MEMOIR

OF

HENRY JAMES CLARK.

1826-1873.

BY

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BIOGRAPHICAL MEMOIR OF HENRY JAMES CLARK.

MR. PRESIDENT AND GENTLEMEN:

Within the year past we have lost a member who may be said, without disparagement to others laboring in the same field, to have been the foremost American histologist and microscopist, and one of our most skilful and accomplished biologists; one the rule of whose scientific life was a practical application of experimental philosophy. A true naturalist, he was an enthusiast, and yet in his methods of study severe, exact, and in all respects scholarly.

HENRY JAMES CLARK was born June 22, 1826, at Easton, Massachusetts. Of his early life little information has been obtained except that he was fond of drawing, an art which proved of much service and credit to him in after years.

He received his collegiate education at the University of the City of New York, graduating in 1848.

His first love for science seems to have grown from his fondness for flowers. At what age this was manifested we do not know, but that it must have been a passion, one determining the bent of his life at the time of his graduation, seems more than probable. Immediately after leaving college he taught for some time at White Plains, New York. While there, in some of his out-of-door rambles—and he was fond of taking long walks—he found a flower which he thought was new. On returning home he ascertained that it was not described in Professor Gray's Botany. He at once began a correspondence with Professor Gray in regard to it, and eventually received an invitation from him to go to Cambridge. He went there as a student of botany under Professor Gray in 1850, and this may be regarded as the date of his scientific birth. While a student at the Botanic Garden, he taught the academy at Westfield, Massachusetts, for a single term, apparently achieving much success as a teacher, and forming life-long friendships.

Soon after this he became a student of Professor Agassiz; but his love for botany never diminished. He studied it in after years from the side of vegetable histology and morphology in connection with and as illustrating the histology and morphology of animals. The influence of his knowledge of botany on his zoological studies was marked. It prepared him for his studies on spontaneous generation, on the theory of the cell, on the structure of the Protozoa and the nature of protoplasm. In studying the lasso-cells of the Acalephs, he traced their analogical resemblance to the stinging hairs of the nettle. By his intimate knowledge of the spores of the smaller Algæ he was able to point out some of the characters separating the lowest Protozoa from the spores of plants, and aid in the work of Thuret and others in eliminating from the animal kingdom certain vegetable spores which had been originally described as infusoria.

His first scientific paper was on a botanical subject, "The peculiar growth of rings in the trunk of *Rhus toxicodendron*," published in 1856, and this was supplemented by unpublished studies on the eccentricity of the pith in *Ampelopsis quinquefolia* and *Celastrus scandens*. He made experiments for a series of years on the value of the bark to the life of the tree. He also studied certain morphological points. As an example, he observed the relation and development of the filaments which connect the anthers to the sepals of *Comandra umbellata*. In his paper on the origin of Vibrio (1859), he showed how the fibrillæ of the muscles during decomposition break up transversely, the fragments assuming the form and movements of Vibrios. He also made observations on the absorption of albumen in the cells of plants. His second purely botanical paper, and the last he published, was on the nature of the glandular dots of the Pine (1859). His skill in the use of the fine lenses made by Spencer, of Canastota, New York, enabled him to see more than his predecessors of the true relations of these dots. But that his botanical studies did not end here may be seen by reference to his diaries, and his frequent allusions to the lower Algæ and to vegetable histology in his "Mind in Nature." In his walks he often botanized, and contributed in this way to Gray's botanical text-books. Thus with the training he received from Professors Gray and Agassiz, he looked upon the world of organized beings from both the botanical and zoological side. He well deserves the name, *biologist.*

He graduated from the Lawrence Scientific School in 1854, taking the degree of B.S. He was for several years the private assistant of Professor Agassiz, who early in 1857 spoke of him enthusiastically, remarking to a friend, "Clark has become the most accurate observer in the country." On Sept. 29, 1854, he was married to Mary Young Holbrook of Boston. They had eight children, of whom seven are living. Between 1856 and 1863 he was associated with Agassiz in the preparation of the anatomical and embryological portions of the "Contributions to the Natural History of the United States." Here his great skill and delicacy in the use of the scalpel and pencil won much praise from naturalists. Nearly all the plates in the Contributions illustrating the embryology and histology of the turtles and Acalephs are signed with his name. The drawings were not only beautifully worked up, but possessed the merit of extreme accuracy.

In the use of the microscope, Clark showed not only mechanical skill and ingenuity, but a patience, caution, and experience in difficult points in histology, which undoubtedly placed him at the head of observers in this country, and rendered him perhaps inferior to few in Europe. He used the highest powers with a skill that few if any living observers have surpassed. He suggested improvements, carried out by Spencer, at the instance of Professor Agassiz, in this instrument. The first great microscope made in Germany was constructed in 1829 by Fraunhofer for Professor Agassiz. A second, and one pronounced by Clark as not surpassed "in all Germany to this very day" (1859), was made by Oberhäuser in 1832. In 1857, Professor Agassiz sent Clark to Canastota to confer with Spencer, and as the result, a microscope was made by Spencer which was fully equal to any made at that time in Europe. Clark suggested that we must have three kinds of objectives: one with the field extremely flat; another, an immersion lens—the first made, so far as we are aware, and now so universally used;—and a "third with a depthing focus extending as far as possible beyond that of the ordinary kind, for the purpose of viewing objects as a whole, in order to ascertain the relations of their different parts." This microscope was in use in 1859. It should be observed that Clark's high opinion of Spencer's objectives was formed, to use his own language, "after having tested from time to time some of the best English microscopes which have been made since the 'Great Exhibition,'" and "therefore I am not to be supposed to have made so great a leap as if from an Oberhäuser to a Spencer." He insists on the value of a flat field and wide angular aperture, and at the present day, fifteen years later, lenses are made with still lower angles of aperture than in 1859 for histological studies. During this time Clark began the serious study of the Protozoa, undoubtedly compelled to do so in order to properly interpret the histological facts then accumulating in the study of the Radiates. After leaving Cambridge he studied the Infusoria and lower plants, and made drawings and notes, comprising descriptions of many new forms of Infusoria. He planned an extensive work upon this subject, portions of which are now in charge of the Boston Society of Natural History for publication. The drawings are of great delicacy and beauty, and, had he lived to complete the work, it would doubtless have been equal to if not in advance of Claparède and Lachman's famous work on the Infusoria. He did not dissociate the Protophyta from the Protozoa, regarding them as almost inseparable in nature; thus, as we have ascertained in his lectures to his classes, well nigh anticipating Haeckel's classification of the lowest forms of the animal and vegetable kingdom into the Protista and Protozoa.

His assiduous, confining labors seriously injured his health. His constitution was not strong. Already, in 1857, we find entries in his diary of symptoms indicating that the seeds of the disease that was to carry him prematurely off were then sown. He was not even then robust, and his life ever after was a struggle with disease, and the cares of a large and increasing family.

In June, 1860, he was appointed adjunct Professor of Zoölogy in the Lawrence Scientific School, which he held until the expiration of his term of office; and, in the spring and summer of 1861, gave a course of lectures on histology at the Museum of Comparative Zoölogy. In the spring of 1863 arose a sudden and unfortunate disagreement with Professor Agassiz, which led to the termination of his connection with the Museum of Comparative Zoölogy. In the spring of 1864 he delivered a course of twelve lectures at the Lowell Institute in Boston, which were published in the same year, under the title of "Mind in Nature;

or, the Origin of Life, and the Mode of Development of Animals." This is in all respects, for its usually sound and clear thinking, its breadth of view, and the amount of original work it contains, perhaps the most remarkable general zoölogical work as yet produced in this country. If the author had left us no other work, this alone would testify to years of the severest labor and independent thought. It anticipated certain points in histology, and the structure of the Protozoa and Sponges especially, which have made the succeeding labors of some European observers notable. It is a most readable book, although the style lacks that elegance and attractiveness which distinguish some of the popular works on science of the present day.

Professor Clark adopted and strongly urged the doctrine of spontaneous generation, from the facts afforded by the experiments of Professor Wyman, and on the question of evolution adopted views resembling those of Professor Owen. The original matter in the book is that relating to the structure of *Bacterium termo,* and *Vibrio baccillus,* the theory of the egg and its polarity and bilaterality, and the cellular structure of Actinophrys, with many other new points relating to the anatomy and physiology of the Protozoa and Radiates. The new discoveries and inductions give a special value to the work, and afford evidence of the scholarly and thoughtful mind of their author. Few are the facts gleaned from other authors which he did not verify, and so fresh and suggestive is the mode of treatment, and conscientious the spirit of the book, that it will, if we mistake not, remain a classic. Certainly there is no work in the English language that covers the field it occupies.

The remaining events in the life of our friend and associate may be, alas, too briefly related. In December, 1866, he was appointed Professor of Botany, Zoology, and Geology in the Agricultural College of Pennsylvania. He resided at Centre County, Pennsylvania, the seat of the College, until April, 1869, when he was appointed to the Chair of Natural History of the University of Kentucky. He lived at Lexington, Kentucky, until February, 1872, when he was elected Professor of Veterinary Science in the Massachusetts Agricultural College.

During this period he suffered much from sickness; still he managed in intervals of college duties to produce some remarkable memoirs. In his first paper on Actinophrys (1863), he discovered that "all vibratile cilia originate in the amorphous intercellular substance," and do not form direct prolongations of cells. In 1864 appeared a brief paper in which he showed that Tubularia was not parthenogenous, having found, by the aid of Tolles' improved quarter of an inch objectives, that it produced eggs. Perhaps the most important work he has done is in his studies on the affinities of the sponges. In November, 1866, appeared, in the American Journal of Science and Arts, a brief paper, entitled "Conclusive Proofs of the Animality of the Ciliate Sponges, and of their Affinities with the Infusoria Flagellata." While he had in his Lowell Lectures endeavored to show that there was a unity of plan in the organization of the Protozoa, their bodies being arranged in the form of a helix, he now endeavored to show that the sponge did not depart from the protozoan type. By the discovery of a remarkable form (Codosiga) he was enabled in it to trace a link, in his opinion, uniting the sponges with the flagellate Infusoria, such as Monas, Anthophysa, and Codosiga. In the full memoir, which was published a year after, with numerous figures, under the title "Spongiæ Ciliatæ as Infusoria Flagellata," he attempted to establish the homology of the flagellate cells, constituting the tissues of the sponge, with the flagellate Infusoria. He demonstrated, by the use of the superior objectives made by Tolles, that these cells are like Monads, with contractile vesicles, nuclei, a collar, and flagellum; that the sponge was in fact a compound monad, and not a compound amœba, as insisted on by Carter in 1854–57, and Lieberkuhn in 1856 and 1857. This was a great step in advance of previous observers. Certainly an organism with cells so highly differentiated as those in the sponge cannot be a plant, and while, as Clark observes, Carter had "been the first to present anything like decisive proofs of the animality of the sponges," yet this was confirmed and demonstrated still more completely by Clark himself. In this memoir he insists upon the fact that these simple "monas-like infusoria," making up the compound body of the sponge, were undoubtedly endowed with a distinct mouth, afterwards, in 1871, distinctly seen; while Carter described them as engulfing food like an amœba, any part of the cell acting as a mouth. Of course it is necessary for our author to prove that Monas is an animal. This he does conclusively, showing it has a distinct mouth, with a "lip," into which food is thrown by the flagellum. The cells or zoöids of the sponge (*Leucosolenia*) agree with Monas in all respects except that he did not detect the mouth, though he saw currents of floating particles which "are constantly whirled in by the flagella and made to impinge upon the area within the collar."

The study of the sponges has since the publication of this important memoir been pursued by Oscar Schmidt, Miklucho Macleay, and Ernst Haeckel. Considerable advance has been made regarding the organization of the adult, while the young of the sponge has been proved to be like the planula of a radiate, and made up of two layers of cells. Haeckel afterwards assumed, and proved, we think, that Clark was wrong in regarding the sponge as a compound Flagellata Infusorian, considering Clark's monads as simple ciliated cells, provided with a collar. Inasmuch as the sponge, then, is made up of two layers of cells, it is not a Protozoan, but, in Haeckel's view, homologous with the Radiata, among which he, in accordance with Leuckart's views published in 1848, consequently places them.

The last paper he published was entitled, "The American Spongilla, a Craspedote, Flagellate Infusorian," in which he criticizes Haeckel's views on the affinities of these animals, and insists upon their affinities to known Flagellate Infusoria. This was published in December, 1871, in the American Journal of Science and Arts. An extended memoir on Lucernaria is now being published in the Smithsonian Contributions.[1]

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[1] One of the memoirs accepted for future publication in the Contributions is on Lucernaria, by Professor Henry J. Clark. His work is divided into two parts; the first devoted to the "general and comparative morphology," and the second restricted to the "anatomy and physiology of *Haliclystus auricula*." In the first part are three chapters; the first on "individuality," in which are considered the questions relating to "polarity and polycephalism," and "the hydroid and medusoid cephalisms." In the second, the thesis that "the type of form is not radiate" is defended, and the form is described as "the dorso-ventrally repetitive type." The third chapter is devoted to the consideration of "antero-posterior (cephalo-caudal) repetition," and under the heads of "the scyphostoma and ephyra varieties of the same morph" and "the individuality of Pelagia and Lucernariæ."

In the second part are four chapters, the third to seventh of the entire work. In the first (third of the work) are described the "general form and structure," including habitat, habits, form, and size, the proboscis, Busy with his work at Amherst, and struggling with the fatal disease (tabes mesenterica) which was rapidly reducing his bodily strength, he wasted away, and died on the first day of July, 1873, in full possession of his mental faculties. He left a wife, seven surviving children, and many warm friends to mourn his loss.

He was a man of the warmest sympathies, a devoted and affectionate husband, a loving brother, and dutiful son; in many respects an admirable teacher, as a lecturer clear and systematic, with an enthusiasm that evinced the true naturalist. The secret of his success as an investigator may be stated in his own words taken from his diary, where he says he made it a rule to practise the "utmost rigidity and thoroughness in his researches, without regard to time consumed or the value of the results." He had the best of teachers, and he made the most of his opportunities. We may look upon the results of his work as elevating the standard of American scientific work.

He was a member of most of the learned societies in this country, while his works have been recognized and referred to by some of the leading zoölogists in Europe.

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the umbella, and the peduncle. In the second is considered the "organography, including the walls," "the muscular system," "the tentacles, the marginal adhesive bodies, or colletocystophora," "the caudal adherent disk," "the digitiform bodies, or digitali," "the digestive system," "the nervous system," and "the reproductive system."

In a third are embraced the results of studies of the "embryology," or various stages of growth of the species, including observations on "the egg and the spermatozoa;" on "a young *Haliclystus auricula*, nearly one-sixteenth of an inch in diameter;" on "a specimen three thirty-seconds of an inch across the umbella;" on "a young specimen one-eighth of an inch across;" on the "special development of a tentacle, a colletocystophore, and a genital sac;" on the "young one-fifth of an inch across;" and on the "young six twenty-fifths of an inch across."

In a fourth chapter the tissues are considered in an "histology of *Haliclystus auricula*," and in the several parts of the body—that is, "the umbellar and peduncular walls;" "histology of the tentacles;" "histology of the colletocystophores" (anchors); "histology of the caudal disk;" and "histology of the digitali" and "the prehensile cysts" (nematocysts and colletocysts).—*Report of the Board of Regents of the Smithsonian Institution for* 1873. Washington, 1874.

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