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EDMUND BEECHER WILSON[1]

By Professor THOMAS HUNT MORGAN

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EDMUND BEECHER WILSON was born on October 19, 1856, at Geneva, Illinois. The first sixteen years of his life were passed there.

When Wilson was not quite sixteen his uncle Davis suggested that he take over the "little country district school," that his brother Charles had taught the year before. The offer was thirty dollars a month and board (with his aunt and uncle). "When the thermometer stood at thirty degrees below zero, as it did at times, this was, I assure you, no joking matter. I wonder how the modern city-bred youth would like such an experience. I had only twenty-five pupils or so, of all ages from six to eighteen, and I had to teach all grades, from the three R's up to history and algebra."

In the following summer he was in Geneva, where his cousin, Sam Clarke, had just returned from Antioch College. "As the summer passed I had gradually made up my mind to try for a college education and a life devoted to biology or at least to science." "I had nothing but my two hundred dollars and with this in hand I packed up my meager outfit in September and started for Antioch College in Southern Ohio." The college was a very simple one but with sound ideals. "We had good teachers. Here, for the first time I received regular instruction in zoology and botany, in Latin, in geometry and trigonometry

[1] Condensed from a memoir presented to the National Academy of Sciences.

and especially in chemistry with regular laboratory work, and I reveled in it all."

In June (1873) he went back to Geneva, where with a tutor he began to study Greek. Instead of returning to Antioch in the fall a new prospect opened. Sam Clarke wrote enthusiastic letters from the Sheffield Scientific School at Yale. "In turning towards Yale I was influenced not merely by Clarke's example but in part by the reputation of the professors of zoology, botany, comparative anatomy and geology, and in part by the almost equally compelling consideration to poor students that Yale offered many advantages in the way of self support. I felt, however, not yet fully prepared . . ." Wilson spent the winter with his family in Chicago in attendance at the university there, preparatory to Yale. Hearing of an opening as recorder in the Lake Survey he easily passed the examination, and was accepted at a salary of a hundred dollars a month. He took part in the primary triangulation of Lakes Ontario and Erie, which lasted until September; then he started east to enter Yale.

He entered the Scientific School at Yale in 1875 and graduated three years later with the degree of Ph.B. He remained there one year more doing graduate work and acting as assistant. During the first year at Yale he took courses in zoology with Verrill, in botany with Eaton and embryology with S. I. Smith. He then decided to regularize his work so that it would lead to the bachelor's degree. His three undergraduate years were, he writes, very busy and very happy years. At the end of the last year at Yale, Wilson was offered a position for the following year, but both Sedgwick, with whom he was on intimate terms, and Wilson himself were getting roseate reports from Sam Clarke, who was then at Johns Hopkins University. Both applied for fellowships there and were duly appointed.

At the end of his first year at Johns Hopkins both he and Sedgwick were reappointed to fellowships and in the third year to assistantships. His three years there opened a new world of ideals; he became aware, he says, of new horizons of research, and wider outlooks in biology. His teachers were H. Newell Martin and W. K. Brooks. It was with the latter that he carried out most of his own work. "It was through informal talks and discussions in the laboratory, at his house, and later at the summer laboratories by the sea that I absorbed new ideas, new problems, points of view, etc." "Through him I first discovered what I really wanted to do." "From him I learned how closely biological problems are bound up with philosophical considerations. He taught me to read Aristotle, Bacon, Hume, Berkeley, Huxley; to think about the phenomena of life instead of merely trying to record and classify them."

Wilson had more and more wished to study in Germany. At the end of the summer of 1882 he sailed to Liverpool. Newell Martin had given him a letter to Huxley, who expressed much interest in the work on Renilla. Later he arranged to have the memoir on Renilla published by the Royal Society.

Wilson settled down at Cambridge. Balfour had been killed in the Alps, but his assistants and students were there, and Wilson recalls meeting Adam Sedgwick, Heape, Caldwell and Bateson. He also met Michael Foster and attended his lectures. He returned to London to give his paper before the Royal Society and then left for Germany. After spending a few weeks in the small village of Thurm to familiarize himself with spoken German he went to Leipzig. Here he worked in Leuckart's laboratory and also attended a few of Ludwig's lectures on physiology. He introduced the section-cutting method that Caldwell had invented in England and it created a sensation. In Leipzig he heard a great deal of the best music.

Naples produced a deep and lasting impression on Wilson. The station came up fully to his expectations. There he came to know Anton Dohrn, with whom he formed a sincere friendship, Hugo Eisig, Edourd Meyer and Arnold Lang—names that are familiar to many American zoologists who have followed in Wilson's footsteps to Naples.

Sedgwick and Wilson had been much interested in the course in biology at Johns Hopkins given by Newell Martin, where in the laboratory the well-known book of Huxley and Martin was used. While at Williams they began planning along somewhat different lines a text-book of general biology. In part to carry out their plan of collaboration Wilson was offered a lectureship with Sedgwick at the Massachusetts Institute of Technology. The book appeared in 1885 and was very successful.

Bryn Mawr College, a new institution for the higher education of women, was to be opened in the fall of 1885 and Wilson was invited to take charge of the department of biology. The college had been founded by Quakers and from the beginning adopted a liberal, even advanced, policy in its educational aims. This policy was largely due to Miss M. Carey Thomas, who as dean and later as president introduced the same standards as those followed by Johns Hopkins. Wilson taught at Bryn Mawr from 1885 to 1891 and had wonderful success, attracting to his classes many of the ablest students in the college.

Henry Fairfield Osborn had accepted a call from Columbia to establish a new department of zoology. He offered Wilson the position of adjunct professor to cooperate with him in organizing the new department. The offer included an arrangement by which Wilson would be given a year of foreign study before

starting on his duties at Columbia. The second year in Europe was spent mainly in Munich and Naples and was even more productive and delightful than the first one, scientifically, because it settled definitely his later line of study, namely, cellular and experimental embryology. Boveri was at that time in Munich, and it was his presence there that had determined Wilson's choice of a place to work. Boveri was "far more than a brilliant scientific discoverer and teacher. He was a many-sided man, gifted in many directions, an excellent musician, a good amateur painter, and we found many points of contact far outside of the realm of science."

At the end of the year he went to Naples with the Norwegian Hjort as traveling companion. At the station he met Driesch and Herbst, both students of experimental embryology, which at that time was a relatively new field and to which Wilson was soon to make valuable contributions. Driesch's work on the experimental production of twins interested Wilson intensely, because of its bearing on his own work on the development of the earthworm and Nereis, then in press. In the spring of 1892 he went to Sicily to study the embryology of Amphioxus. Returning to Naples he sailed for Genoa, where he saw the famous Joseph Guarnerius violin of Paganini. "The thrill that it gave me was only equalled by my ascent of Etna."

In 1904 Wilson married Anne Maynard Kidder, the daughter of Dr. Jerome Henry and Anne Maynard Kidder. Dr. Kidder was a friend of Spencer F. Baird, who established the United States Fish Commission at Woods Hole. The Kidder family, who lived in Washington, D. C., built a summer cottage at Woods Hole and were on the most friendly terms with members of the Marine Biological Station. After the death of Dr. Kidder, Mrs. Kidder continued to go to Woods Hole. Many of us will remember her as charming, cultivated, witty and hospitable and she was regarded by us as much a member of our group as though an official member of it. It was at Woods Hole that Wilson first knew Anne Kidder, whose marriage to him added officially another valuable member of that family to the Woods Hole group. Their daughter, Nancy, Mrs. John Lobb, became a professional cellist of outstanding ability, and, during the latter years of Wilson's life, one of his greatest pleasures was watching her progress in her profession. This, in a sense, rounded off Wilson's passion for music.

Wilson's first extensive work, "The Development of Renilla," was published in 1883 in the Philosophical Transactions of the Royal Society, London. It was a splendid piece of descriptive work, admirably presented. The sixteen plates that illustrate the text are an example of his skill and taste in drawing.

During the six years he taught at Bryn Mawr College (1885–1891) he published a brief account of the movements of Hydra, and an extensive paper on the embryology of the earthworm (1889). After his appointment to Columbia University (1891) his research productivity steadily increased. In 1892 he published "The Cell-Lineage of Nereis."

The problem of the organization of the egg was an old one, but after the experimental work of Roux on frog's eggs and that of Chabry on ascidians' eggs, and the experimental work of Driesch on sea urchins' eggs, the theoretical deductions that they drew from these experiments, which were opposed, aroused wider and wider interest. From that time onwards the older phylogenetic problems lost interest, and embryologists took up the experimental study of embryology with increasing success and enthusiasm. Much of Wilson's later work was concerned with the evidence and its discussion in this new field.

In 1902 a graduate student, W. S. Sutton, pointed out that the two maturation divisions furnish an explanation of Mendel's laws. Wilson writes, "During the past year working in my laboratory he has obtained more definite evidence in favor of this result (the separation of maternal and paternal chromosomes), suggested by Montgomery (1901), which led him to the conclusion that it probably gives the explanation of the Mendelian problem." This conclusion of Sutton's has turned out to be more than "probable," and is to-day the basis for the mechanism of Mendel's two laws.

The most complete papers that Wilson published in 1904 deal with "Experimental Studies on Germinal Localization." The first deals with the egg of Dentalium; the second with Patella and Dentalium. These papers were the outcome of eight months' residence at the Naples Zoological Station in 1903.

Wilson's most outstanding contributions are his eight studies on chromosomes published from 1905 to 1912. These deal almost exclusively with the reduction divisions during spermatogenesis. Here accuracy of observation and care in interpretation of the behavior of the chromosomes are shown in a high degree. The actual counts of the number of chromosomes is in itself not difficult, at least in those forms that have a small number, and Wilson chose mainly such forms, but the changes that take place during the ripening of the sperm cells call not only for extraordinarily careful observations but also for skill in interpretation. In both respects Wilson was unusually gifted. None of his results has been rejected by later workers, while some of the erroneous chromosome counts of other contemporary cytologists held back for several years the solution of the role of the sex chromosomes in the determination of male and female.

In 1905 Miss Nettie Stevens at Bryn Mawr College

published in the Publications of the Carnegie Institution of Washington an account of the role of the sex chromosomes in the beetle Tenebrio. She showed that the male had 19 large and 1 small chromosome (the Y), the latter going to half the spermatozoa. She also showed that at the reduction division it (the smaller one) was the mate of one of the large chromosomes. Consequently half the ripe sperm had 10 large chromosomes and half had 9 large and 1 small chromosome. In the oogonial cells there were 20 large chromosomes which would reduce to 10 in the egg after maturation. She pointed out that an egg fertilized by a sperm with 10 large chromosomes would give a female with 20 such chromosomes, and that an egg with 10 large chromosomes fertilized by a sperm with 9 large and 1 small chromosome would restore the number characteristic of the male.

In the same year (1905) Wilson published a similar conclusion in regard to the role of the sex chromosomes in two other insects in which the female has one more chromosome than the male; thus *Anasa tristis* ♀ has 22, and the male 21; and Protenor ♀ has 14, and the ♂ 13. The Stevens type XX-XY and the Wilson type XX-XO are the same in principle. It has turned out that the former is much commoner than the latter as a sex-determining mechanism occurring widely in groups other than insects.

Five years after his appointment at Columbia University he published his book on "The Cell" (1896) which was at once recognized as the outstanding summary of the work in this field. Wilson drew upon his wide experience covering, as it did, the role of the cell in fertilization and development, in experimental embryology, in spermatogenesis, as well as thorough familiarity of the work of his contemporaries dealing with the cell. A third and greatly extended edition appeared in 1925. During the interval between the first and third editions, work in cytology had advanced in many directions and a voluminous literature had grown up. In a masterly way Wilson summarized this literature, separating the wheat from the chaff. I can not do better than quote here the words of Professor E. G. Conklin spoken at the time of the award to Wilson of the Daniel Giraud Elliot Medal (for 1925) by the National Academy,

"The third edition of 'The Cell in Development and Heredity' has been written out of this unique experience; it represents not only the mature point of view of the world's leading student and teacher of cytology, but it is to a large extent the work of its leading investigator in this field. Few other workers are left who were in at the birth of this science and who can speak of its development with the knowledge that comes from intimate contact with persons and problems, and no one could deal with this subject in a more comprehensive and judicial manner."

Wilson was a member of all the leading learned societies of Europe and America. He was a recipient of honorary degrees from the universities of Columbia, Harvard, Yale, Johns Hopkins, Chicago, Louvain, Cambridge (England), Lwow and Leipzig. He was awarded the gold medal of the Linnean Society, London; the Elliot Medal of the National Academy of Sciences; the John J. Carty Medal and Award. He will be lovingly remembered by his many friends as a reserved, cultured gentleman whose sincerity, judgment and breadth of knowledge were shown by the perfection of his lectures and his scientific papers.

WIND-WORN STONES IN GLACIAL DEPOSITS OF THE MIDDLE WEST

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FOR many years the plains of the middle western States have been a classic area for studying deposits formed by the Pleistocene ice sheets. The preliminary work of mapping and distinguishing between sheets of debris spread during each successive episode of the Glacial Period is largely completed. In studies encompassing such vast areas many details will be overlooked, however, and left for the attention of later workers. This is not to the discredit of early investigators, for new data are commonly found each time a particular locality or rock outcrop is revisited.

One detail little noticed until recent years is the association with glacial deposits in central interior States of stones that were shaped, etched, modified or polished through abrasion by wind-driven sand. Such stones are common in modern deserts and have been found in many consolidated aeolian deposits, or "fossil deserts." Bryan[1] proposed the general name "ventifact" for all wind-scoured stones.

Hobbs[2] noted abundant ventifacts on barren plains bordering the Greenland ice-cap, where strong winds generated above the ice drive sand, silt and dust over stones too large for the winds to carry. Ventifacts

[1] K. Bryan, *Rept. Comm. on Sedimentation for 1929–30, Nat. Res. Coun. Cir. No. 98,* 1931, pp. 29–50.

[2] W. H. Hobbs, *Jour. Geol.,* 39: 381–385, 1931.