual privilege of devoting much of my time to research work, the accomplishment of it was rarely without some snag somewhere. The stellar radiation work of July-August, 1914, is a good example. At the suggestion of Doctor Stratton, I wrote to Doctor George E. Hale, director of Mount Wilson Observatory about the use of the 60-inch reflector—the largest reflecting telescope then available. Doctor Hale expressed much interest in my project, but referred me to the Smithsonian Institution because the latter already had a lien on that instrument. The advice received from that source was, 'By all means do not interrupt the work of the 60-inch reflector.' This was probably the best advice I have ever received in the interest of science. . . . Naturally, from the viewpoint of the astronomer it would have been sacrilegious to interrupt the observing program of the 60-inch reflector—a view that was probably enhanced because in my modest estimates of the sensitivity of my instruments (which I had purposely underestimated) I had written simply that I wanted to 'take a few shots at measuring the heat from stars!' Of course they would be 'shocked' at such a flippant proposal. On the other hand, if I had said that my laboratory tests showed that my instruments could 'detect the heat of a candle 52 miles away' they surely would have questioned my mental equilibrium."[9]

In 1914 Coblentz made a spectacular pioneering contribution to astrophysics; in eighteen nights' use of the Crossley 36-inch reflector at the Lick Observatory (Mt. Hamilton, California) combined with his radiometers, he measured the heat from 110 stars (including magnitude 6.7) and three planets, Venus, Mars, and Jupiter. At the Lick Observatory, Coblentz was assisted by a young astronomer, Seth B. Nicholson, who in 1915 joined the staff of the Mt. Wilson Observatory and there in 1922 inaugurated radiometric observations of stars and planets with the 100-inch reflector. Because Coblentz was denied the use of larger mirrors at the Mt. Wilson Observatory, he, with the full cooperation of F. O. Lampland, pursued stellar, planetary, and ultraviolet solar radiation studies by using the 40-inch reflector at the Lowell Observatory (Flagstaff, Arizona) in 1921, 1922, 1924, 1926, 1929, 1934, and 1938.

Furthermore, he measured radiation from the corona during the solar eclipse at Middletown, Connecticut, in 1925 and in Sumatra in 1926, and continued measurements of solar ultraviolet on the Jungfrau in 1932 (subsidized by the American Medical Association) and in San Juan, Puerto Rico, in 1935 (with support from the School of Tropical Medicine). For more than two decades, he constructed the most sensitive thermopiles for special investigations in botany, physiology, polarimetry, and psychology. These included needle-pointed thermopiles for insertion into leaves of growing corn to determine the temperature during photosynthesis, and electrically

[9] *Ibid.*, pp. 153-54.

compensating thermopiles having gold-plated and platinum-black receivers for measuring nocturnal radiation, that is, the loss of terrestrial radiation to outer space during clear or cloudy nights.

An interesting experiment was an investigation of the "Relative sensibility of the average eye to light of different colors and some practical applications to radiation problems," published in 1917. Such an experiment had not been done accurately before by others, hence it seemed a legitimate problem for the Radiometry Section. After testing 125 members of the Bureau's staff (including a freak identified as W.F.M.) for the visibility of radiation, by the flicker photometer method, Coblentz was instructed to discontinue the work for fear of encroaching on the Colorimetry Section.

"As time progressed it became evident that Radiometry could not be developed into what would appear to be a logical unit or service. . . . I therefore resolved to conduct the radiometry work, more and more, in distinct projects; and because of lack of help, I conducted the work on the one-man-and-assistant basis, working on one project, hitting it hard, then turning to another project. . . . If my Bibliography reads like a one-man affair there is good reason. Not until almost at the end of my official career . . . was an attempt made to overtake what was lost in building an up-to-date radiometry section. Starting from nothing in 1904 and considering the ever-changing and widening field of activity with inadequate assistance and funds, it is not an idle boast to assert that I hit as many high points as should be expected."[10]

"Some were amazed at the amount of work accomplished by one man and a minor assistant. One writer even insinuated that the quality of my work must have suffered at the expense of the quantity produced. But they overlooked one thing; un-

[10] *Ibid.*, p. 137.

interrupted and long-sustained effort in a familiar field. With the work systemized [*sic*] everything moved with clockwork precision. . . . At least in the earlier years, it was my custom to have each day's work planned before arriving at the laboratory. . . . The evening would be spent in working over the results and planning for the next day. For some years I used to work in the laboratory all day and write on some paper in the evening. This meant twelve or more hours of research work, *which in time began to show in its effect upon my health.*"[11]

In brief, Coblentz was chief of the Radiometry Section of the National Bureau of Standards from 1905 to 1945; he devoted much of his time to the development of instruments and standardization of methods of radiometry as applied to various problems in astronomy, biology, botany, chemistry, meteorology, photochemistry, physiology, psychology, and physics. In later years he spent considerable time on the problem of evaluating ultraviolet energy for use in therapeutics, and in attending several international congresses on this subject. His various researches were conducted as projects: absorptive, emissive, and reflective properties of matter, constants of thermal radiation, temperatures of stars and planets, photoelectrical properties of matter, germicidal and erythematogenic action of ultraviolet radiation, protection of the eye from injurious radiation, investigation of radiometric standard- and ultraviolet lamps.

Readers who desire a detailed summary of Coblentz's physical investigations and some applications of the results will find a fine statement in his autobiography (pp. 166-91) where he says, in part, that "with the recent advent of nuclear physics an entirely new set of problems are presented for solution. . . . No doubt many of the crumbs will drop from the master's table to the section of thermal radiometry, the initiation of which fell

[11] *Ibid.*, p. 149.

to my lot in an unforeseen manner in May, 1905. Unfortunately, in later years infrared spectroradiometry seemed to be neglected. There were a number of reasons for this apparent neglect: (1) I was overwhelmed with other projects and usually had only one assistant; (2) lack of finances and instrument makers for attempting to develop automatic recording apparatus; and (3) especially because of my averseness to duplicating a service so ably conducted at the University of Michigan by Harrison M. Randall, who, at a great expense of time, money and personal effort, as well as the assistance of graduate students and colleagues, was building up a complete infrared spectroradiometry installation. During the recent world war all this was revolutionized by the development of electronic amplification and automatic recording apparatus. In the meantime several types of complete spectroradiometric apparatus are being produced by commercial instrument manufacturers, thus exemplifying the trite old saying that necessity is the mother of invention. The necessity arose during the recent world war."[12]

His reasons for not prosecuting spectroradiometry more vigorously and not promoting automation in later years may have satisfied him but I personally doubt it. It is true that his interests and obligations expanded because he was born with a consuming curiosity about many things, beginning with his search for the alphabet in tree roots at the age of ten and continuing beyond the age of eighty-one when he published his book on psychical experiences and experiments. Other investigations, far removed from infrared spectroradiometry, are found among his publications, for example, the light of the firefly, the color of the light emitted by lampyridae, the emergence of the cicada, the exudation of ice from stems of plants, the erythemic reaction of the human skin to ultraviolet radia-

[12] *Ibid.*, pp. 189-90.

tion, the distribution of ozone in the stratosphere, and the spectral range of biological effectiveness of sunburn-preventive creams. Furthermore, seventy years after he started to collect natural letters and figures he published a note about them!

"I do not recall a single research that produced so much intramural ill feeling and opposition as did the first one on stellar radiation. After completing the measurements and before leaving Mt. Hamilton the Lick astronomers advised me, as a physicist to state the results on the first page of my paper so that astronomers, glancing through it, would see the astronomical applications.

"In those days it was not the custom to have a scientific paper preceded by an Abstract, the results being given in a Summary at the end of the paper. Hence, my innovation of telling it all in the introduction, as recommended by interested astronomers, was revolutionary. The young cockerel, to whom the paper was submitted for reading for the Bureau's editorial committee, handed down a long typewritten statement in which he expressed the opinion that 'the part entitled "introduction" was no introduction at all'; and that 'Instead of telling it all, the author should have left the reader to discover for himself that it was a remarkable piece of work!' Talk about patience! Would any self-respecting person submit complacently to such an accusation of sublime egotism? Not I, with my background of reactions to imposition. I shall always regret that I did not throw that fellow into a tailspin, with a crack on the jaw as I did the red-headed country Jake who called me a 'red-headed S. O. B.'

"Having introduced into this narrative the 'editorial committee,' I wish to record that I highly approve of such a service when properly conducted. Under Doctor Stratton's regime the rule was that the committee can advise but not command. He repeatedly instructed me to use only the good suggestions in revising my papers. This came about after one reader insisted that I make 'corrections' to the data in my paper on the distribution of energy in the acetylene flame, which some years later I had to retract. . . . But it is to be noted that it was I, not the referee, who had to assume the blame. This put me on my guard, and ever after that I challenged many a suggested revision. Naturally with publications every year for over thirty-nine years there have been numerous challenges. . . . As an illustration of the vindictiveness of some of the editorial readers let me cite one example in which the reader refused to pass the paper, because, in his opinion, one section of the manuscript (consisting of 52 lines) was too long relative to the rest of the work. When told to rewrite this section this reader did so; reducing this part of the manuscript to 46 lines, introducing new material, and incidentally misstating all the facts! Finding that the reader's whole objection was based upon the total number of manuscript lines, to save time I deleted one paragraph, retaining the integrity of the scientific facts, reducing this section of the paper to 45 lines; and the reader for the editorial committee was willing to recommend the paper for publication! Incidentally it never seemed to percolate into that diplodocus-skulled reader that he had made a consummate ass of himself (and mighty near of the Bureau) by attempting to rewrite that paper,—Pepys was right!"[13] (Technical readers please take note.)

Coblentz was a prodigious producer of scientific data, and being extremely sensitive about due credit and priority he published profusely and sometimes perhaps hastily. Also, he strongly resented the notion that amateurs or novices could improve any of his papers. Consequently (as indicated above), he had many conflicts with technical readers for the Bureau's editorial committee, and these were responsible for most of his

[13] *Ibid.*, pp. 156-57.

misery at the Bureau. He attended many symphony orchestra concerts just to forget his wrangles with the editorial committee. Because I did not consider myself qualified to criticize or correct papers on radiometry. I was not selected as technical reader of Coblentz's manuscripts, but on one occasion I wrote a memorandum to the editorial committee defending his revision of an earlier paper. This act ingratiated me with the troubled author, who thereafter frequently came to my laboratory to report other clashes with technical readers. After an hour or two of complaining and cursing, Coblentz invariably said "Thanks for listening" and returned to his laboratory with a sense of relief or victory until he wrote another paper.

With regard to automation, Coblentz never took much interest in it, and even at the end of his research career he took pride in defending his orthodox methods against the modern ones: "This is an age of gadgetry, with automatic recording of everything, including infrared absorption spectra. This is as it should be in the continuous production of an article of manufacture. But if the apparatus is used only occasionally, more time is lost in keeping the automatic recording device in working order than in observing the infrared absorption spectrum of a substance by the old-fashioned 'string and shutter' method. I recall the plaint of one fellow that while he was engaged for two years in building recording apparatus, 'Coblentz using the old-fashioned procedure' mapped the infrared emission spectra of sources he had planned to investigate! Recently I was amused by the remark of a youth, who was just beginning to record infrared absorption spectra automatically, that he was surprised to find the wavelengths of the absorption maxima I published four decades ago 'so accurate.' Seeing that the automatic apparatus he was using had no spectrometer circle, and that its calibration was obtained by using the wavelengths of the maxima of absorption bands observed years ago, by orthodox methods, naturally there was good agreement with present observations!"[14]

Coblentz started and finished with prism-refraction spectrometers containing prisms of fluorite or rock salt, for which he accepted the refractive indexes (and their variation with temperature) published by others. In 1935, after I had photographed the emission spectra of noble gases in the near infrared (to 13000 Å = 1.3 μ), Coblentz was invited to detect greater wavelengths with his sensitive heat engines in the focal plane of our large diffraction-grating spectrograph. Probably either an intrinsic fear of gratings or a natural distrust of cooperation prevented him from trying, but it was later done with success and high accuracy by my colleague, Curtis J. Humphreys, who in 1945 followed Coblentz as chief of the Radiometry Section.

Coblentz's interest in extrasensory perception began at the age of ten years when the interpretation of dreams was a topic of conversation at the breakfast table and fortune tellers were common. His interest expanded into extensive reading of the literature on dreams, clairvoyance, telepathy, telekinesis, materialization, and spiritualism. After 1910, he had many personal experiences with mediums, and, in company with a few friends, participated in many séances where he attempted physical experiments to record spirit voices (with an Edison phonograph) and detect possible effects of metals, magnets, and materials on auras or view the latter through pocket spectrosopes or Nicol prisms. These physical experiments were disappointing, but through the ordinary senses of seeing and hearing he made many interesting observations of apparitions, materializations, dematerializations, ectoplasm, slate writing, table rapping or moving, and water dowsing with divining rods. In his eighty-first year, Coblentz reported all his experiences with

[14] *Ibid.*, p. 167.

psychic matters in a book entitled *Man's Place in a Superphysical World;* his "Summary and Conclusions" follow:

"After more than four decades of careful observation and thoughtful analysis, I would summarize my conclusions in the following eight basic propositions:

"1. The human organism can be sensitized to receive cerebric radiation, at least in persons having latent extrasensory perception.

"2. The organic receptor has at least five types of response, viz.:

"a. Scenes and events are televised during sleep, either symbolically by codes or tokens, or by views of the person concerned.

"b. An undefined spontaneous telepathic impression is manifested as a feeling of apprehension about the person concerned, who as is learned later was thinking about contacting the percipient, for example a mother with a sick child wanting to make contact with the father who is in a distant city.

"c. There is a clairvoyant view of the person concerned, apparently in response to agitated thoughts transmitted by this person.

"d. Thoughts of the person undergoing deep mental stress are transmitted to the percipient through a psychic control purporting to be a deceased person, usually closely related to the person concerned.

"e. The organic receptor of the percipient takes on the pathologic condition of a deceased person, as impressed on the mind of a living person.

"3. The so-called control appears to be the dual personality of a psychically sensitized person. It can bring to the sensitized person information:

"a. About a deceased person that is in the mind of a living person as noted above.

"b. and, either directly or by stimulating a deceased person, it can televise information concerning a mentally perturbed living person.

"4. A code of interpretation of dreams can be established by observing a repetition of the same kind of dream followed in each instance by a repetition of the same kind of event. Apparently our ancestors codified their dream tokens in this manner.

"5. Prognostication, at least in some instances, appears to be built upon a space-time lattice of wishful thinking and inchoate thoughts that are already in the minds of living persons but do not appear to have any relation with the predicted event.

"6. Nerve and muscle activity resulting from mental cerebration during automatic writing is sometimes accompanied by emission of light from the fingers, hand, and forearm of the operator, suggesting a possible origin of the aura.

"7. My observations on other persons in this connection, together with my own personal experience, convince me that the mind, under as yet undiscovered conditions, operates as a complete power plant, capable of transmitting and receiving information which at times is in advance of the occurrence of the event as perceived on the time scale of our consciousness.

"8. The above mentioned few of the various forms of psychic communication between living persons—for example a clairvoyant view of the person, a feeling of uneasiness or something wrong, apprehension, etc.—indicate the possibility of surviving consciousness using the same means of communication.

"The foregoing report suggests that it is possible to develop latent psychic powers, and to attempt a self-analysis of one's experiences. From the analysis of my numerous psychic experiences and similar experiences of other persons, I feel I have given a consistent formulation of psychic communication, and that I have shown for the first time a scientifically sound possibility of surviving consciousness using the same means of communication that occurs between minds in the living."[15]

For many years, Coblentz made serious attempts to develop psychic powers, and I am half-inclined to believe that he succeeded in some measure. For example, during our forty years of friendship preceding the publication of his book, he never once mentioned this subject in my presence. This might be explained by saying that he "extrasensed" my skepticism of so-called occult phenomena, but it is also likely that, because of his sensitive nature, he restricted discussion of such controversial subjects to known believers or followers.

During his career as a researcher, Coblentz was a member of the National Academy of Sciences, American Association for the Advancement of Science, American Physical Society, American Astronomical Society, Optical Society of America, Société Française de Physique, Washington Academy of Sciences, Philosophical Society of Washington, Sigma Xi, and American Society for Psychic Research.

His physical researches were recognized publicly by the award of the following medals: the Howard N. Potts medal of the Franklin Institute, in 1910, for his researches on reflection spectra of metals; the Jannsen medal, Institut de France, Académie des Sciences, in 1920, for his measures of stellar radiation; the John Scott medal and prize of $1000, of the City of Philadelphia, in 1924, for his researches in planetary and stellar temperatures, and the application of his instruments and methods to medical problems; the gold key of the American Congress of Physical Therapy, in 1924, for meritorious service

[15] *Man's Place in a Superphysical World,* pp. 221-24.

to medical science in the field of ultraviolet therapy; and the Rumford medal of the American Academy of Arts and Sciences, in 1937, for his investigations in heat and light. In 1945 the Optical Society of America awarded him the Frederic Ives medal for distinguished work in optics, and in 1953 the Society for Applied Spectroscopy honored him with its medal.

Perhaps his greatest honor came in 1954 when the Committee on Infrared Spectroscopy, formed at the Ohio State Conference on Molecular Structure and Spectroscopy, announced the formation of the Coblentz Society, the object of which is "to foster the understanding and application of infrared spectra." Membership card #1 was given to Dr. W. W. Coblentz as a Lifetime Membership, and in 1963 his original monograph, *Investigations of Infrared Spectra,* Parts 1-7, was republished. Unfortunately, Coblentz unexpectedly died shortly before this volume appeared. The Society promptly endowed a Coblentz Memorial Prize to be awarded annually to any deserving candidate under thirty-six years of age.

Incidentally, remembering the difficulties he encountered in financing his higher education, Coblentz later endowed a scholarship fund at the Case Institute for Technology by converting his gold medals to cash and contributing additional funds from time to time.

The November 1963 issue of *Applied Optics* was originally planned to honor Dr. Coblentz on his ninetieth birthday, but because of his untimely death it was issued as a Coblentz Commemoration issue with brief articles on his contribution to infrared spectroscopy, his influence on radiometry, and his astrophysical work.

There is no doubt that William Weber Coblentz was the principal pioneer in radiometry and infrared spectroscopy. No one else has ever equaled his output of radiometers or observations by their means. Remember that this was accomplished almost singlehandedly with strictly limited resources, in spite of many discouragements, including in later years an attempt by expanding administrative services to seize his laboratory (5.5×8.5 meters in area) and convert it to a mail and file room. When funds were denied, he often took cash from his pocket to buy materials and instruments. Most of his astronomical investigations were financed either by academies or observatories.

He was born with exceptional aptitude for fine handicraft and with unlimited patience and perseverance to make and assemble tiny pieces of thermopiles. He was devoted and indefatigable in the use of these delicate detectors of radiant energy in tediously plotting galvanometer deflections observed point by point in the spectrum. "Thus the years passed by and the results of long sustained effort began to pile up. There is no doubt in my mind that, if I had spent less time in the laboratory and more of it in showing off and 'bluffing' like some of the young cockerels about me, I would have made a better impression and would have advanced more rapidly in salary. . . . For years my work was practically the only thing in my life that was going the way I wanted it and I drowned my then seeming disappointments in my work. Looking back at this date, I have no regrets. Club and general social life had no attraction for me. No doubt I could and should have made a wider acquaintance among men; but that would never have given me the pleasure that I have found in the woods, with the flowers, the birds, the little young things along wayside paths and flowing streams."[16]

In addition to the above admission, there are other evidences that Coblentz was antisocial and that he possessed a peculiar, sardonic, and somewhat primitive sense of humor. For example, he was sole author of most of his scientific papers

[16] *From the Life of a Researcher*, p. 150.

partly because he was suspicious of "cooperation." "Doctor Stratton's fetish was 'cooperation.' But that was one-sided; and I found myself doing fundamental research for others under the guise of an interlaboratory test, instead of a cooperative research. However, I had plenty of research ahead of me, and hence did not stop to consider this lack of generosity."[17] "How different life would be if we could work for people instead of with people!"[18] Two young men who for many years successfully cooperated with Dr. Coblentz were Walter B. Emerson and Ralph Stair; their names appear as coauthors of many Coblentz papers.

A long hard struggle for an education, followed by intensive research without adequate support and many wrangles with editorial committees, together with entire lack of social activities, no doubt aggravated Coblentz's disposition toward isolationism and introversion. Fortunately, this was interrupted in 1924 when he married a gracious, charming young woman, Catherine Emma Cate (1897-1951). Miss Cate was born in the village of Hardwick, Vermont, next door to the village library. While in grade school, she read every book in that library, and actually became village librarian while in the ninth grade. At age eight, she decided to remember just how she felt at that time so that she could one day write for eight-year-olds. In high school she did general reporting for the local weekly newspaper. In 1918, to help win World War I, she came to Washington, D.C., as an employee at the National Bureau of Standards. By attending night classes at The George Washington University she earned a B.A. degree, and on June 10, 1924, married Dr. Coblentz. The newlyweds spent their honeymoon at Flagstaff, Arizona, where Catherine wrote her first book for juveniles while William measured the heat from stars and planets. This

[17] *Ibid.*, p. 153.
[18] *Ibid.*, p. 158.

division of labors was repeated in several subsequent sojourns at the Lowell Observatory. Two children resulted from their union, but, unfortunately, both died in infancy. These tragic events enhanced their interest in children and Catherine continued to write books based upon folklore and history to charm youngsters.[19]

"As a lasting tribute to the work of Catherine Cate Coblentz, the Children's Room which bears her name is set off from the Lobby of the Cleveland Park Branch of the Public Library, Washington, D.C., by a series of ten story-telling panels. The designs for the panels are adapted from illustrations in favorite books by Catherine Cate Coblentz and executed in intaglio relief on glass . . . selected as the most fitting medium to perpetuate the shining memory of a distinguished author of children's books and friend of children. The interests and well-being of children were a driving force in her life, and this Library is one of the many community services she was eager to realize for youth. She worked for it unceasingly and inspired others to understand the need for a Library in this neighborhood."[20]

After the untimely demise of Catherine in 1951, William published his two books (mentioned above) and a few final reports on earlier activities, but nothing after 1954. Most of his last decade he lived in seclusion with flowers, birds, and chipmunks, troubled by gallstones and hernias (avoiding surgery, however), and enjoying memories revived by periodic visits of his old friends from the National Bureau of Standards and elsewhere.

[19] *The Junior Book of Authors,* ed. by Stanley J. Kunitz and Howard Haycraft (2d ed., revised; New York. H. W. Wilson Company, 1951), pp. 73, 74.

[20] "The Catherine Cate Coblentz Panels" (folder). Cleveland Park Branch, Public Library, Washington, D. C., 1955.

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In the *Journal of the Optical Society of America,* 36:62-71 (1946), there is a list of scientific publications of W. W. Coblentz containing 412 items, dated from 1903 to 1945; in 1954 he added 24 items, including 2 books and 10 patents. A casual inspection of these lists revealed that, in each case of a publication in a scientific or technical journal, only the initial page was given, thus concealing the size and character of the contribution. Upon closer examination, it was found that a few listings were only titles of talks, many were abstracts (of nine or more lines) of ten- or fifteen-minute oral presentations to meetings of scientific societies, a considerable number were papers authored by others who quoted data by Coblentz, credited in a footnote, and some were verbatim translations into foreign languages but listed separately. In the early years, before scientific journals became overcrowded, the same material was often accepted by two or more. Most of the scientific publications of W. W. Coblentz have been examined to complete their pagination, to detect duplication, and to distinguish titles, abstracts (A), letters (L), and notes from the more important contributions to original research. Many minor items have been omitted in the following bibliography; in partial compensation, some typographical errors were corrected and several items that were overlooked by Coblentz have been added.

KEY TO ABBREVIATIONS

Am. J. Electrother. Radiol. = American Journal of Electrotherapeutics and Radiology
Astrophys. J. = Astrophysical Journal
Bull. Am. Meteorol. Soc. = Bulletin of the American Meteorological Society
Bull. Bur. Stand. = Bulletin of the Bureau of Standards
Bur. Stand. J. Research = Bureau of Standards Journal of Research
Electr. World = Electrical World
Illum. Eng. (London) = Illuminating Engineering (London)
J. Am. Med. Assn. = Journal of the American Medical Association
J. Franklin Inst. = Journal of the Franklin Institute
J. Opt. Soc. Am. = Journal of the Optical Society of America

J. Research Nat. Bur. Stand. = Journal of Research of the National Bureau of Standards
J. Wash. Acad. Sci. = Journal of the Washington Academy of Sciences
Jahrb. Radioaktiv. u. Elektr. = Jahrbuch der Radioaktivitat und Elektronik
Monthly Weather Rev. = Monthly Weather Review
Phys. Rev. = Physical Review
Physik. Z. = Physikalische Zeitschrift
Pop. Astron. = Popular Astronomy
Proc. Nat. Acad. Sci. = Proceedings of the National Academy of Sciences
Publ. Astron. Soc. Pac. = Publications of the Astronomical Society of the Pacific
Sci. Monthly = Scientific Monthly
Sci. Pap. Bur. Stand. = Scientific Papers of the National Bureau of Standards
Tech. Pap. Bur. Stand. = Technological Papers of the National Bureau of Standards
Trans. Illum. Eng. Soc. = Transactions of the Illuminating Engineering Society
Z. Beleucht. = Zeitschrift für Beleuchtswesen

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