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BIOGRAPHICAL MEMOIR ALFRED GOLDSBOROUGH MAYOR

1868-1922

BY

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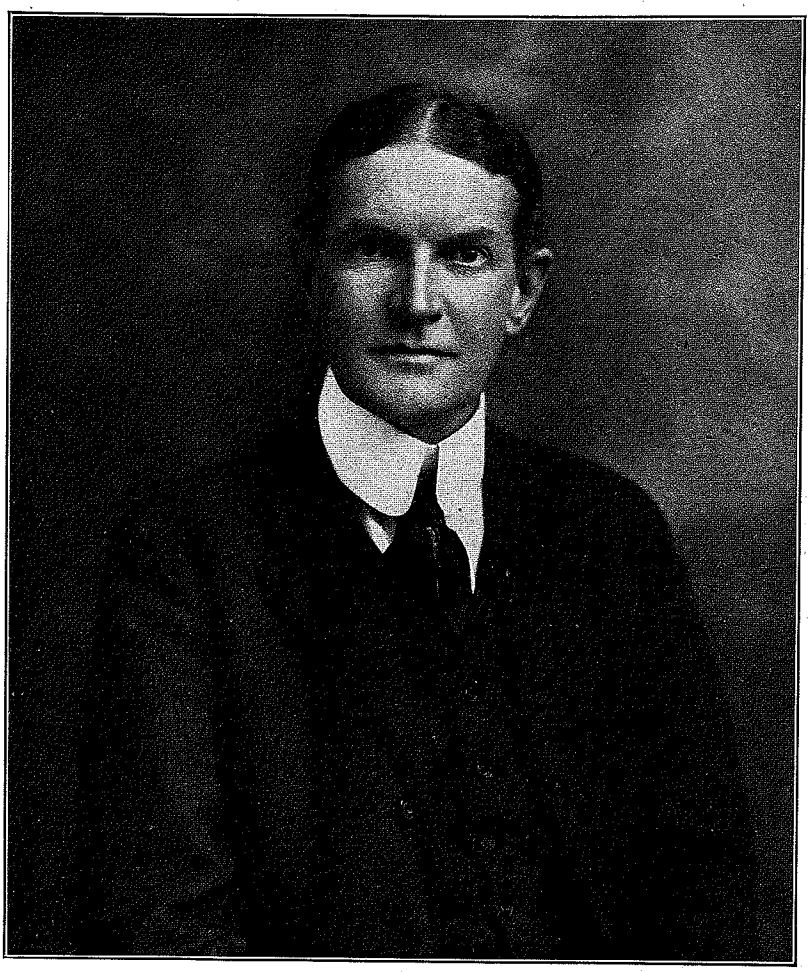

Alfred G. Mayor

ALFRED GOLDSBOROUGH MAYOR

By C. B. Davenport

INTRODUCTION

This biography of Alfred Goldsborough Mayor is based largely upon a remarkable document entitled "Autobiographical notes, by Alfred Goldsborough Mayor, written in response to the request of the chairman of the committee upon biographical memoirs of the National Academy of Sciences, January, 1917, with notes to 1919, inclusive." This manuscript had been deposited, sealed, with the secretary of the academy. It is, indeed, the most extensive document prepared in response to this call. The fact that Mayor had thus prepared it greatly lightened the task of his biographer. It is to be hoped that other members of the academy will be led by his example to prepare such autobiographies, as a part of the duty that they owe to science. The manuscript of Mayor is often quoted here, and such quotations are usually designated by the symbol (A. G. M., MSS.). Mayor compiled, with Dr. R. S. Woodward, the National Academy's memoir of his father, and this is referred to as Mayer and Woodward (1916). For data concerning the Goldsboroughs I am indebted to several members of the family, and particularly to Mrs. Amelia F. Tyler, of Luray, Va., A. G. Mayor's mother's sister.

BIOGRAPHY

Alfred Goldsborough Mayor[1] was born April 16, 1868, at his mother's father's home, "Sunnyside," near Frederick, Md., son of Dr. Alfred Marshall Mayer, professor of physics at Lehigh University, Bethlehem, Pa., and Katherine Duckett Goldsborough, his wife. His mother died May 2, 1868, at "Sunnyside," of puerperal fever (A. G. M., MSS.). After his mother's death the infant was taken to his father's home at Bethlehem. When Alfred was 16 months old, Professor Mayer married a second time, Miss Maria Snowden, of Anne Arundel County, Md. In 1874 Dr. Alfred M. Mayer became professor of physics at Stevens Institute, and the family was brought to South Orange and later to Maplewood, N. J., where young Alfred passed his boyhood. Alfred entered Stevens Institute at the age of 16 years and pursued the engineering course, in consonance with his father's desire rather than his own tastes. He graduated four years later, M. E., 1889, and was appointed assistant to Professor Michaelson at Clark University, Worcester, Mass. Here he made many friends, but he stayed only one year. He was assistant in physics under Professor Blake at the University of Kansas from 1890 to 1892. He left there rather abruptly in the early spring of 1892 and came to Harvard University to study biology; since his attempts at physics had been failures, due largely to a dislike of the subject.

At Harvard a new world opened to him, an opportunity to study zoology, following a strong, apparently innate, bent. He took advanced courses in the subject and began research on butterflies and moths, their colors, color patterns, and pigmentation in general. During the summer of 1892 he was invited, with some other Harvard students of zoology, to study at Alexander Agassiz's laboratory at Newport. Mr. Agassiz encouraged him to make drawings and to observe the habits of the Medusæ, and he was so successful that, before the summer was over, Mr. Agassiz suggested that they cooperate in the preparation of an illustrated work upon the Medusæ of the Atlantic coast of North America. This quickly led to the close association of Mayor with Agassiz in many of his trips. In the winter of 1892–93 Mayor served as Agassiz's assistant upon his cruise in the chartered yacht *Wild Duck* in the Bahamas and Cuba. In 1896 he went with Agassiz in the *Croyden* to the Barrier Reef of Australia, and

[1] "On August 5, 1918, the family name was changed from Mayer to Mayor by the Court of Common Pleas of Mercer County at Trenton, New Jersey. The family having been loyal American citizens since 1785, it seemed but fitting to repudiate the last link of association which bound us to a nation that had forced our country into the line of its enemies." A. G. M., MSS. See comment of Professor Mendenhall, Science, Aug. 18, 1922.

thence around the world. In 1898 the Fiji Islands were explored in the steamer *Yaralla*, and finally in 1899–1900 the *Albatross* took Agassiz and his party, including Mayor, across the tropical Pacific, visiting the Marquesas, Paumatos, Society, Cook, Nieue, Tonga, Fiji, Ellice, Gilbert, Marshall, and Caroline Islands, and thence to Japan. Mr. Agassiz sent Mayor upon minor expeditions ranging from the Bay of Fundy to Tortugas, Fla.

The prolonged voyages with Agassiz naturally interfered much with his scholastic work. Moreover, an inflammation of the left eye made it necessary for him to spend 1893–94 in a dark room. This episode led him to avoid using the higher powers of the microscope and determined to a considerable degree the character of his future researches. He made a trip to France and Belgium and returned to Harvard in the autumn of 1895. He was given the degree of Sc. D. by Harvard University, 1897.

In 1895 Mayor was appointed assistant in charge of radiates in the Museum of Comparative Zoology at Harvard and retained that position until 1900. In that year he was elected curator of natural science in the new museum of the Brooklyn Institute of Arts and Sciences. He was married on August 27, 1900, to Miss Harriet Randolph Hyatt, a woman of marked artistic gifts, daughter of Prof. Alpheus Hyatt, and they began housekeeping in Brooklyn. Four children were born to them, Alpheus Hyatt in 1901, Katherine Goldsborough in 1903, Branz in 1906, and Barbara in 1910. In 1904 he was elected curator in chief of the museum, a position which enabled him to make certain desirable changes in the management and policy of the institution. While serving the Brooklyn museum he went on scientific expeditions to Florida and the Bahamas, and dredged off the Massachusetts coast in the yacht *Philopena*, lent for the purpose by its owner, H. B. Stearns, Esq. As curator he not only accumulated collections but he inaugurated two publications: Science Bulletin and Memoirs.

At the December, 1903, meeting of the trustees of the Carnegie Institution of Washington it was decided to establish a marine laboratory upon the Tortugas Islands, Fla., and Doctor Mayor, who had urged the laboratory in Science, was appointed its director. He assumed this position in the summer of 1904. Mayor writes:

> A sixty-foot, ketch-rigged yacht having a 20-horsepower auxiliary engine was constructed at East Booth Bay, Maine, during the summer of 1904, and in the meantime two large wooden portable buildings were transported from New York to Tortugas, and landed upon the beach at Loggerhead Key, where they were erected in July, 1904, to serve as a nucleus for the establishment of the laboratory. In less than three weeks the bay cedars had been cut away and the two buildings erected on Loggerhead Key, Tortugas.
>
> Soon after this, the yacht *Physalia* was completed and we sailed out from Booth Bay, Maine, late in August, going slowly down the coast, making frequent surface hauls to study the medusæ, siphonophores, and ctenophores. Thus we put into almost every harbor between northern Maine and Southern Florida, and arrived at Miami in February, 1905. The seaworthy qualities of the yacht were well tested in a hurricane north of Cape Hatteras, which she survived with only the loss of her jib, while all other vessels within sight of us were driven ashore. (A. G. M. Mss.).

While this was the first, it was by no means the worst, storm the *Physalia* weathered during the seven years in which she served the laboratory. In 1911, she was replaced by the twin-screw, 100-horse power, 70-foot vessel *Anton Dohrn*, which was built at Miami, Fla.; being the largest yacht that had hitherto been constructed in southern Florida. Of the work of his department, Mayor states:

> It was the plan of the department to offer to well qualified investigators exceptional opportunities to pursue researches for which the tropical ocean affords peculiar advantages. Thus intensive studies have been conducted in the fields of physiology, ecology, heredity, evolution, animal psychology, variation, the geology and growth of coral reefs, the bacterial precipitation of limestone in tropical seas, the chemical constitution of sea water as a physiological fluid, the coloration of reef fishes in relation to environmental influences and natural selection, the habits of sea gulls, memory and warning coloration in fishes, the systematic description of new and interesting animals, and the ecology and physiology of plants of the region. Indeed, the major part of the researches which our country has produced as a result of studies of the marine life of the West Indies since the laboratory was started has been performed under the auspices or with the cooperation of the department of marine biology.

Mayor's department soon provided at the Tortugas the most thoroughly equipped marine biological station in the tropical world. To this station he returned each spring, with a number of investigators, and here they remained until August, when the hurricane season was apt to begin.

The activity of the Tortugas laboratory is indicated by the nearly 4,500 quarto pages and 500 plates resulting from researches done under its auspices. Just to gather together these papers, to prepare them for and see them through the press was a great task, mostly performed during the autumn and winter. At the same time he was engaged in writing up his own researches. In addition he undertook personal researches in or led parties into other parts of the world. In 1907–8 he studied marine life off the coast of Cornwall, England, and at the Naples Marine Biological Station he spent a delightful winter investigating medusæ. During the period from 1912 to 1916 he visited the various West Indian Islands seeking a site for a permanent laboratory. In 1913 he went with a party consisting of Frank A. Potts, of Cambridge University, and Drs. Clark, Harvey, and Tennant from America to Murray Island in Torres Straits, Australia, and the Island of Papua. Here echinoderms, crustacea, and corals were studied, ecologically and physiologically; later the party traveled eastward via Java and Europe, thus completing the voyage around the world. In 1917, he went to Tutuila, Samoa, to study the problems of coral reefs and growth-rate of corals in the Pacific, and to this island he returned in 1918–19 in company with Prof. R. A. Daly, of Harvard, and Mr. John W. Mills, the engineer of the department. At this time Mayor studied the submerged seaward slope of the coral reefs and planted out, weighed, measured, and photographed corals down to 50 feet of depth. In May–July, 1920, he studied at Samoa and at Fiji, for the last time.

During most of the period of his connection with the Carnegie Institution of Washington Mayor's home was in Princeton. In 1910–11 and again in 1915 to his death he held an honorary appointment of lecturer in biology at Princeton. Among other appointments and honors received by Mayor were the following: In 1904, after retiring from the Brooklyn Institute of Arts and Sciences the trustees gave him the complimentary title of "Honorary curator of Natural sciences." From 1903, he served on the scientific council of the New York Aquarium, and for some years after as a member of the board of trustees of the marine biological laboratory at Woods Hole. He was president of the Cambridge Entomological Club in 1899; president of the eastern branch of the American Society of Zoologists, 1913; vice president of the Washington Academy of Sciences in 1915. In 1916 he was elected a member of the National Academy of Sciences. Other societies of which he was a member and in which he took an active part were: The New York Zoological Society, fellow and patron; the American Society of Naturalists, the Society for Experimental Biology and Medicine, the Academy of Natural Sciences of Philadelphia, and the American Philosophical Society.

During the World War Mayor's activities were for a time directed into war work. The *Anton Dohrn* was leased to the United States Navy from July, 1917, to November, 1918, to serve as a patrol boat, guarding Key West Harbor. In August, 1917, Mayor passed the examinations for a first-class mariner's license for seagoing yachts and then taught navigation to enlisted men of the Navy who, being under age, were permitted to return to their studies at Princeton University. In the autumn of 1918 he taught seamanship in the student's Army training corps at Princeton University up to the time of the armistice. In connection with this work he published a booklet on "Navigation, illustrated by diagrams."

After two years of ill health, he died on June 24, 1922.

PHYSICAL TRAITS

Mayor was about 67 inches tall—slightly under the average stature of Anglo-Saxons. His mother was 2 inches below the average stature of women and his father was also not tall. He remained always lithe and slender.

His eyes were blue, like those of both parents, deep set, and capable of the liveliest expression. His brown hair, even as cut close, had a marked wave, and it is stated that he had ringlets as a small child. His mother's hair was quite straight, but his father's was curly, and the gene for this trait came, doubtless, from the paternal side. Mayor did not have thick hair from early youth, if ever. By 40 it was sparse on top, though there was no baldness. His father had similar sparse hair. His face was rather short and broad, with fairly high cheek bones like his father's. He had a rather large chin, like his mother. His step was quick and short.

ELEMENTS OF SCIENTIFIC MAKE-UP

Fondness for natural history.—Alfred G. Mayor early showed a great interest in living things. Especially butterflies attracted him. As a boy he collected them and made drawings of them and painted them in extraordinarily lifelike fashion, so that it seemed hardly possible that the iridescent and shimmering wings had not been pasted on the page. It can not be doubted that there was an unusually acute capacity for color discrimination and sense of form that lay back of all this behavior. The capacity was so great that its exercise was highly successful and gave great satisfaction. There is no doubt, from his own statements made to the writer, that from an early age there was nothing else gave so keen a delight as animals of striking form and color. And just this capacity of discrimination guided his pen and brush and made him an animal artist of high quality. In his autobiographical notes he stresses a certain love of solitude in his boyhood as contributing to his contact with nature.

> I threw myself heart and soul into a world of the imagination wherein I lived apart from man, and sought my playmates among the creatures of the woods and fields. I literally loved individual butterflies I had raised from early larval stages, and exulted in their imagined joy as they flew from my hand to flutter over the clover-laden fields. Only when sorely needed for specimens in my collections did I force myself to kill the beautiful creatures which seemed so wholly to accord with the world of flowers and sunshine I myself adored.
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> Even at Bethlehem, when not more than three years old, I remember being held spellbound by the operations of wasps building their nest in the window shutter of my nursery. . . . I also pondered over the reason for the roundness and smoothness of the white pebbles that formed the paths around my father's house. The frog pond was a universe of waters; but the climax came when a blue-purple butterfly (*Basilarchea ursula*) flitting in the sunlight filled my little mind with such rapture of delight that I must needs run to my beautiful old grandmother only to learn the miraculous fact that "butterflies come from caterpillars."

He lived at South Orange and Maplewood, N. J., from 1874 to 1889. He continues:

> Day after day throughout the summer I wandered forth, butterfly net in hand, and before my teens were passed I had reared, and made colored drawings of, nearly every species of butterfly and many of the moths known from this region.

This intense interest in the beauties of natural form and color was found also in his father, who at an early age "plunged into the pursuit of all things scientific, from collections of insects to the study of the stars" (Mayer and Woodward, 1916). Later in life A. M. Mayer edited books on sport, including articles on fish and game birds. Of his mother it is stated that she was fond of all nature, and so must have been her father, who lived in the country, farmed and enjoyed gunning, and her mother, whose special interest was in her flower garden and in trees.

A. G. Mayor's love of organisms was thus keen and lasting. While his father required him to go through an engineering school, he says:

> Almost every spare hour of my college years was given to natural history; and hundreds of colored drawings of turtles, snakes, newts, frogs, and insects had resulted from these charmed hours of exultation. (A. G. M., MSS.)

The three years employed in teaching physics were painful to him, and he was in an "ecstacy of delight and hope" when he entered the zoological laboratory at Harvard University to be started upon that professional career as a zoologist, in fidelity to which he never wavered.

Ability in animal painting and interest in color.—As stated in his autobiography, Mayor desired to record permanently the beauties of the animals whose form and color so moved him. The faithfulness of his reproductions was uncanny, and it was this ability that brought Agassiz's suggestion that he make colored drawings of the jellyfishes. This he did for many years, and these paintings are reproduced in color in Mayer's Medusæ of the World, in three volumes, of which he modestly says:

> It has always been a sorrow to me that when (they) were finally published in 1910 Dr. Agassiz had passed away, and he had declined to permit his name to be associated with the work, which was in truth the fruit of his inspiration." (A. G. M., MSS.)

Other applications of physics, chemistry, and mathematics to biology.—After Mayor's appointment as director of the marine laboratory of the Carnegie Institution it was natural for him to continue his studies of the beautiful jellyfishes. Their pulsation had long interested him, and he sought to get light on its causes. He entered upon this novel research with much enthusiasm, and

made the most interesting and ingenious experiments on the matter, by cutting up the muscular disk into strips of various sorts in which contraction waves were trapped and kept going for days. He used his training in chemistry to advantage in many researches. He studied the effect of various solutions on contractions. Thus he found that sodium chloride of the sea water is the chief stimulant to pulsation in Cassiopea, while magnesium is the chief inhibitor. These chemical studies became elaborated in the successive years. They led to a new and greatly improved method of stupefying marine animals by means of a pure magnesium solution isotonic with sea water and to a method of stupefying by carbon dioxide. He found that—

sodium, which is a powerful nervous and muscular stimulant, depresses the movements of the rhythmically beating cilia of trochophore larvæ, ctenophores, etc. On the other hand, these cilia beat at an abnormally rapid rate in magnesium. There is thus a converse relation in the effects of these ions upon the activity of these cilia in comparison with their effects upon nerves and muscles, for which sodium is a stimulant and magnesium a depressant. The explanation is that cilia-bearing cells are very sensitive to pressure and when the surface of the body is bathed in sodium a strong muscular contraction results, thus augmenting the pressure upon ciliated cells and stopping them." (A. G. M., MSS.)

Later, he studied the degree of acidity of the sea water in the zone of the coral reefs.

His researches, similarly, led him to use his training in physics, as already suggested. While he was assistant in physics at Kansas he began a research which showed that leaves are as efficient as a lampblacked surface in their ability to absorb or to radiate heat, but if dew collects upon the leaf its radiation is reduced, becoming that of a water surface. This research involved the use of a highly sensitive thermopile and a reflecting astatic Thomson galvanometer; he had to devise still other apparatus. In his researches on color in Lepidoptera (which is located on the scales) he showed, by pendulum experiments, that scales are not useful to increase the friction between wings and air. At the Tortugas Dr. T. W. Vaughan, who was studying the growth of corals, needed information on the effects of temperature upon Coelenterates and Mayor made the required studies, which are published in Nos. 40, 41, 44, and 54 of his bibliography. These temperature studies were made, inter alia, on the large medusa, *Aurelia aurea*, the only Scyphomedusa that extends from pole to pole. At Tortugas, where at the surface the sea is often 29° C., this temperature is an optimum for Aurelia, which suffers if the temperature is appreciably higher or lower than 29°. At Halifax, on the other hand, Aurelia is killed by a temperature of 29°; but it may be frozen with impunity. There is thus a remarkable adjustment of this organism in different climates to the temperature conditions of the various regions. The results of these temperature studies he applied to the problem of coral reefs. It appears then that Mayor's engineering training was of great use to him in the solution of biological problems. It is obvious that he had some of his father's dexterity in physical manipulation.

Mathematics, Mayor states in his autobiography, was one of the courses at Stevens Institute which attracted him. Accordingly, we find him making much use of it in his researches. He discusses mathematically the degree of retardation of the pendulum if the scales on the wings of Lepidoptera function to increase friction. He discusses mathematically the chances that a given mutation should have occurred independently in the 5 species out of 25 in the genus in which it is found. He finds that the starved jellyfish loses weight in accordance with the formula $y=w\ (1-a)^x$, where y is the weight at the end of x days, w is the weight at the beginning of the experiment, and a is a constant less than unity. Again, he shows that the rate of nerve conduction in Cassiopea increases in a direct ratio as the electrical conductivity of the sea water increases between salinities of 18 per cent to 40 per cent in accordance with the formula $y=0.945x+4.4$, where y is the rate of nerve conduction (that in normal sea water being 100), x is the degree of dissociation of the cathions of sodium, potassium, magnesium, and calcium in sea water; that of normal sea water of 36.24 salinity and 8.22 PH being 100. Repeatedly he succeeds in expressing relations between environmental conditions and vital response in a simple formula; he was satisfied with nothing less. In this respect Alfred G. Mayor was like his father, whose law of the relation between the time during which the after sensation of a sound does not appear to diminish in intensity and the number of vibrations

per second is expressed in a formula known as Mayer's law. Mayor applied his facility in mathematics, especially trigonometry, in his little text-book on Navigation, prepared during the World War.

Mayor's interest in color, even apart from form, is well illustrated in his paper "On the color and color patterns of moths and Lepidoptera"—one of his earliest researches at Harvard. In Plates 6 to 8 of this paper are representations of the color areas of butterflies drawn in a sort of "Mercator's projection" of the wing, which made homologous areas comparable but distorted the pattern of the whole, so as to elicit a strong protest from Alfred R. Wallace, in "Nature," to the effect that the essential significance of the color areas as mimetic, or protective, was lost. Wallace missed the point, namely, that any mimetic pattern is, after all, limited by the physiological developmental capacities of the organism. In this research color itself became a special object of investigation. The relative frequency of the different kinds of colors was plotted; the pigment colors were quantitatively expressed by means of Maxwell's disks and analyzed spectroscopically by a special apparatus. Here Mayor's physical training again stood him in good stead. While he reacted strongly against physics as a subject of research (doubtless because it once threatened to oppose his main interests), yet he readily applied physics to biology. Had he become a physicist he would probably have become a student of light and color, subjects which his versatile father took up again and again. It may be added that Mayor returned to the topic of color and color patterns in Lepidoptera repeatedly. His doctor's thesis considered the development of pigment in the wing; he formulated a new (and most valuble) hypothesis of seasonal dimorphism in color; he gave a Woods Hole lecture on the development of color in Lepidoptera; he discussed the value of color in the mating of these insects; in 1902 he published an extensive research on natural selection versus race tendency in relation to the color patterns; in 1906 he published results of experiments on the reactions of caterpillars and moths. Mayor's interest in the great "color-display" group of insects lasted long into the period when other interests had become strong.

Marine work and travels.—Mayor is best known for his work on marine organisms, which opened up an important part of the field of thallassography. He was 24 years of age before he first visited the seashore to do biological work. This was at Mr. Agassiz's laboratory at Newport. Thus he came to be associated with one of the world's leading thallassographers, and this gave Mayor an opportunity to discover his hereditary fondness for the sea. While curator of the Brooklyn museum he undertook various marine expeditions. As the Tortugas laboratory was usually open only from April to August, Mayor had time to make expeditions to other parts of the world; thus, in 1907–8, to Cornwall, England, and to the Naples station. In 1913 Murray Island and also Papua were visited with a party which circumnavigated the globe.

"The greater number of the West Indian islands were visited in 1912–16 with a view to selecting a site for a permanent laboratory, the work of which might in some measure serve to continue that of the Naples station, which had suffered sadly through the World War. Special expeditions were made also to Kingston, Montego Bay, Jamaica, Guanica, Porto Rico, Pigeon Point, Tobago, and Andus Island, Bahamas," and in 1917 and again in the winter of 1918 voyages were undertaken to Tutuila, Samoa, to study the problems of coral reefs and the growth rate of corals in the Pacific. It is probable that no other biologist of this epoch has had so extensive as well as detailed acquaintance with all the seas and seashores as Mayor.

The results of Mayor's researches on coral reefs are described by him as follows: It was found that, generally speaking, those forms which can withstand high temperature are also correspondingly well able to withstand the smothering due to being buried under mud. Hence those corals can live in the shallow reef flats near shore, where the temperature is high and the silt abundant. On the other hand, the corals which must live in relatively cool water are confined to the seaward parts of the reef where they are surrounded by cool water free from silt. Thus the correlation between temperature reactions and the effects of silt account for the peculiar distribution of the various species of corals over the reef flat.

This fact was discovered in 1913 at Maer Island, in the Murray Islands of Torres Straits, Australia. Here Mayor made the first quantitative ecological study of a coral reef ever undertaken. During his expedition to this region it was found that, despite the fact that the corals of Australia suffer from excessive heat, while those of Florida are correspondingly affected by cold, yet natural selection appears not to have resulted in improving any genus of coral by increasing its ability to withstand temperature conditions. The majority of the *species* of reef corals grow best in the region of the breakers, yet the greatest number of coral heads are found in a zone just shoreward of the inner wash of the breakers, where the water is relatively calm and yet free from silt.

His studies confirm the conclusion that sea water does not dissolve limestone at a rate sufficient to account for the formation of atoll lagoons in this manner. He concludes therefore that Murray and Agassiz were mistaken in assuming that the lagoons of atolls are solution basins. He discovered also that the streams and springs of Samoa and Oahu are alkaline despite the fact that limewater is acid. Thus water pouring outward from the shores of these islands can not dissolve limestone by reason of its acidity, since it is not acid. Other studies, especially at Tutuila, showed that these Pacific corals form limestone at about twice the rate which Vaughan had determined from corresponding genera of corals in the Atlantic.

Finally, in his last trip to Samoa he determined by borings that the reef is underlain by a basaltic rock at a depth of 40 to 50 meters. The modern fringing reefs of this part of Tutuila are not superimposed on the ancient reefs which lie still deeper but are independent structures which have grown out over the submerged basaltic slopes of the island. Mayor consistently entertained doubts as to the universal applicability of the Darwin-Dana theory of coral-reef formation.

There is no question that Mayor enjoyed this life on the sea. Whenever on board the *Physalia* or *Anton Dohrn* he took command; and often assumed grave responsibilities in doing so. The following account of one of his short voyages on the *Physalia* is from his annual report to the Carnegie Institution, 1907.

> Our voyage among the Bahamas proved to be the most adventurous the yacht has yet encountered. On April 1, 1907, a strong southerly gale forced us into a harbor of refuge under the lee of Elbers Cay, about 50 miles southeast of Nassau. The sun was about to set when, on the northern horizon, vast masses of black clouds suddenly arose, driving before them the heavy breakers of the oncoming storm, and in an instant the wind reversed and we found ourselves dragging anchors toward the rocks of a coral reef. With all haste we got the yacht under way. It proved impossible to steam up into the gathering storm, and we had no choice but to scud before it; "jumping" a bar with less depth than our draft, and sailing out between the jagged masses of rock, we reached the open water, where we met the roghest sea the *Physalia* had encountered since she was launched. At midnight the naphtha-tank burst, through the excessive rolling of the vessel, and, with all lights out and only an electric "candle" held close to the binnacle, we went on through the night under storm sails, and when the morning broke we were more than 100 miles away from our former anchorage. A large bark foundered near us in this storm, and a yacht larger than the *Physalia*, which left Miami with us, was never again heard from. However, the *Physalia* returned to Miami in excellent condition, her seaworthy qualities having been thoroughly tested.

What Doctor Mayor does not make clear in this account is that he was at the wheel and his good judgment saved the vessel.

Mayor's long experience in navigation was put by him at the disposal of the Government during the World War. As stated above he taught navigation to naval recruits. There were about 50 men in his first class at Princeton and the course ended in a cruise between New York and Key West in February, 1918, for practice. His success was such that in the autumn he was made lecturer on navigation at Princeton and taught seamanship to 350 men in a training unit there. To facilitate the work of this unit he wrote a small book upon "Navigation Illustrated by Diagrams." A reviewer writes: "Dr. Mayor has the happy faculty of speaking *with* his readers rather than *at* them. . . . The book has a certain charm not often met with in textbooks." This charm, of course, was a reflex of the charming personality of the author. It seems quite certain that Mayor had a strong natural liking for the sea; a genuine thalassophilia; and this was associated with a nomadic tendency. The latter showed itself at an early age in a love of wandering over the country. "In the beautiful country on the

slopes of the Orange Mountains I soon knew every pond and brook, field and forest within five miles of my father's house." Mayor writes further: "Often loneliness has oppressed me in the streets of great cities, but never once upon the sea or in the deep primeval forest, not even when as a boy of thirteen I was lost for a couple of days in the wilds of Maine. I felt angry at the trees that obscured the view but never once *lonely* in their lordly presence." (A. G. M. Mss.) Nomadism is generally a sex-linked trait, found in men and apt to be also in one or more of their mother's male relatives. His mother's brother, Dr. Charles Worthington Goldsborough, married early and had a large family; according to his sister he was "crazy to go to California," had a strong desire to travel, but was tied down by his family of 7 children. These two cases of strong love of travel in mother's brother and nephew are related, as expected, on the assumption that the nomadism was constitutional. However, in the Mayor line are many with an extreme fondness for travel, as Branz Mayer (1878, p. 63) points out.

But in addition to nomadism, Mayor had clearly the trait of thalassophilia; and evidently such a trait should be found in other members of the family on both paternal and maternal sides. On the paternal side such thalassophilia was probably present in Christian Mayer; his father's father's grandfather—a leading East Indian shipowner and merchant of Baltimore, and probably, like most merchants of his day, a voyageur. He organized a marine insurance company. Christian's son Lewis went to India at 8 years (in 1801); was sent as supercargo to Europe at 16 years. Lewis's son, Charles F. Mayer (grandfather of Alfred G. M.) made a voyage to Cape Horn, Valparaiso, and Lima in 1848–1850, and he traveled extensively in the United States and Europe. C. F. Mayer married Eliza C. Blackwell, daughter of Capt. F. Blackwell, a commander in the merchant service. One of their sons (Alfred G. M.'s uncle) was a civil engineer in Brazil, a regular officer of the Engineer Corps, United States Army (1859–1867), who served with special merit under Farragut in the capture of New Orleans.

On the mother's side is Charles Goldsborough of the Confederate Navy, a third cousin of Alfred's mother; also Admiral L. M. Goldsborough, who during the Civil War destroyed the Confederate batteries on Roanoke Island. Thus it is probable that the early trips made by Alfred with Alexander Agassiz awoke an innate love of the sea that determined his career.

Social gifts.—Mayor had social gifts of a high order; among them were companionableness, a love of conversation, a marked sense of humor, and a capacity for administration. His companionableness is testified to by all who traveled with him or worked at the Tortugas laboratory. Thus Dr. Davenport Hooker writes about life at Tortugas:

> "At 6 p. m., after supper, he walked with us along the path to the lighthouse, then to the eastern shore of the island and along the shore to the southwestern tip of the island. Here each one burrowed a comfortable hole in the sand, stretched out and gossiped about books, research people, and things in general, while the sun went down in gorgeous splendor.

At this time, as Prof. E. N. Harvey recalls, they would "listen to Mayor's stories of the chiefs of Fiji, the mutiny of the Bounty, or the narrow policies of the missionaries. Doctor Mayor was one of the most delightful talkers, with an interest in every field under the sun." In his conversational qualities Mayor was like his father, who was "a versatile conversationalist and charming story-teller" (Mayer and Woodward, p. 256). In his love of the bizarre and harmlessly shocking in his stories (like the preferences of cannibals for the flesh of different human races) Doctor Mayor reminded one of his kinsman Edgar Allen Poe—the second cousin of his mother's mother, Amelia Poe, the daughter of Jacob Poe, of Frederick, Md.

Mayor was an excellent administrator. His laboratory at Tortugas and his expeditions to remote seas were planned and conducted in admirable fashion. On the long trips all contingencies were foreseen. At his laboratory menu cards were prepared for a 10-day period so as to provide an adequate rotation of meals. The volumes of reports from his laboratory are evidence of this marked administrative ability.

He had high ideals as to the requirements of courtesy both toward his guests on shore or on the marine equipment; and toward the representative of the Government in the out-of-the-way places that he visited. He always first visited the commandant or chief man of the place where he had occasion to stop. He was punctilious in marine etiquette, deeming it essen-

tial in crises that men and officers should know their places and duties. When a governor or commandant came aboard, the social requirements must be strictly met even if the visitor was a dusky magistrate from one of the Bahamas, who had been invited to dine. But the moment the guests were gone he was the first to remove collar and white coat and plunge into work. So far from being a snob, he was "absolutely democratic at heart and willing to encourage the most insignificant investigator and treat him as a person equal in knowledge and attainments to himself." These high social gifts came from both sides of the house. His father was chosen by the Century Association of New York, on the occasion of the farewell dinner to Professor Tyndall in 1873, to arrange the social details. The Goldsboroughs stood at the top rank socially in Maryland. Two of the family have been governors of the State. Gov. Phillip Lee Goldsboro was a first cousin of Alfred's mother's father; and Gov. Charles Goldsborough, governor in 1818–19, was a first cousin of Alfred's great-grandfather.

Another striking trait of Mayor was his warm-heartedness and his feeling of responsibility for the comfort of those who were associated with him. Two letters of his to Dr. E. N. Harvey are worth printing because they are so characteristic.

S. S. "HOUTMAN,"
At Celebes, Nov. 28th, 1913.

MY DEAR HARVEY: We miss you greatly but hope to find you in Ceylon. The *Dorrego* was a good old roller in the heavy beam sea and we became as smudged as cats in a coal bin but the officers were nice fellows and we enjoyed it hugely. We expected to rough it and give the cannibals and the anopheles a fair chance at us in New Guinea but when I paid my respects to His Excellency the Governor he invited us to be his guests at Government House and provided us with the Government launch to enable us to tow and to see the native villages within 20 miles of Port Moresly, so we saw 40 miles of villages of a very primitive type built out over the water and with natives clothed quite in the old way.

H. E. also provided us with horses but unluckily Potts developed a New Guinea sore on his heel which was quite as bad as the one you had forward so I was glad enough to get him off on the *Houtman* two days before the time we planned for! He is now doing well but it is a slow affair and may necessitate our giving up Java.

I will in any case stay with him.

Everyone in New Guinea has malarial fever badly from the Governor down. 100 white men out of the 1600 in New Guinea died this year but it is a beautiful wild country that calls you in like a siren on the rocks off Cape Sorrento. I wish I could have gone up the Fly River. The cannibals there grab you by the arm and say U–u–u———.

Cordially,

ALFRED G. MAYER.

PORT SAID, EGYPT, *Dec. 30, 1913.*

MY DEAR HARVEY: When Potts and I reached Colombo on Dec. 19th we were distressed to receive your letter telling of the renewed trouble with the New Guinea ulcer.

We confidently hoped to find you in Colombo and our disappointment was very great, especially as I feel sad over having left you. I should not have been so confident that you would continue to improve and should have gone with you.

I will always reproach myself for not having done this, and will not feel content until I hear that you are well and have suffered no permanent injury.

Your spirit in saying that you were glad that the illness came *after* your research was finished is fine, and ought to have been matched by my staying with you as long as you were ill . . . . .

Mayor's regard for the health of his party repeats the qualities of his mother's father, who was the old-fashioned type of country physician, ready to respond to calls at any time of day or night, and to plunge on horseback through rain and mud at the call of "the stork." He was the beloved father confessor for all in physical or mental distress for miles around. He kept slaves and these idolized him. He hated to sell a slave, and on one occasion a slave he had sold acted so badly that he was returned to Doctor Goldsborough, where he remained satisfied and loyal. Mayor recalls that a slave of his grandfather's told him how "in responding to a sick call he found the Monocacy River dangerously swollen and cut one of the horses loose from the carriage and rode on horseback to the opposite shore despite the frightened protest of his devoted servant, who believed his master was plunging to certain death in the rushing torrent." These social traits were found again in Mayor's mother, who wrote delightful letters, was a charming conversationalist, gentle and kind, and a general favorite because always jolly, optimistic, and extraordinarily generous. They appeared again in Mayor's uncle, Charles

Worthington Goldsborough, who reproduced his father's traits as the beloved, unruffled, generous, high-minded country physician. Other members of his fraternity were characterized by a sweet disposition and unselfishness. This Goldsborough family trait of unselfishness Alfred carried into his scientific work, for he readily yielded to others problems toward whose solution he had made some progress, as when he turned over to Prof. H. E. Crampton the studies on Partula he had begun while at the Brooklyn museum. After he wrote a book on Sea-Shore Life he transferred his rights in it to the New York Zoological Society's Aquarium.

Physical health.—Through Mayor lacked a mother's care in early infancy, he developed into an active, tough, slender, somewhat seclusive lad. Always lithe and active, he seemed to have a wiry constitution. Yet he had certain physical limitations characteristic of his family. One of these was a tendency toward inflammation of the eyes. His mother's sister Amelia had to stay in a dark room for six weeks on account of this trouble, and Alfred suffered an apparently similar breakdown after the cruise of the *Wild Duck*, on which he was constantly making drawings. The ciliary muscles of the left eye became inflamed and he had to live for some months in a dark room. He writes characteristically of this period, "my devoted stepmother, who throughout my most hopeless years had not lost faith in me, kept my intellect alive by reading aloud in an adjoining room." (A. G. M., MSS.).

Through his subsequent main period of activity, from 1895 to 1918, Mayor's output of work indicated a man in the prime of health. In the early spring of 1919 and again in 1920 he went to American Samoa and while there examined the submerged seaward slopes of the coral reefs from a diving hood. Returning to America, he fell ill in the autumn of 1920, and it was later decided that tuberculosis had become active. For nearly two years he fought off the disease, just as his first cousin, Henrietta Lee Goldsborough, did. She eventually recovered, but the outcome was not so happy in his case. Despite a warning that it might be fatal to attempt it, he insisted in coming from Arizona to Dry Tortugas to look after the laboratory in 1922 as he had in 1921. There he rapidly grew worse and died in the water, apparently swooning from weakness while bathing on the beach.

As Dr. Asa Schaeffer, who was with him at the Tortugas on that last day, well writes:

> As I think of Mayor's great and absorbing devotion to marine biology, his childlike love of the sea, his passion to get away from the conventional, that peculiar ingredient of wierdness in his personality, but particularly the loving care with which he looked after every detail of the laboratory at Tortugas, even to planting the laboratory grounds with Cocoanut palms, Australian pines, the beautiful scarlet Hibiscus and the delicate Spider Lilies—as these things pass through my mind I can not help but feel that there was a certain appropriatness in his saying his last farewell on the shores of beautiful Tortugas.

SCIENTIFIC PAPERS BY ALFRED G. MAYOR

(Arranged by himself)

1890

1. Habits of the box tortoise. Popular Science Monthly, vol. 38, p. 60–65, 3 figs.

1893

2. Habits of the garter snake. Popular Science Monthly, vol. 42, p. 485–488, 4 figs.
3. The radiation and absorption of heat by leaves. American Journal of Science, vol. 45, p. 340–346, 1 fig.

1894

4. An account of some medusæ obtained in the Bahamas. Bulletin Museum Comp. Zool. at Harvard College, vol. 25, p. 235–241, 3 pls.

1896

5. The development of the wing-scales and their pigment in butterflies and moths. Bulletin Museum Comp. Zool. at Harvard College, vol. 29, p. 209–236, 7 pls.

1897

6. On the color and color patterns of moths and butterflies. Bulletin Museum Comp. Zool. at Harvard College, vol. 30, p. 169–256, 10 pls.
7. A new hypothesis of seasonal dimorphism in lepidoptera. Psyche, vol. 8, p. 47–50; 59–62.
8. On an improved heliostat invented by Alfred M. Mayer. American Journal of Science, vol. 4, ser. 4, p. 306–308, 2 figs.

1898

9. *With* Alexander Agassiz: On some medusæ from Australia. Bulletin Museum Comp. Zool. at Harvard College, vol. 32, p. 15–19, 3 pls.
10. *With* Alexander Agassiz: On Dactylometra. Bulletin Museum Comp. Zool. at Harvard College, vol. 32, p. 1–11, 13 pls.

1899

11. *With* Alexander Agassiz: Acalephs from the Fiji Islands. Bulletin Museum Comp. Zool. at Harvard College, vol. 32, p. 157–189, 17 pls., 146 figs.

1900

12. On the development of color in moths and butterflies. Woods Hole lectures, tenth lecture, p. 157–164.
13. On the mating instinct in moths. Annals and Magazine of Natural History, London, ser. 7, vol. 5, p. 183–190; also in Psyche, 1900, vol. 9, p. 15–20.
14. An Atlantic Palolo, Staurocephalus gregaricus. Bulletin Museum of Comp. Zool. at Harvard College, vol. 36, p. 1–14, 3 pls.
15. Descriptions of new and little-known medusæ from the western Atlantic. Bulletin Museum Comp. Zool. at Harvard College, vol. 37, p. 1–9, 6 pls.
16. Some medusæ from the Tortugas, Florida. Bulletin Museum Comp. Zool. at Harvard College, vol. 37, p. 13–82, 44 pls.

1901

17. The variations of a newly-arisen species of medusa. Science Bulletin, Museum Brooklyn Institute of Arts and Sciences, vol. 1, p. 1–27, 2 pls.

1902

18. Effects of natural selection and race-tendency upon the color-patterns of Lepidoptera. Science Bulletin, Museum Brooklyn Institute of Arts and Sciences, vol. 1, p. 31–86, 2 pls.
19. The Atlantic Palolo. Science Bulletin, Museum Brooklyn Institute of Arts and Sciences, vol. 1, p. 93–103, 1 pl.

1903

20. Some species of Partula from Tahiti, a study in variation. Memoirs Museum Comp. Zool. at Harvard College, vol. 26, p. 117–135, 1 pl.
21. *With* Alexander Agassiz: Medusæ of the tropical Pacific. Memoirs Museum Comp. Zool. at Harvard College, vol. 26, p. 139–175, 13 pls. and 1 map.

1904

22. Medusæ of the Bahamas. Memoirs of Nat. Sci., Museum Brooklyn Institue of Arts and Sciences, vol. 1, p. 1–33, 7 pls.

1906

23. Medusæ of the Hawaiian Islands collected by the steamer *Albatross* in 1902. U. S. Fish Commission Bulletin for 1903, p. 1131–1143, 3 pls.
24. Rhythmical pulsation in Scyphomedusæ, I. Publications of the Carnegie Institution of Washington, No. 47, 62 pp., 36 figs.
25. The annual breeding swarm of the Atlantic Palolo. Papers from the Tortugas Laboratory of the Carnegie Institution of Washington, vol. 1, p. 105–112, 1 pl.
26. Rhythmical pulsation in Scyphomedusæ, II. Papers from the Tortugas Laboratory of the Carnegie Institution of Washington, vol. 1, p. 113–131, 13 figs.
27. *With* Caroline G. Soule: Some reactions of caterpillars and moths. Journal of Experimental Zoology, vol. 3, p. 415–433.

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28. On the use of carbon dioxide in killing marine animals. Biological Bulletin, Woods Hole, vol. 16, p. 18.

1909

29. On the use of magnesium in stupefying marine animals. Biological Bulletin, vol. 17, p. 341–342.
30. The relation between ciliary and muscular movements. Proc. Soc. Experimental Biol. and Medicine, vol. 7, p. 19–20.
31. The cause of rhythmical pulsation in scyphomedusæ. Proc. Seventh International Zool. Congress, 4 pp.
32. The annual swarming of the Atlantic Palolo. Proc. Seventh International Zool. Congress, 5 pp.

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33. Medusæ of the world. 3 vols., 735 pp., 76 pls., 428 text figs. Published by the Carnegie Institution of Washington. Publication No. 109. Quarto.
34. Alexander Agassiz, 1835–1910. Popular Science Monthly, vol. 76, p. 419–458, portrait, 2 figs. Reprinted in Smithsonian Report for 1910, p. 447–472. Issued in 1911.

1911

35. Alpheus Hyatt, 1838–1902. Popular Science Monthly, p. 129–149, portrait, 2 figs.
36. The converse relation between ciliary and neuro-muscular movements. Papers from the Tortugas Laboratory of the Carnegie Institution of Washington, vol. 3, p. 1–25, 8 figs.

1904–1919

37. Annual Reports of the Director of the Department of Marine Biology of the Carnegie Institution of Washington. Year Books of Carnegie Institution of Washington, 1904–1919. (See also No. 69.)

1912

38. Ctenophores of the Atlantic coast of North America. 60 pp., 17 pls., 12 figs. Publication No. 162, Carnegie Institution of Washington.

1913

39. The Tortugas Laboratory of the Carnegie Institute of Washington. Internationale Revue der gesamten Hydrobiologie und Hydrographie, Bd. 5, p. 505–510, Taf. 11.

1914

40. An expedition to the coral reefs of Torres Straits. Popular Science Monthly, vol. 85, p. 209–231, Illustrated.
41. Effects of temperature upon tropical marine animals. Publication No. 183, the Carnegie Institution of Washington, p. 1–24, 12 figs.
42. The relation between the degree of concentration of electrolytes of sea water and the rate of nerve conduction in *Cassiopea*. Ibid., p. 25–54, 13 figs.
43. The law governing the loss of weight in starving *Cassiopea*. Ibid., p. 55–82, 1 pl., 21 figs.

1915

44. Ecology of the Murray Island coral reef. Proc. National Academy of Sciences, vol. 1, pp. 211–214.
45. The nature of nerve conduction in Cassiopea. Proc. National Academy of Sciences, vol. 1, pp. 270–274.
46. Medusae of the Philippines and of Torres Straits. Publication No. 212, the Carnegie Institution of Washington, pp. 157–202, 3 pl., 7 text figs. Reprinted in modified form in Proc. U. S. National Museum, 1917; as a report from the U. S. Bureau of Fisheries.

1915–16

47. A history of Tahiti, A history of Fiji, Papua where the stone age lingers. The men of the mid-Pacific, the Islands of the mid-Pacific, Java the exploited island. Popular Science Monthly, vols. 86–87, and the Scientific Monthly, vols. 1 and 2, 188 pp., figs.

1916

48. Sub-marine solution of limestone in relation to the Murray-Agassiz theory of coral atolls. Proc. National Academy of Sciences, vol. 2, pp. 28–30.
49. A theory of nerve conduction. Proc. National Academy of Sciences, vol. 2, pp. 37–42, 2 figs.
50. Nerve conduction and other reactions in *Cassiopea*. American Journal of Physiology, vol. 39, pp. 375–393, 2 figs.
51. Further studies of nerve conduction in *Cassiopea*. Proc. National Academy of Sciences, vol. 2, pp. 721–726, 2 figs.
52. *With* Robert S. Woodward: Biography of Alfred Marshall Mayer, 1836–1897. Biographical Memoirs National Academy of Sciences, vol. 8, pp. 243–272, portrait.

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54. Nerve conduction in *Cassiopea xamachana*. Publication No. 251, Carnegie Institution of Washington, vol. 11; papers from the Department of Marine Biology, pp. 1–20, 15 figs.
55. Coral reefs of Tutuila with special reference to the Murray-Agassiz solution theory. Proc. National Academy of Sciences, vol. 3, pp. 522–526.
56. Observations upon the alkalinity of the surface water of the tropical Pacific. Ibid., vol. 3, pp. 548–552.
57. On the non-existence of nervous shell shock in fishes and marine invertebrates. Ibid., vol. 3., pp. 597–598.
58. Is death from high temperature due to the accumulation of acid in the tissues? Amer. Jour. Physiol. vol. 44, pp. 581–585.
59. Formula for the rate of nerve conduction in sea water. Ibid., vol. 44, pp. 591–595.
60. Report upon the scyphomedusae collected by the U. S. Bureau of Fisheries steamer *Albatross* in the Philippine Islands and Malay Archipelago. U. S. National Museum, Bulletin No. 100, pp. 175–233, 24 figs.

1918

61. Ecology of the Murray Island coral reef. In Publication No. 213, Carnegie Institution of Washington, 48 pp. 19 pls., 9 text figs. Volume 9 of papers from the Department of Marine Biology.
62. William Stimpson, 1832–1872. Memoirs National Academy of Sciences, vol. 8, pp. 419–433, portrait.
63. Navigation illustrated by diagrams. 207 pp. 97 figs. Lippincott, Philadelphia, Pa.
64. The growth-rate of Samoan coral reefs. Proc. National Academy of Sciences, vol. 4, pp. 390–393.
65. Toxic effects due to high temperature. Papers from the Department of Marine Biology, Carnegie Institution, vol. 12, 6 pp.
66. Nerve conduction in diluted and concentrated sea water. Ibid., 5 pp. 1 fig.

1919

67. Detecting ocean currents by observing their hydrogen-ion concentration. Proc. American Philosophical Society, vol. 58, pp. 150–160, 1 fig.

1920

68. Samuel Hubbard Scudder, 1837–1911. Memoirs National Academy of Sciences, vol. 17, pp. 79, portrait.

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69. The effect of diminished oxygen upon the note of nerve-conduction in Cassiopea. American Journal Physiology, vol. 51, pp. 543–549.
70. The reefs of Tutuila, Samoa, in their relation to coral-reef theories. Proc. American Philosophical Society, vol. 19, no. 3, 14 pp., 3 figs.

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71. Hydrogen-ion concentration and electrical conductivity of the surface water of the Atlantic and Pacific. In Publication No. 312, Carnegie Institution of Washington, pp. 61–85, 3 charts.
72. Tracking instinct in a Tortugas ant. In Publication No. 312, Carnegie Institution of Washington, pp. 101–107, 3 figs.

1924

73. Rose Atoll, American Samoa. In Publication No. 340, Carnegie Institution of Washington, pp. 73–79, 2 pls.