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OF

JOHN MASON CLARKE

BY

CHARLES SCHUCHERT

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John M. Clarke

"In the classroom of the venerable brown Albany Institute, Joseph Henry, a teacher of mathematics and physics, sent a galvanic current through a mile of copper wire and thereby created a circuit which, when broken, struck a bell. That little bell, a sacred relic, has sent its note around the world. That invention and discovery were the parent of the modern telegraph and telephone, the motor, the automobile, and the radio." The bell used by Henry in this experiment was secured by Clarke for the New York State Museum, and the portrait shows him with it.

JOHN MASON CLARKE

BY CHARLES SCHUCHERT

In the death of John Mason Clarke, America loses its most brilliant, eloquent, and productive paleontologist, and the world its greatest authority on Devonian life and time. Author of more than 10,000 printed pages, distributed among about 450 books and papers, of which 300 deal with Geology, his efforts had to do mostly with pure science, and he often lamented, in the coming generation of doers, the lack of an adequate appreciation of wondrous nature as recorded on the tablets of the earth's crust. He was peculiarly the child of his environment; born on Devonian rocks replete with fossils, in a home of high ideals and learning, situated in a state that has long appreciated science, he rose into the grandeur of geologic knowledge that was his.

Clarke is survived by his wife, formerly Mrs. Fannie V. Bosler, of Philadelphia; by Noah T. Clarke, a son by his first wife, who was Mrs. Emma Sill (née Juel), of Albany; by two stepdaughters, Miss Marie Bosler and Mrs. Edith (Sill) Humphrey, and a stepson, Mr. Frank N. Sill. Out of a family of six brothers and sisters, four remain to mourn his going: Miss Clara Mason Clarke, who, with Mr. S. Merrill Clarke, for many years city editor of the *New York Sun*, is living in the old homestead at Canandaigua; Rev. Lorenzo Mason Clarke, pastor of the First Presbyterian Church of Brooklyn; and Mr. William B. Clarke, managing editor of the *Baltimore American*.

The cause of Clarke's death was a malignant growth in the sigmoid, which did not cause distress until the last few months of his life, and was not discovered to be such until three weeks before. He died under the fourth operation on May 29, 1925. On the afternoon of June first, a throng of his friends and fellow workers assembled in St. Peter's Presbyterian Church to listen to its beautiful service and to pay their last respects. He is buried in the Albany Rural Cemetery, where also lie James Hall, Ebenezer Emmons, R. P. Whitfield, and Philip Ast, all members of the New York State Geological Survey.

The present writer's acquaintance with Clarke dates back to the autumn of 1889, when he also joined Hall's staff at Albany, but as his private assistant. Then ensued delightful Thursday evenings with Clarke and his family, when we discussed our favorite fossil brachiopods and exchanged remarks about the doings of our strenuous chief. What glorious evenings of inspiration these were! When the writer went to Washington, he still met Clarke two or three times each year and our letters were frequent, and this same close relationship was continued to the end. We saw each other for the last time at the 1924 meeting of the Geological Society of America at Ithaca, and Clarke's last letter, of May 14, 1925, was in his characteristic style, but with an undertone of possible seriousness ahead. The last few days before going to the hospital were, in fact, spent in adjusting official matters between himself and his staff, and in giving helpful suggestions to the Regents of the New York State Museum regarding its future welfare.

No finer thing can be said of John M. Clarke than has already been said by another close friend and associate, Doctor John H. Finley, former president of the University of the State of New York and now editor of the *New York Times*, from whose columns the following quotation is taken:

He endeared himself not only to those of his own field of science, which has to do largely with the past, but also to scientists in every field and to the people of the State generally, because of his intelligent, practical and helpful interest in everything in the realm of nature under, about and above man's daily life. He was the best friend of the birds, the trees, and the wild flowers. He was concerned even for the migratory birds that flew across the State, and he followed them to their homes in the Gaspé or elsewhere to protect them there. And though a scientist of the highest standing, he still insisted that Pan is not dead. "I have seen him oft," he said, "among the forests of the mountains," and heard him "rustling through the iris swamps" or caught a glimpse of him "in the shadows of the salmon pool or coming down the lavender banks of evening." He had not only the scientific eyes to see beneath the surface of the earth, but the ears to hear the "reedy pipes" that "sing everything that can be sung" and "tell everything that can be told."

During the Sixty-first Convocation of the University of the State of New York, the evening of October 15, 1925, was devoted to memorial exercises for Doctor Clarke, the speakers

being the president of the University, Doctor Frank Pierrepont Graves, the Honorable William G. Rice, State Civil Service Commissioner, and Doctor Charles D. Walcott, secretary of the Smithsonian Institution. On this occasion, President Graves said:

In the death of John Mason Clarke the scientific world has lost its greatest paleontologist; the United States its most brilliant literary scientist; the State of New York its foremost champion of historic monuments, scenic beauty, and natural resources; the department of education its most distinguished scholar, its foremost intellect, and its chief ornament; and each of its members his most admired and inspiring friend. It is possible that his equal may some time in the future enter this building to serve the state and the cause of scholarship and science, but this good fortune is scarcely to be expected.

Secretary Walcott also said, in part:

New York State owes to Dr. Clarke an eternal debt of gratitude for preserving the records of its scientific activities of ninety years or more, and for developing and carrying on, as a part of the educational system of the State, a museum unexcelled among State museums. James Hall, the founder of the museum and the great scientific leader of New York State for fifty years, died with the impression that there was no one who would take sufficient interest to carry it forward as an educational factor in the life of the oncoming generations of the people of the State. He did not fully realize that the young man who had been associated with him for years had all the qualities essential to successfully sustain the work of the world-renowned State Geological Survey, and the up-building of a model State Museum. Dr. Clarke, by birth, training, ability, and spirit, was the ideal successor of James Hall, and it is to the honor and credit of the Regents of the University that they recognized his ability and fitness for the task and assigned it to him. Dr. Clarke effectively carried on a most important and valuable work, yet so quietly and modestly was it done that even those closely associated with him did not fully realize the contribution that he was making to science and to the reputation of the people of the State. His passing is a distinct loss to scientific interests in America, and to intelligent humanity throughout the world. The influence of such a personality extends through the medium of kindred minds to the men and women and to the boys and girls who are to be the future leaders and guardians of the material and spiritual welfare of the people of every nation.

PERSONALITY

Clarke stood about five feet nine inches, was sparely built, and probably at no time weighed more than 150 pounds. Dark

of complexion and blue of eye, he had a well balanced head and face, with a thin head of dark hair. In earlier life he wore a small mustache, but later on his face was clean shaven. Probably his most striking facial feature was his brilliant, alert, and flashing blue eyes, which portrayed much of the momentary feelings of the inner man; they were set in a face that even though rarely sad or stern, was not a smiling one. Ambitious, jealous of the New York Devonian, perhaps unduly suspicious at times, strong in likes and dislikes and quick of temper, he was easily aroused, and his face, and especially his eyes, changed with his mood. However, he usually had these phases of his make-up under good control. He was a great tease, and particularly brilliant in the company of ladies, delighting in the give and take of repartee, in which he was rarely outdone. He was richly endowed with imagination, which had its full play in his last book, "L'île Percée" (1923). Of sarcasm he had much, and woe unto the man who angered him into action! Always well groomed, eloquent in speech, pleasing in manner, and deliberate in action, he moved easily in society with the unconscious ease of one to the manner born.

Mentally, Clarke was brilliant, alert, orderly, and well trained. Always a lover of the worth-while in life, the beautiful in nature and art, and ever a hard worker, he quickly became a prodigious producer of excellent paleontologic and stratigraphic results. These qualities made of him also a collector of antique ceramics and furniture, and historian of the fisher-folk of Quebec, and they were reflected even more strongly in the unusual character of the museum under his direction, which is probably his best monument.

Clarke's ideals in science were of the highest, and his leanings were decidedly toward pure science rather than the applied aspects. At times he was very outspoken in this matter, lamenting that so few geologists nowadays go into science for the love of the work, and that most men take up the subject as a means toward a better living. This will of course always be so in most instances, and yet there is no denying that the tendency in the United States has long been alarming, and especially since 1914. Ever since the Great War our universi-

ties have found a marked dearth of good men to take up teaching, and the surveys look in vain for leading geologists and paleontologists. Accordingly, to make himself felt in this matter, Clarke at times overstated the situation, giving rise to ill feelings. On the other hand, he fully understood that the mining world can pay higher salaries to good men than can the universities and surveys, and yet it can not be said of him that as director of the Geological Survey of New York he neglected to develop the natural resources of the State. Certainly he did for the mining and engineering worlds ever so much more than did his predecessor.

Even though the New York State Survey and the Museum have long been under the guidance of the Regents of the University of the State of New York, the appropriations for their maintenance have to come through the state legislature. Therefore both Hall and Clarke have seen much of the regulation statesmen and their humorous, if not always wise, ways of doing things for science. Hall rarely was the gentle mixer with people, but his great prestige in science generally assured him success with the legislature. Clarke, on the other hand, had the gift of making good addresses and of meeting easily men of importance, and this, together with his caution in keeping abreast of coming events among the powers that are and are to be, made him a tower of strength behind the Regents. He was therefore much more successful in making things possible in the Science Division of the University than any of his predecessors.

ANCESTRY

During the years previous to 1892, Clarke was searching out his family history, and in this year he completed the task and transcribed the information by hand on twenty-five cards 6 x 3 inches that were later bound into a leather-covered booklet. Before it was finished he showed it to me one Thursday evening, and I now have this treasure again in my hands. Illuminated and embellished with tail pieces and with two signatures of the ancestral Clarke, and with two well executed full-page line drawings of the New Hospital at Plymouth, Devon, and of the site of Lieutenant Clarke's house in Northampton, the three

chapters and three appendices of the booklet are done in the style of composition and spelling of the early Colonial days, forming an interesting example of Clarke's painstaking care and artistic skill, wrought out for the eyes of his family only. It is entitled "A Fragment of the Life of Lieut. William Clarke, Puritan and Pioneer: An Early Member of the Massachusetts-Bay Colony settling on the Dorchester Plantation and afterward removing to Northampton. He lived an Honoured and Useful Life and founded a Large Family in a New World: To a few of his Descendants these pages are indited. The Tuyck, 1892." Much of what follows is taken from this booklet.

On the twentieth of March, 1630, there sailed from Plymouth, in Devon, the ship "Mary and John," a vessel of 400 tons, with 140 men and women of the East Anglian yeomanry, bound for the Charles River in the Colony of Massachusetts Bay. They were set ashore at Nantasket, now Hull, on the thirtieth of May, 1630, and shortly afterward most of them located at Dorchester Plantation, the second oldest settlement in the colony.

In this party was William Clarke, of pure English strain, although nothing further is now known of his ancestry. It is, however, the booklet adds, "fair to presume that the subject of this sketch was a young man of honour and probity, whose mind had been profoundly moved by the theological controversies of the age. . . . In his days he was a tiller of the soil, though withal a vigorous man of affairs."

There is no other record of William Clarke until June 23, 1636, when his name appears on the church records at Dorchester, together with that of his wife, Sarah, who was probably also of the "Mary and John" party. They lived at Dorchester for twenty-one years, tilling the land and raising a family of ten children. Then all of them moved to a newly arisen center that soon came to be known as Northampton.

The journey from Dorchester to the Connecticut Valley, made in 1659, was a plunge into an Indian-ridden wilderness. Mr. Clarke was then fifty years old, and made the way on foot, his wife riding horseback. "Panniers slung across the horse held each a baby, one the little William (whence our line is derived), the other the infant Sarah." The journey accomplished, Mr.

Clarke took possession of the twelve acres assigned him by the selectmen in the western part of the town on land which is now occupied by a part of the Smith College buildings. Here he built a log house, and later, on the river front, grist and saw mills, and here he lived for twenty years.

Life in the little settlement of some forty persons "was not only primitive and agricultural, but dangerous as well, for the savages did not treat these settlers with the uniform kindness shown to those at Dorchester, but their murderous onslaughts were disturbing and not infrequent. The town was at once obliged in self-defense to organize a military company, of which Mr. Clarke was chosen Lieutenant, the highest secular honour in the power of the little hamlet." Other honors came quickly, and for seventeen years he was representative at the General Court at Boston, and justice of the peace for a long period.

Lieutenant Clarke's descendants prospered, and the line of seven generations terminating in Noah Turner Clarke, the father of the subject of this sketch, was prolific, each generation furnishing about ten children. The line proceeds through five successive William Clarkes, spreading from Northampton to Lebanon and thence to Windsor in Connecticut.

William Clarke the fifth was a member of the Continental Congress, fought at Lexington and at Bennington, and after the Revolution moved by oxcart to the "Seneca Country," where he was one of the founders of Naples. It is interesting to make a slight digression here to note the cause for this migration. All of New York west of Seneca Lake originally belonged to Massachusetts, but she sold her rights to one million acres to Oliver Phelps and Nathaniel Gorham. They in turn sold these lands to the veterans of the Revolution, and to citizens of Massachusetts and Connecticut. Thus it came about, as Clarke says, that "these early villages were bits taken out of the Puritan atmosphere and set down in western New York," where Canandaigua and Geneva became "dignified centers of education and refinement."

The ninth child of William Clarke the fifth, born at Windsor in 1787, was Lorenzo Clarke, whose second child, born at Naples on April 8, 1817 (died 1898) was Noah Turner Clarke.

Noah Clarke married Laura Mason Merrill, and they had six children, of whom John Mason was the fifth.

In the booklet above referred to, Doctor Clarke writes further: "There was another man aboard the 'Mary and John' in whom we (I say this to my next of kin) have an equal interest. I mean Mr. (afterward Captain and Major) John Mason, some time resident of Dorchester, later the doughty fighter in the Pequot Wars." He soon moved to Windsor, as did the Clarkes, and from the family which he founded came Laura Mason Merrill, the mother of Doctor Clarke. Major Mason was born in England about 1600, came to this country, as we have seen, in 1630, played a prominent part in the struggle against the Pequot, founded the town of Norwich, Connecticut, and died there in 1672.

John Mason the second, we learn from data furnished by Noah T. Clarke, married in 1786 Sally Woodward, direct descendant in the fifth generation of Governor Bradford of Plymouth Colony and Alice Southworth, his wife. He had eleven children by Sally Woodward, of whom the fifth was Laura Mason, born at Castleton, Vermont, in 1796, and married in 1819 to Selah Higley Merrill, a lawyer of Castleton, son of Enos Merrill and of Delight Higley, a scion of the Brewster family of Plymouth. Mrs. Merrill died on July 9, 1820, four days after the birth of her daughter Laura. The child was brought up by her mother's sister, Altha Stevens Mason, who was the widow of Aaron Dana and who eventually went to live with the Clarke family at Canandaigua, dying there in 1880 at the age of eighty-six.

Another aunt, Sarah Mason, married Gideon Davison of Saratoga Springs, and Laura Merrill spent part of her girlhood in that village, going to school there. A third aunt, Margaret Fanning Mason, married Henry Howe, who became resident principal of Canandaigua Academy, and with this family the girl Laura resided later, going to school at the Ontario Female Seminary. In 1846 she was married to Noah Turner Clarke, then associate principal of the academy at Canandaigua. She died in that village on November 5, 1887, her husband and all her six children surviving her.

YOUTH AND RISE INTO GEOLOGY

John Mason Clarke, the fifth in a family of six children, was born in the beautiful lake resort of Canandaigua, New York, on April 15, 1857. His father, Noah Turner Clarke, was for fifty years a teacher of science, and for nearly thirty years principal of the Canandaigua Academy. The boy John not only got his first schooling in the Academy building, but was actually born there, since his father did not begin to erect the Clarke homestead until 1858, and occupied it first in 1859.

Noah Clarke, at the age of twenty-one (1838), got his first experience in geology from James Hall's field assistant, Eben N. Horsford, who was born and raised in the Genesee Valley. "The latter found in Clarke a young school teacher of just his own age, a native of the place, interested in everything out of doors, and to him he appealed for guidance through the gullies and over the hills of the region. . . . The young schoolmaster afterward became a student in chemistry for one year under Horsford at Harvard" (Life of James Hall, p. 74). In 1870, Noah Clarke found a nest of early Upper Devonian crinoids, one of which Hall named after him (*Melocrinus clarkei*). The Clarke family, therefore, had long been interested in the geology of New York, in fact ever since the organization of the State Geological Survey by Governor Clinton.

Of Clarke's boyhood, his sister, Miss Clara Mason Clarke, has this to say:

It seems to me John was always picking up "stones." When our home was built, the yard had just been filled in and "cowhorns" and "shells" were numerous. As a lad he used to trudge off with his bag and hammer to investigate some gully or lake shore. . . . He was particularly fortunate in finding trilobites, and my sharp-pointed black pins were greatly in demand for picking away the rock, so that the trilobite should stand out as it originally was.

His younger brother, Rev. L. Mason Clarke, adds:

When he and I were not more than seven and five, respectively, we were interested in cutting out pictures of all sorts of animals which came with the big circus and menagerie posters, then in common use.

We arranged them in match boxes, the long, old-fashioned blue ones, and tied the boxes with string and drew them along the hall floor as a procession, and John would learn all he could about the varieties and discourse more or less to me about them. He began his first "finds" in our old garden. John would hoe up spear and arrow heads. . . . He was always very sharp-eyed and could see something where I could not: . . . Of course Father was a good deal the same way and John found considerable encouragement from Dad, who as a surveyor was usually digging up something curious in the way of fossils. John was ever collecting; he had it in his system. . . . He always was a leader in what he undertook, even as a child. Born a Nature-enthusiast, yet even as a child he was always alert for other things.

Fortunately for us, Clarke himself wrote out the history of his earliest days, working on this at different times, particularly in 1904 and 1917. From this account we learn that shortly after his father moved into the new home a well was dug, and on the pile of Hamilton shales thrown out young Clarke collected his first fossils. He got in abundance "cowhorns" (cup corals) and "shells." He goes on to say:

I can see now the blue paper match boxes which contained these treasures lying on the shelves of the closet off my sleeping room. Too young for a teacher or for an intelligent appreciation of these things, an instinct seemed to guide me in their acquisition, and after every ploughing of the large garden I forked over the soil searching for such fossils as the loose stone would afford, and over the gathered heaps of stone which had been brought together to clear the soil. I presume my blue boxes date back to a time when I was not more than seven years old, but I must have been ten when my father, who encouraged every impulse in me in this direction, put me in possession of Hugh Miller's writings and Hitchcock's "Text-book of Geology." The texts were too much for me, but the pictures in Hitchcock were an inspiration. In it on one page was the picture of a "Silurian trilobite," on another a "Devonian trilobite." My father's house was built on a high cellar wall made of large field stones, crystalline boulders and blocks of Coniferous limestone. The corner stones were of larger size and all of the latter kind, full of the fossil remains with which that rock abounds. I could never in later years get my father to remember, though clear enough to me even now, a day when I eagerly called him to one of these corner stones to show him where I had found a "Silurian trilobite" and a "Devonian trilobite" in the same block!

In 1923, in his eloquent "L'Île Percée," Clarke comes back to the Hugh Miller of his youth:

Hugh Miller's books were my earliest guides in geology—I will not say inspiration, for some of them were pretty hard reading for a boy, but after all he made his odd fish rather attractive by his extraordinary descriptive powers and his trenchant English style. . . . My debt to him was a personal one.

To go back now to the 1904 account:

In a desultory way as opportunity afforded between the later demands of school, and as the inspiration caught me, though laid aside at times, my interest in this collecting of fossils continued and became a productive pursuit as soon as I had learned how to make use of the volumes of the Paleontology of New York. [This was in the early seventies.] My home region was most beautifully supplied with the objects of my search, the shale cliffs along the shores and the ravines of the lake teemed with fossils, and I was in great measure solely a creature of my environment.

The region of Clarke's home is in the type area of the New York Devonian,

the simplest, most lucid and most complete development of one great geological system, the Devonian, that the world has ever revealed. . . . The rocks of the country overflowed with fossils, often in beautiful preservation. They showed themselves in the stone fences and farm foundations; they lay loose along the streams and on the shores of the Finger Lakes; and they protruded from the rocks on the edges of the cliffs. So ubiquitous were they that the Seneca Indians used the fossil cup corals for pipes, strung together the joints of crinoid stems into necklaces, and buried brachiopod shells along with axes and spear points in the graves of their brave.

Beside the daily strenuous demands of school these natural proclivities had no standing and were pushed into the background. But the break in the routine permitted me to indulge a growing interest in the mollusca of the region, and before leaving for college I had got together the mollusk fauna quite completely, both of lake, stream and woodland. When my good father sent me [1874] in turn to college at the cost of all he could get together, for there were four of us in succession, my zeal lay dormant or was for a while snowed under by the Latin and Greek and mathematics of the old-time course. I would not to-day surrender the little I have retained of the former for a good slice of my store of science. Not till I arrived at junior year and the course of gentlemanly and refined discourses on mineralogy by Professor C. U. Shepard in which the students were allowed to look at but not to handle specimens, did my suppressed love break out in full force.

In his "Sketch" of 1917, he says:

Entering Amherst College in 1874, I fought bravely against the handicap of a poor preparation in Greek, warmed reasonably to my Latin, was dead in mathematics;. . . it was not until I reached the courses in geology, mineralogy and zoology given by the distinguished Professor Benjamin K. Emerson, that my love for natural science, born long before, had a new birth. . . Thus I got my start and left college [at the age of twenty years] with the class of 1877, the best of its kind.

The first year out of college [1877-1878] was on the home ground, teaching in the Academy anything that came my way and diligently pursuing the study of the local geology. I had now become methodical. I collected from the Hamilton rocks with the greatest diligence and in profusion, plotting the vertical range of every species and these to the number of 300-400.

It was in this year that Clarke met D. Dana Luther, an amateur geologist living at Naples, of whom he goes on to say:

Like interest in the mysteries of the rocks brought us together. One the staid, wise and cautious man, and the other a young, trained enthusiast. One had nothing else to do and both everything to learn. With his acquaintance came long summers together of excursions into all the rocks of western New York.

Continuing the discussion of his stratigraphic work, he says:

On this basis I sought to establish a zonal division of these strata by faunules. . . . It was the first attempt of the kind, I think, on the Paleozoic rocks of New York, and though the homogeneous Hamilton shales did not well lend themselves to this effort, yet in a fair degree this end was obtained.

Clarke did not begin to publish these stratigraphic results until 1885. In the meantime, H. S. Williams had been appointed to the chair of geology at Cornell (1880) and his publications of 1881-1882 show that he also was studying fossil faunas as units for investigation in the Ithaca region. It therefore appears that these two paleontologists independently discovered the value of zonal stratigraphy, though Williams, who was ten years older than Clarke, got into print about three years earlier.

In the autumn of 1878 I was called back to Amherst as assistant to Professor Emerson, and part of my work while there was to arrange the great C. U. Shepard collection of minerals which was next year destroyed by fire, and also the extensive C. B. Adams collection of Mollusca, out of which I culled an extensive familiarity with molluscan species and prided myself somewhat on the fact that I could then recognize and give the names of a thousand species at sight. While thus

engaged I wrote my first paper in a scientific journal (*American Journal of Science*) upon the discovery of a rare molluscan genus [*Gundlachia*] in western New York.

Now burning with the fires and fairly well along in my training, I returned to Canandaigua Academy for another year [1879-1880] of teaching and of geological work in the country side. My collections had grown to commanding proportions and ever crowded upon the space available for them in the old home.

In the autumn of 1880 I became teacher of science in the Utica Free Academy, succeeding the late George H. Williams, my collegemate and co-worker at Amherst in graduate work. Then in 1881-1882, on the recommendation of Professor Emerson, I was invited to go to Smith College as instructor in Geology, Mineralogy, Zoology and Botany. I demurred to the botany, and to the salary. Of the former I knew but little and the latter was no improvement on that in hand. The trustees met my objections most freely and thither I went. . . .

At my second year there I was made professor, and the end of this year [1883] I retired, having determined to wait no longer for my long hoped for experience in Germany. My withdrawal was regarded as temporary and with expectation on part of the president and myself of return.

In the summer of 1883 I went to Göttingen and joined Von Koenen, and returned in October, 1884. These days made history for me and will ever be filled with happiest recollections. I returned to Northampton to give the instruction in geology which had been cut down during my absence and the position curtailed by the establishment of a professorship of biology.

Just before Clarke was ready to return to America, I learn from his son Noah, he received a letter from President Seelye of Smith, accusing him of heterodoxy, and closing with the statement that Smith did not require his services longer. This was a direct violation of Clarke's agreement, but what was he to do under the circumstances? The change cut short his hopes of continuing his studies at Göttingen and of obtaining the doctor's degree in course. During the school year 1884-1885, therefore, Clarke gave instruction in geology, zoology, and German at the Massachusetts Agricultural College at Amherst. Then followed days of waiting at Canandaigua, where he continued to work on the Upper Devonian (mainly the Naples fauna), a study begun in the summer of 1877 and intended as his dissertation at Göttingen. Out of employment, he appealed for work to James Hall, whom he had known since 1875. His

persistence was rewarded, through the strenuous assistance of a state senator, and on January 1, 1886, he became assistant to the man who was then the master paleontologist of the country.

Clarke's entry into Hall's service is described in his "Life of James Hall," as follows:

In the autumn of 1885, I came to Albany partly to attend, so far as I might be permitted, a meeting of the National Academy of Sciences . . . but more particularly to show to Professor Hall and Mr. Beecher a quantity of new things in trilobite and crustacean lines which I had been extracting from the Devonian rocks in western New York. . . . The trilobites made so effective an appeal that I was to join the force at once and trust to good luck to edge my way into the service. On the first of January, 1886, nine o'clock in the morning found me in front of the great stove in Mr. Hall's "office" on the Beaverkill, trying to dry my soaked clothes after a rough tramp of two miles through a foot of freshly fallen snow. No one else was there; but presently the ruddy Santa Claus of Hall's figure coming in from breakfast appeared through the door, and with a gray look of surprise in his spectacles as he saw me by the stove, he said: "Oh, yes. How do you do? Could you lend me two dollars?" Then began my association of twelve years with this extraordinary man [then 79 years old] whom I had known slightly for ten years past but whose equations I had yet to learn.

The office assigned Clarke in the State Hall he occupied for twenty-five years, until he moved into the Education Building.

MUSEUM CAREER

From January first, 1886, until his death in 1925, Clarke was connected with the Geological Survey of New York, rising to the position of State Paleontologist in 1898, and in 1904 to that of State Geologist and Paleontologist and Director of the State Museum and of the Science Division of the Education Department. From 1894 on, he was also professor of Geology and Mineralogy at the Rensselaer Polytechnic Institute in Troy. Of these appointments, that to the directorship of the Science Division was the most significant one in his life, since now he had not only inherited Hall's official mantle, but added a great deal more. As he says:

This position involved not only the State Museum, but as well the research departments in Entomology, Botany, Zoology, and Archeology. My time had now to be divided between my special scientific interests and the creation of a new State Museum.

In 1907 and 1909, Clarke was also working toward a State Historical Museum, and his plan for it was distributed to all the historical societies in New York, and to others. Its growth was to come gradually through the present museum, and a beginning was made with Ethnology. Shortly afterward, a gift of \$15,000 from Mrs. F. F. Thompson made possible the installation of the "Governor Myron H. Clark Museum of Iroquois Ethnology," now represented in the Museum by six large cases showing the family and religious life of these Indians in a manner unsurpassed elsewhere. In 1908 the Museum was made the keeper of all the wampums of the Iroquois Confederacy, and the director was given the title of Ho-san-na-ga-da, "Keeper of the Name."

The needs of the rapidly growing museum and of the other divisions of the University brought about the construction of the great Education Building, which was completed in 1913. In the autumn of that year, the Museum began to move into its new quarters, which occupied the entire upper floor, with 60,000 square feet of space. One-half of this space is devoted to Geology and Paleontology, an expansion that brought about an increase of staff and a modernization of the grand collections. The dedication of the building took place on December 29, 1916, before the assembled geologists of the country, who were addressed by Theodore Roosevelt. This was the proudest day in Clarke's life.

New York now has the best state museum in America, with the finest array of highly significant Paleozoic fossils. In invertebrate paleontology, it possesses one of the world's most valuable collections, containing upward of 7,000 type specimens, and constituting a mecca to which all students of the older Paleozoic go for inspiration and interpretation. Clarke also inaugurated the plan for the very artistic and lifelike restorations of Ordovician, Silurian, and Devonian marine assemblages of New York, now shown in the Museum, and this type of installation and teaching had its culmination in February, 1925, when he placed before the public a reproduction of the Gilboa Devonian forest, a living picture of the first flora to clothe Mother Earth. The creation of this attractive State Museum

Clarke regarded as his chief contribution to the civic and educational development of his state.

Clarke also planned and put into execution, with expert aid, the splendid volumes entitled "Birds of New York" and "Wild Flowers of New York," both of which have done great service to the people of the State, especially through their widely distributed cheaper editions. He established, with the support of the president of the University, the annual State Bird Day, and the annual courses of free public lectures given in the Museum.

Another service to the State which Clarke brought about was the acquisition of "unique or remarkable bits of geological scenery of high educational value . . . endangered by the progress of settlement or industry." He began this movement for the protection of natural monuments in 1908, and his first result came five years later with the gift by Mrs. J. B. Thacher of 350 acres to establish Indian Ladder Park, west of Albany, where the actual base of the Devonian can be studied to best advantage. Soon followed Lester Park, near Saratoga, showing in a striking way the Upper Cambrian algaoid ledges; the Myron H. Clark Reservation, a glacial park near Syracuse, showing, among other effects of glaciation, the making of a wall over which dropped falls that were nearly as grand as Niagara; and the Starks Knob Reservation, near Schuylerville, with its long extinct volcano. There are now six of these parks or reservations under the administration of the New York State Museum.

Clarke dreamed of a yet greater state museum, a central one covering the entire field of museum interest within the scope of the State, with full supervising control of local museums. The statutory conception of a New York State Museum, he said in 1913, is "any public museum which the people of the State may choose to bring into existence, whether it be a museum of history, of art, of industry, or of education." It was, however, not to be a world or metropolitan museum, but one solely devoted to the things of the State. Clarke's plan for this great conception was completed in 1916, and presented to the assembled geologists at their Albany meeting, and in 1922 the Regents had received favorable consideration from the State

Roosevelt Memorial Commission. But his dream, when its fulfillment seemed almost at hand, was for the time set aside by the legislature of that year, when it voted two and one-half million dollars for a Roosevelt Memorial to be connected with the American Museum of Natural History in New York City. This act of the legislature broke Clarke's administrative spirit, and ever afterward he failed to show his former strength of planning and the dash so characteristic of him. As Walcott said in his memorial, "He felt most keenly and grieved to the end of his life that the effort to deprive the capital of the State of a great memorial to its former governor and foremost citizen of his time, Theodore Roosevelt, should have been successful."

STATE SURVEY

While Clarke had charge of the Geological Survey of New York (1898-1925), with the aid of a competent staff nearly one-half of the State was geologically mapped on the scale of one mile to the inch, and the mineral wealth exploited. Summoning to his assistance the best experts available, and issuing their results in something like seventy bulletins, he brought the knowledge of New York geology, its rock structure, its marvelous fossil record, and its mineral industry to a condition that makes it safe to say that no equal area of 50,000 square miles in the world is so completely known and understood. Among those who did most of this work may be mentioned D. Dana Luther, James F. Kemp, H. P. Cushing, Rudolf Ruedemann, W. J. Miller, H. L. Fairchild, H. P. Whitlock, D. H. Newland, J. B. Woodworth, A. W. Grabau, G. H. Chadwick, and others.

GASPESIA

No sketch of John M. Clarke, man or geologist, would be complete without recording the second great passion of his life, that for his beloved Gaspé. Attracted first to this far eastern portion of Quebec by the promise of geologic riches, he found besides a land of vivid beauty, discovered by Cartier in 1534, and peopled by fisher folk whose simplicity of living and traditions of hospitality spell peace to men weary of the strife of

the market place. It was not strange, therefore, that he returned to Gaspé summer after summer, tramping its shores for three hundred miles, and living among the people of the coast, so that few knew the country, its human records, and its natural history, as he did. His interpretation of the geology is dealt with later in a discussion of his scientific work, but here we may pause to mention the two books in which his mastery of style finds itself at its best—both born of Gaspé. Few regions of the earth have had so ardent an interpreter, in whose pages the wonders of the geologic past, the marvelous beauty of land and sea, the stately days of the Seigneury, and the quaint customs of the present day mingle with equal warmth and color. "The Heart of Gaspé," published in 1913, and the even more charming "L'Île Percée" of ten years later constitute an important contribution to literature as well as to history and science.

In studying the history of Gaspé, Clarke helped to locate the site of the old French Customs House occupied by the Intendant, M. Revolte, and destroyed by Wolfe in 1758, and to dig out from the sands of the peninsula where it stood the relics of the old régime now in the Chateau de Ramezay. From Cap des Rosiers he took the Cartier medallion, and from Bonaventure Island he had the old freebooter Duval's cutlass with its gold plated brass mountings, and its beautiful damascened and inlaid blade, carrying the royal arms and the monogram of George III heavily worked into the hilt. Later he felt that the latter reminder of pioneer days should remain at Percé among the old families who knew the local history, and so he gave it to the leading merchant of the village, Mr. Charles Biard.

Clarke's interest in old china also found a new field in Gaspé, and, as he says, "led to the acquisition, at a time when no one else was interested, of a large collection of the old wares of the people." His publications on ceramics include "English Gold Lustres" and "the Swiss Influence on the Early Pennsylvania Slip Decorated Majolica," both privately printed at Albany in 1908.

Clarke actively concerned himself to arouse provincial and federal interest in the preservation of the waterfowl nesting

places on Percé Rock, Bonaventure Island, and the Bird Rocks of the Magdalen Islands off Gaspé. He visited the Magdalens frequently, and wrote accounts of their geology and history. In recognition of his interest in Gaspé, the Quebec Board of Geographic Names in 1917 attached his name to a township covering the upper reaches and great salmon pools of the Grand Cascapedia River.

OTHER PUBLIC ACTS

Clarke's strong historical sense is again seen in his placing of memorial tablets. This began in 1901, when he and a few of his associates placed on the home of Ebenezer Emmons on Hudson Avenue and High Street in Albany a tablet commemorating the fact that in this house in 1838-1839 was started the Association of American Geologists, the parent body of the American Association for the Advancement of Science. In 1908 he placed a tablet in Letchworth Park near the Portage cataracts on the upper Genesee to commemorate the first geologic work done by James Hall in western New York in 1839-1843. Five years later, through his efforts, Logan Park was set aside in Gaspé, and here he unveiled before the geologists of the Twelfth International Geological Congress a bronze tablet memorializing Sir William Logan's pioneer field work in eastern Canada. In 1916, at the meeting of the Association of American State Geologists, a memorial tablet was placed on Hall's private museum in Beaver (now Lincoln) Park in Albany. The grandest memorial of all, however, is to be unveiled this autumn (1928) in front of the old Albany Institute during the convocation of the University of the State of New York—a large bronze statue of Joseph Henry, the first secretary of the Smithsonian Institution, who was a native of Albany. Clarke started the movement for this memorial in 1916, raising \$25,000, and he was to have made the unveiling speech.

Clarke was always much interested in the welfare of the city of Albany. Here he did much to rehabilitate the Albany Institute, one of the oldest scientific societies in the country, and was its president for many years. He was also president of both the Historical and Art societies, and they thrived greatly

under his care, as did the Burns Club and the Walter Scott Memorial Association. He helped and cheered on the good work of the ladies of the Dana Natural History Society; was trustee of the Schuyler Mansion, and from 1916 on, of the Dudley Observatory. A member of the Fort Orange Council of the Boy Scouts, as well as of the National Council, he arranged for the Mayflower Medal to be awarded each year to the scout showing the best knowledge of the local history.

Clarke's championship of the need of preservation of scenic beauty was best exemplified in the case of Niagara Falls; as he so well says:

The claim of the higher life, the demands of the finer emotions, the love for the beautiful in nature, express themselves in part in the government protection of natural wonders from defacement and destruction; in organizations created to keep alive this sentiment and extend the ægis of the State over natural glories which belong to mankind rather than to men. No wise man confesses himself devoid of such emotions. The violation of this principle in present practice offends the best sentiments of the race.

The "menace to Niagara" resulting from the desire of the power companies to utilize the falls, Clarke was one of the first to point out. The danger had long been threatening, and in 1904 the fight culminated in the New York Assembly. Clarke stood out against it, and in public addresses and otherwise pointed out that—

The conservation of Niagara Falls is a question of public morals. About 800,000 tourists visit the Falls each year, and their number demonstrates how closely the interest of the whole world is focussed on Niagara, for these visitors are representatives of every nation. How many hundreds of thousands will seek out Niagara when the world learns that the Delilah of commerce has shorn it of its glory? Will they traverse the seas to behold the wonders of a breakfast-food factory, or any other industrial triumph? These are everywhere; Niagara is unique.

This battle, in which Clarke played so large a part, was won by the conservationists, and a treaty has been made with Great Britain, keeping the water of the Falls under reasonable control.

In 1902, Clarke was delegated by the Geological Society

of America to represent that body at the dedication of a memorial to Hugh Miller, the Scotch quarryman, newspaperman, and geologist, who had been in some measure the inspiration of his youth, and for whose memorial—the Hugh Miller Museum at Cromarty—he had raised a considerable sum from the Scot's American admirers. At a later day, and as an appropriate cis-Atlantic memorial to Miller, Clarke proposed the name "Hugh Miller Cliffs" for the Devonian fish beds at Migouasha, a name accepted by the Quebec Geographic Board. Of these cliffs Clarke writes in "L'Île Percée":

The Hugh Miller Cliffs are planted on French Catholic soil but their face looks sternly out over the river to Scotch Presbyterian New Brunswick. There one may stand on the shores where the salmon now run and from the rocks extract their odd, heavily armored ancestors, which might have died of their mongrel Greek names if a merciful nature had not put them to a kinder death. Among them was the magnificent Eusthenopteron (*pardi!*), which is as fine a salmon as the "Auld Red" ever produced. Hundreds of specimens of these ancient fishes have been taken from these rocks and thousands remain for him who will search them. My hammer never touched a rock with a more inspiring impact than here. Fishing! At every "cast" of the weapon some fish rises, or mayhap a fern-leaf gets tangled in the tackle. And this is the sort of fish one can ship to his friends without hurry or ice; they will not spoil after their millions of years of storage.

BIOGRAPHIES

With a strong historic turn of mind, it was but natural that Clarke should be an excellent biographer. This is only too apparent in the sketches which he has given us of G. H. Williams, G. B. Simpson, C. E. Beecher, J. C. K. Laflamme, R. P. Whitfield, N. H. Winchell, H. C. Hovey, C. S. Prosser, W. B. Clark, James Eights, H. P. Cushing, James Hall, and Archibald Geikie. The tribute to his old chief, published in 1921, a book of 565 pages, is in a class by itself. Hall was a youth of 25 years when he entered the service of New York and seven years past fourscore when that service ceased. In the biography, Clarke portrays "the man as he was; the influences that guided him and that he imparted; the work he did and the manner of doing it; the friendships he made and the esteem he won." Written in an animated style, eloquent in diction, replete with

humor and anecdote, it shows us not only what manner of man Hall was and the tremendous amount of work he did, but also the men with whom he worked and those with whom he came into direct contact. It is, in fact, one of the two best contributions to the history of North American geology and paleontology, set in a background of these sciences in Europe. Reading it, we are forced to the conclusion that New York State truly has been the "mother of geologists." My review of this book in *Science* pleased Clarke, and he wrote me in one of his letters: "If you don't get your reward on this earth, I'll try to arrange matters with St. Peter so that we can sit together."

HONORS

Of "honors which beautify and crown success," Clarke had many. Four times he was called by leading universities to take their chairs in geology, and each time with a better salary than he received at Albany (Ohio State 1898, Columbia 1900, Yale 1904, and Pennsylvania 1919), but each time he declined, saying that his work was in New York. To his own commonwealth he gave his best as a loyal son, and he was deeply grateful for the liberal support that she gave him in return, as appears again and again in his annual reports to his superior officers.

Clarke was elected to something like fifty scientific and historical societies in this country, Canada, England, Germany, France, and Russia; made an Immortal in the National Academy of Sciences in 1909; elected to membership in the American Philosophical Society, the American Academy of Arts and Sciences, the Geological Society of London, the Authors' Club of London, the Société Russe de Minéralogie. He was vice-president of the Geological Society of America in 1909, and its president seven years later; first president of the Paleontological Society in 1909; received the Prix de Léonide Spindiaroff of the International Geological Congress in 1910 for his work in Gaspé, a gold medal from the Permanent Wild Life Protection Fund in 1920, the Hayden Gold medal of the Philadelphia Academy of Natural Sciences for excellence in geological re-

search in 1908, and the Thompson Gold Medal of the National Academy of Sciences the month before his death.

Of honorary degrees he also had many. Most signal of these, in his own opinion, was the honorary Ph. D. conferred upon him by the University of Marburg in 1898, "done without my knowledge and done so rarely that not half a dozen such degrees are conferred annually by all the German universities together. At the time it was given no American known to me and none now [1904] bears the same degree." Colgate gave him an honorary Sc. D. in 1909, Chicago in 1916, and Princeton in 1919. From his Alma Mater he received the LL. D. in 1892, and from Johns Hopkins in 1915. To all these honors was to have been added another, since letters from Professor Barrois of Lille state that he was to have been made a fellow of the French Academy at its next annual meeting.

PUBLISHED WORK

PALEONTOLOGY AND MORPHOLOGY

After five summers' work in the field, Clarke began to show results, and his first three papers in a scientific journal appeared in 1882 during his professorship at Smith. They have to do with a new species of the living mollusc *Gundlachia*, and with rare specimens of Crustacea—phyllocarids and barnacles—from the New York Devonian. Arthropods were, therefore, his first love among fossils, and they continued all through his life to have for him a dominating interest. In these early papers he bursts upon the scientific world, as it were, as a full-fledged descriptive paleontologist, since they show nothing of the beginner; even then he wrote in a clear and direct fashion which, however, as yet displayed none of the phrase-making, quaintness, love of strange words, and power of embellishment so characteristic of his later writings.

With Clarke's appointment to the New York Survey, his career as a paleontologist and stratigrapher was assured, and from his head and hand there came a continuous stream of the best kind of geologic publications, the great bulk of which have to do with the Devonian and were issued by his native state.

His complete bibliography contains 452 titles, and of these about 300 are of a paleontologic or geologic nature, exclusive of the 76 reviews in the same fields. Together his printed books and papers cover over 10,000 pages, in which he is godfather to 135 new genera and at least 870 new forms; how many species of fossils he studied will probably never be tabulated. At least 3 genera and 42 species are named after him.

Clarke was born on Devonian rocks, and they ever remained the magnet of his endeavors. "The work of a geologist is pre-eminently what his environment makes it." The strongest pulls were those exerted by New York and southeastern Quebec, but he was also attracted by the Devonian of South America, Germany, and Maryland. Probably three-fourths or more of his total output has to do with the paleontology, stratigraphy, and mapping of this period. He long ago became one of the two greatest world authorities on Devonian, the other being Emanuel Kayser of Marburg and Munich, who has also passed away since this memoir was written. Clarke's study of the Upper Devonian faunas of Iberg, Germany, was written at Göttingen while a student of Von Koenen, and it was at this time that he became acquainted with Kayser. His loyalty to these two teachers of his is shown in his contributions to their *Festschriften*: "Evidences of a Coblenzian Invasion in the Devonian of eastern North America" to that of Von Koenen in 1907, and to that of Kayser in 1915, "Conceptions regarding the American Devonian."

BRACHIOPODA

Shortly after Clarke got to Albany (1886), he became deeply interested in some work that Beecher was then doing. It appears that in 1878-1879 C. D. Walcott made extensive collections for the New York State Survey at the famous Silurian locality in Waldron, Indiana, sending Hall about seven tons of fossils and slabs. In washing this material Beecher saved all the freed dirt and so got together a large quantity of minute specimens. He and Clarke, working by lamplight night after night during the years 1886-1887, picked out of these washings about 50,000 baby brachiopods, with lengths ranging from less than 1 up to 5 millimeters. Finally, they culled out 15,000 good

examples which they separated into twenty species, each abundantly represented by specimens. Arranging these in growth or ontogenetic series, they then worked out the appearance of the specific characters. Their results are set forth in "The Development of some Silurian Brachiopoda" (1889). This was probably the first ontogenetic work on fossil brachiopods, and while of an elementary nature, it prepared both authors for a better appreciation of their later studies on this class of organisms. Probably the most striking result was that the inceptive shells, of whatever species, were smooth, only slightly convex, and had a subcircular outline. This led Beecher later on to the discovery that all brachiopods start in life with this kind of shell, which he called the *protegulum*, and since the nearest fossil mature forms are of the genus *Paterina* (*Iphidea*), he called the *protegulum* the *Paterina* growth-stage.

When Clarke had completed the work on the Devonian Crustacea in 1888 (see page 208), Hall wanted him to take up a revision of the species of the Paleozoic Brachiopoda, but the young man had in mind a greater and more philosophic scheme. Their joint planning resulted in a turning away from a study of fossil faunas to a generic one having also to do with the phylogeny and evolution of an entire class. It was in search of material for this work that Hall came to Cincinnati in the summer of 1889, and seeing my large and well identified collection of brachiopods, proposed that I come to Albany as his private assistant, and allow him the use of my private collection—an arrangement that lasted for nearly two and a half years.

Our joint labors resulted in the work entitled "An Introduction to the Study of the Genera of Paleozoic Brachiopoda," by Hall and Clarke, which appeared in 1892 and 1894. In this memoir of 760 pages and about 90 plates, better known as "Paleontology of New York, Volume VIII," 180 old genera are redefined and 58 new ones added, while as a by-product came the description of 57 new species. While the books were in press, the study was extended to a synoptic revision of all the brachiopod genera, living and extinct, along with a summation of the known anatomy of the soft parts in the living species,

and their bathymetric and geographic distribution; it appeared in two octavo volumes under the title "An Introduction to the Study of the Brachiopoda, intended as a Hand-book for the Use of Students," the two parts being issued in 1892 and 1894, respectively. This reworking showed that the class had at least 325 genera and subgenera worthy of recognition. The four books, treating of a group of organisms that has lived since at least the beginning of Cambrian time, form the most comprehensive study ever made of a class of invertebrate fossils, and represent one of Clarke's highest attainments in morphologic and phylogenetic work. Due largely to their stimulus, researches on these organisms throughout the world have resulted in the recognition of almost 700 genera of brachiopods.

CRUSTACEA

When Clarke began his official work under Hall in 1886, he was set to work on his pets, the Crustacea. This study resulted in the memoir usually known as "Devonian Crustacea" (Paleontology of New York, Volume VII, 1888, by Hall and Clarke). In this volume, which included much new material that Clarke had collected in his earlier years and had brought with him from his home, are described 144 species (50 new) in 28 genera (9 new). Of these, 127 species are of the Devonian, 83 forms in 10 genera being of Trilobita. Among them are highly ornate and gigantic forms, the last of a rapidly declining stock. The xiphosurans are represented by 1 species, the eurypterids by 3, phyllocarids by 26 species in 8 genera, decapods by 1, phyllopods by 2, and cirripeds by 11 in 4 genera. Of this volume Clarke said in 1921:

This book on the Crustacea was a substantial descriptive work which has served well, but it attempted nothing serious in the way of classification; it did, however, establish some interesting facts in development or ontogeny.

SPONGES

Finally came what may be regarded as the concluding volume in the series known as "Paleontology of New York." This was "A Memoir on the Paleozoic Reticulate Sponges constitut-

ing the Family Dictyospongiadæ," by Hall and Clarke (1898-1899). Here are described and figured all the late Devonian and Mississippian forms of "glass sponges," of which there are 128 species. It is mainly in New York that the great fossil "sponge plantations" occur. Of new subfamilies there are 7, of new genera 22, and of new species 75, and the whole forms the most elaborated study ever made of Paleozoic sponges.

EURYPTERIDA

The most detailed morphologic, ontogenetic, and phylogenetic study of fossils made by Clarke is the joint memoir with Ruedemann on the eurypterids of New York (1912). It is only locally that these fossils are common and yet thousands of specimens were assembled, probably more than had ever before been brought together, with the result that North America was seen to have 62 species (26 are new), and 46 of these occur in New York. No locality in America ever yielded more material of this interesting group than that in the Silurian (Bertie) at Buffalo. They ranged from the Upper Cambrian into the early Permian, and were marine animals into the Silurian. Then they became euryhaline or able to live in both salt and brackish water, and finally throughout the Devonian and Carboniferous they were small and scarce animals that lived wholly in fresh water. "Some were best adapted to swimming, others to crawling and many to finding their food by grubbing in the mud."

Clarke and Ruedemann had specimens as small as 2 millimeters in length, and the ontogeny of the Eurypterida was shown to agree with that in *Limulus*. Neither line had any direct relationship with the trilobites, and their origin probably goes back to the Proterozoic, the trilobite-crustacean and arachnid lines doubtless having independent origins in chætopod annelids. The order Eurypterida was here divided into Eurypteridæ and Pterygotidæ.

PALEONTOLOGY AND STRATIGRAPHY

SILURIAN-DEVONIAN BOUNDARY

While Clarke was a student in Germany, a lively discussion was going on, centering about Professor Kayser, who had in

1878, 1881, and 1884 raised the question as to the actual boundary between the Silurian and Devonian. The founder of these terms, Murchison, had established neither a top for the one nor a base for the other. In 1889 Clarke spoke to me about the "Hercynfrage," saying that he was writing an account of it, and that, as he saw it, the Lower Helderberg was the base of the Devonian in America. But how to get this paper by our watchful chief, with his quite different views? Long afterward (1915) Clarke wrote:

Hall was so absolutely hostile to the suggested interpretation that in order to even secure publication for this array of evidence, it became necessary to change a possible argument into a neutral statement of facts, and all conclusions into queries.

Hall published the paper, however, in 1889 and I was converted to Clarke's view, namely, that the lower Pentamerus limestone (= Coeymans), and not the Oriskany, as had long been held by Hall and Verneuil, was the base of the Devonian system of rocks. Clarke returned to the discussion in 1891 and 1894 (review of Tschernyschew's "Fauna d. unteren Devon," 1893), holding "that the fauna of the Helderberg division is not Silurian is demonstrated." It was not until 1900 that I got a chance to take a stand on the question in print, and my paper in the *Bulletin* of the Geological Society of America led to another controversy, with Clarke and Schuchert on one side, and Henry Shaler Williams on the other, and it was as a result of this discussion that the two former went to Gaspé, as will be seen further on. The storm clouds have, however, long since blown away, and the Coeymans is accepted as the base of the Devonian on this side of the water. The boundary in continental Europe is now also adjusted on this basis, but in Great Britain, where the Devonian system started, the older geologists are still trying to adjust themselves to the views of the rising generation, namely, that the Ludlow closes the Silurian, and that what is above is Devonian.

ORISKANY FAUNA

In 1892 Beecher found on Becraft Mountain, near Hudson, New York, a new locality for the Oriskany fauna, and one

far more varied than any heretofore known in that State. This discovery Clarke elaborated, and published his conclusions in 1900 in the memoir "The Oriskany Fauna of Becraft Mountain, Columbia County, N. Y." Here are described 113 species, 31 being new. About one-fourth of the fauna is from the Helderbergian below, and ten forms go into the Middle Devonian. The faunal characteristics of the Helderbergian are also analyzed, with the result that everything from the base of the Coeymans up is definitely referred to the Devonian, while a review of the Manlius biota shows that it is still clearly of the Silurian.

GUELPH FAUNA

Until 1903, it was not known to what extent the Guelph faunas occurred in the Lockport limestone of New York. In that year a great deal of material, brought together by several collectors, was elaborated in the memoir by Clarke and Ruedemann entitled "Guelph Fauna in the State of New York." Here it is shown that the Lockport contains two distinct faunas, an older one, the outgrowth of the Rochester below, and the Guelph, which pulsates two or three times from elsewhere into the upper part of the Lockport. This recurrent Guelph fauna has 71 species in New York, and of these the memoir describes 14 as new. It is a fauna composed dominantly of thick-shelled molluscs and some brachiopods, which lived in a shallowing and vanishing, warm and dolomite-making sea, surcharged with salts. The authors trace the extent of this seaway and conclude that the fauna is of northern origin.

DEVONIAN OF GASPÉ

As was said above, in 1900 I had become involved in a controversy with Williams as to the lower boundary of the Devonian, while Clarke a few years earlier had assembled Oriskanian fossils from beds in northern Maine that were said to be Silurian by Williams. Both of us had read the work of Logan and Billings ("Geology of Canada," 1863) on the very long "Siluro-Devonian" section of Gaspé Peninsula in Quebec, where the Silurian was said to pass unbroken into the Devon-

ian. We therefore arranged to see this wonderful record during that summer. Together we first visited the coast of Arisaig, Nova Scotia, then that of Dalhousie, New Brunswick, where Clarke became interested, and this interest grew as we went on to Percé in Quebec, and finally to Gaspé. We then agreed to divide the work between us, Clarke to take the Oriskany equivalents, and I the Helderbergian and Arisaig faunas. In the end, however, Clarke worked out the whole of this Devonian, since there is no Silurian involved in the Gaspé section, while my students and I described the Arisaig Silurian sequence and its faunas.

On this trip of 1900, Clarke told me that he had found in Gaspé what he had long been looking for—a land of quaintness that reminded him of Scotland and the Old Red, both lands of red sandstones and of fish, fossil and recent, reawakening in him memories of his boyhood days and his reading of Hugh Miller's popular books. To this part of the Maritime Provinces, therefore, Clarke returned nearly every summer, and became the high priest of its geology. From 1900 on, he published at least fifteen papers and books on the paleontology and geology of the region, preëminent among which stands his magnum opus, "Early Devonian History of New York and Eastern North America" (1908-1909). These two quarto volumes, comprising upward of 600 pages and 100 plates, treat of the Lower Devonian stratigraphy and faunas of Quebec, New Brunswick, and Maine, fitted into the older background of the equivalent formations of New York and the Appalachian geosyncline. In this faunal study he was concerned with more than 700 species and described about 450, of which 160 were new. We do not see here that degree of paleontologic refinement shown in his study of the Naples fauna, but the stratigraphy and geologic structure of eastern Canada are far more difficult than those of central New York, and, moreover, he was dealing with Lower Devonian faunas and intricate seaways throughout a spread of about 1,500 miles. And even this was not all, for the faunas were also seen against the background of those of western Europe.

Clarke concluded that during Helderbergian and Oriskanian times the Gaspé seas were generating faunal centers that dispersed their life southwestward through the St. Lawrence trough, but that in Hamilton time the migration was reversed.

The Gaspé sequence of strata, as defined by Logan, has 2,000 feet of limestones, divided into eight divisions, and followed by about 7,000 feet of sandstones. The two basal divisions have come to be known as the St. Alban limestone (160 feet thick with a fauna of 51 species), which is followed by the poorly fossiliferous divisions 3 to 6, now called the Cape Bon Ami limestone (1,050 feet, with 11 species), and then by divisions 7 and 8 = Grande Greve limestone (800 feet with 150 forms). The St. Alban series correlates with the Coeymans and New Scotland of New York, while the Grande Greve is mainly Oriskany with some Onondaga. The overlying Gaspé sandstones have, about 1,000 feet above their base, an unmistakable Hamilton fauna (having 48 species of which 14 are new), but higher the fossils are scattering land plants and fishes that do not as yet give the exact age of the higher strata of this thick sandstone sequence, other than that they are Upper Devonian. Then followed intense mountain making—the Acadian Revolution which was succeeded by the accumulation of the Bonaventure land conglomerates to depths ranging up to 1,500 feet in the structural valleys now occupied by the Bay de Chaleur.

All in all, "Early Devonian History of New York and Eastern North America" is not only Clarke's master work, but also one of the most comprehensive faunal studies that we have in America, and shows Clarke to have been among the world's best stratigraphers.

NAPLES FAUNA

As Clarke was intending to go to Germany for a doctorate after he should be graduated from Amherst, he began in the year of his graduation (1877) thinking about subject matter for his dissertation. The Portage group had been thought to be very poor in fossils, but as he and D. D. Luther had found many of them in strata of this age, Clarke concluded to take

up a detailed study of the group and its contained faunules. As we have seen earlier in this paper, his plans for a degree in course in Germany did not come to fruition, and it was not until 1898 that the finished results of his study on the Naples fauna began to appear, and part 2 of the final report was delayed until 1904. In the meantime he had written sixteen other papers on this stratigraphic unit and its faunules. One of these has a great deal of stratal detail not in the two final papers, and this should be borne in mind by the student; it is entitled "The Stratigraphic and Faunal Relations of the Oneonta Sandstones and Shales, the Ithaca and the Portage Groups in Central New York" (1897). In Clarke's "Naples Fauna" we have one of his two best memoirs on faunal and stratigraphic studies, and it is one of the finest examples that a worker in similar fields can set before himself as an ideal to be attained.

The Naples fauna is characterized by *Manticoceras intumescens*, which occurs throughout the 600 feet of strata situated near the base of the Upper Devonian. It is a part of the Portage group, and occurs in two facies—black shales and sandstones—which alternate with one another several times. In eastern New York lay land, while to the west was deepest water, and the typical Naples fauna becomes disentangled from the shore faunas at the meridian of Cayuga, but fails to be present at the west end of the State. It is a distinct biota occurring only in the Genesee province of New York, while farther east is first the Ithaca and then the Oneonta province. The life is peculiar in that it is chiefly of the floating and swimming types, in the main bivalves (cardioconchs and Lunulicardia), cephalopods (mainly goniatites), and gastropods and pteropods. In all there are 153 species, as follows: pelecypods, 72 forms (52 new); cephalopods, 37 (25 new); gastropods, 26 (14 new); brachiopods, 7; and scattering, 11. The work yielded 37 new genera. Clarke says that the warm-water element, the Styliolina faunules, came in from the south, while the main part, with the goniatites, came in from the northwest in a colder water that "laved the northern and eastern shores" of the Appalachian gulf; and that "the proximal path of its

migration lies buried beneath Lake Erie." Finally, that at least the goniatite elements of the Naples fauna had their origin in Timan (arctic Siberia), spread thence down the Cordilleran geosyncline into the Genesee province and from there eastward to Europe. That there is this direct European linkage with the "intumescens fauna" is seen in 18 species in common with the Genesee province, along with at least 19 others having close relationships.

ZONES

Clarke was careful in his studies of faunas to note their differences and to attach definite values to them. For instance, a hemera (Buckman) is the time duration of a guide fossil like *Manticoceras intumescens*, while a zoehemera (Clarke 1898, "Naples Fauna") specifies the duration of a particular faunal province like that of the Naples fauna of western New York. A preunucial fauna (Clarke 1898) is a heralding assemblage of a later, more fully developed fauna, as the Styliolina assemblage in the Genesee is preunucial to the Naples one. The meaning of sequential faunas (Clarke 1898) is self-evident. On the other hand, an indigene fauna (Clarke 1902) is "one which, taking possession of the marine province at an early date, held the ground (subject to variations in its species combination) for a long period, during which may have occurred various minor invasions. . . . Every indigene fauna is alien in its inception."

EVIDENCE OF ICE IN UPPER DEVONIAN TIME

As long ago as 1843, Hall found in the Portage formation of New York grooved and striated surfaces on sandstones that in their courses are "as unbroken as in the glacial or alluvial scratches upon the surface of the present rocky strata." He could not explain these and other surface characters like "mud flows" and "*Fucoides graphica*" (regarded as seaweeds), and they have puzzled all who have seen them. Clarke had noted these markings since his college days, but not until he wrote "Strand and Undertow Markings" in 1918 (1917) did he attempt to explain them. He then said that the "mud flows" were

due to the rilling of water running down a flattened beach slope, and that some of the striations were made by floating algae dragging over the bottom, but that most of the groovings and striations were due to moving shore ice, and that the *Fucoides graphica* were the filled holes made by ice crystals growing in the bottom muds through the formation of ground-ice. "There is then reason for inferring that the late Devonian was a period of cold . . . and may well have created conditions . . . which would give plenty of means for channeling the Devonian strands of New York, by the movement of land ice toward the sea or by the landward thrust of the sea ice back from the water." *Fucoides graphica*, however, is now regarded as the burrow of a marine annelid (see Amer. Jour. Sci. (5), vol. 14, 1927, p. 159).

In the Portage at Ithaca, H. S. Williams was attracted in 1881 to "channel fillings," which channels, he explained, "were caused by the scratching of icebergs on the shoals represented by the interbedding shales." He, like Hall before him, noted that these channels and groovings strike east and west. These are interesting explanations, and, if true, must find corroborative evidence elsewhere. In "L'Île Percée" (1923), Clarke restates the evidence advanced several times before that beneath the fish beds of Upper Devonian age at the Hugh Miller Cliffs in Quebec, many of the boulders "are scored and nicked, polished and glazed, and some show without doubt the scratches and striations which could hardly have been made in any other way than by a movement on each other within a sheet of land ice. . . . Here is, then, the evidence of land ice over Gaspé at a time following immediately upon the great continental elevations which took place toward the close of the Middle Devonian."

DEVONIAN-CARBONIFEROUS BOUNDARY

Regarding the upper boundary of the Devonian, Clarke expresses himself fully in "Construction of the Olean Rock Section" (1903). The Carboniferous fossils, he says, appear at the base of the Cattaraugus in the Wolf Creek conglomerate, and it is in fossils that we have "the support of the most direct

evidence." Distonformities in horizontal strata may be more apparent than real, since in the Upper Devonian "sand reefs constantly display indications of deep decapitation due to shifting of bars and change of direction of currents, or a modification by heavy tidal flow on a shelving coast. Unconformities thus frequently exist which are no indication of unrecorded time." This short paper states clearly what should be the criteria in drawing boundary planes "in sediments characterized by the uniformity of their succession."

THE NEW YORK DEVONIAN AS A WORLD STANDARD

Finally, what the New York Devonian means in the setting of this period throughout the Americas and Europe, Clarke presents in a paper that he wrote as a tribute to the great *Devonkenner* of Europe, Professor Emanuel Kayser, on his seventieth birthday. The standard of reference throughout the world, he here shows, should be the Devonian of the State of New York, since the latter "is very properly designated a Devonian state, for more than one-half its area is covered by the rocks of the period, and the succession of its members from base to summit comprises a record whose pages are almost intact and effectively illustrate the variant happenings of the time." "Not in Devonshire nor in the Rhineland, not in the Urals nor in Siberia, not in the Bosphorus or in South Africa, not in the basin of the Amazon, of the La Plata or in the Andean Cordilleras, is the full and variant succession of Devonian events so well recorded or at least so clearly and simply presented, and perhaps so fully known, as in New York."

DEVONIAN OF SOUTH AMERICA

A few years after Clarke joined the New York State Survey, his friend, Orville A. Derby, of the Brazilian Geological Survey, who was also a New Yorker by birth, asked him to describe certain Silurian and Devonian fossils. This beginning led to eleven publications between 1890 and 1919, totaling some 600 pages and 37 plates of fossils, and describing 260 species, of which 131 are new, along with 14 new genera. Of these forms,

21 (16 new) are Silurian, all the rest being of the Lower and Middle Devonian. "Fósseis Devonianos do Paraná" (1913) brings together all that is known of the Devonian faunas in South America and Falkland. The Silurian and Devonian of the Amazon region are of one faunal province and have relationships with North America, while the Lower Devonian ones of southern Brazil, the Andes, and Falkland are of the austral province and distinctly linked with South Africa. These works show that Clarke put into order and brought up to date the whole of the Devonian faunas of South America. With them, and with his far more extensive studies of the Devonian of the Appalachian geosyncline, we are now able to understand the relationships of the Devonian of the New World to that of Europe, Asia, and Africa.

THE PHILOSOPHY OF CLARKE THE PALEONTOLOGIST

The philosophy which Clarke derived from his paleontologic studies is to be found mainly in five of his papers, namely, his address to the Paleontological Society as its first president in 1910 (1911); "The Philosophy of Geology and the Order of the State," being the presidential address to the Geological Society of America in 1916 (1917); "Postbellum Reflections on the Place of Paleontology among the Sciences" (1920); "Organic Dependence and Disease," published in 1919 and 1921; and "The Age of the Earth from the Paleontological Viewpoint," read before the American Philosophical Society in 1922. His conception of what the life of the past should mean to the living human world may be summed up as follows:

The pursuit of science does not, alas, raise a man to the practice of a higher morality and it has no power to enlarge the soul of the man whose concern therein is only the acquisition of new information.

Paleontology is . . . the most far-reaching of all the sciences. In it lies the root of all truth, out of it must come the solution of the complex enigmas of human society. . . . It is the panoramic display of the life of the ages, the expression of the organic law of a hundred successive worlds.

I regard as peculiarly a doctrine of paleontology that of recapitulation . . . the fact that each individual carries in himself and his develop-

ment history, the history of the race to which he belongs, however accelerated or however retarded it may be.

The problem as to how species have originated . . . does not belong to paleontology. Students, both of living organisms and of fossil ones see the engrossing fact of evolution, but see it out of different eyes; the former perhaps as one would see a vast throng gathered together to acclaim a momentous event, a great victory or a high armistice; the latter as an endless army marching by, its vanguard already out of sight in the mists of the horizon, stragglers along the way falling back or giving up in hopelessness, while the interminable procession ever emerges out of the shadow.

The mutation is a clearly recognizable entity in paleontology, is the bridge crossing from species to species, the connecting link which establishes the continuity of the chain. . . . The mutation is the departure from the one, seeking adjustment and failing, or seeking and finding it in what must be recognized from accepted standards as a distinct specific form, a different species from its parentage.

The standards of our best civilization are not those which have been derived from a clear apprehension of the paramount law, [the biologic law. On the other hand, reflecting man has] some notion of how short is the way he has traveled toward excellence and how long the road that lies ahead. . . . The physical man is an item in the scheme of life . . . but it is the most compelling fact of existence that we are that item.

[All animals in Nature are born free, but not all are] born to an equality of opportunity. . . . Equality of opportunity in paleontology and in human history would mean a world of life with the chief factors of evolution eliminated. . . . If there had been equality of opportunity through the ages of paleontologic history there would be no men in the world today.

The greatest significance of evolving life as seen throughout the geologic ages came to Clarke from his studies of the earliest phases of the parasitic or dependent conditions of life—a study of mutual organic associations that lead to commensalism, sessility, and finally to parasitism. The degenerate modes of life involve

the essential abandonment of normal direct upright living and the benefactors thereby are types of life which Nature has cast out and aside as hopeless. . . . Individual and locomotive independence then, it would seem, has been the major function and prime determining factor in the progress of life. . . . All progress in life, as reckoned in terms of man, has come through independence and through those lines of animal

life in which independence has been maintained at any cost. . . . Rescue of dependents is therefore not a part of the scheme of Nature, except through the exercise of intelligence.

The paleontologist, looking at the record of life on the earth, says to the State:

Be intelligently guided in the treatment of hereditary community parasites, defectives, congenital or confirmed misdemeanants, whatever the form of degeneration may be, by recognition of the presumption that in so far as they can not be physiologically corrected, they are abandoned types in which there lies little hope of repair.

Nature makes for the individual. . . . This truth is registered on the tablets of the race. . . . Over and over again the dominant race has started on its career as an insignificant minority struggling for its existence against an overburden of mechanical and vital obstacles, armed only with specific virtues which have little by little fought their way into the foreground, and by so doing consummated their upward purpose. . . . The majority is purely numerical, while wisdom and truth may rest with the minority. . . . The voice of the people is not the voice of God. Nature's fundamental laws can not be applied. They apply themselves; they govern without consent. . . . The law is of God, the standard of man.

The simple life . . . is the life which really endures. I mean by that it is the life which is ever entering slowly into something better, through sons and daughters born and to be born, and ever leaves a greater share behind it as simple as at the start. The starting point must always endure, the seed must remain if the fruitage is to continue. We are taught to-day the immortality of the simple. . . . For the vast majority of mankind must always be of simple mind, intent upon the simple and material things of life. . . . Of poets and prophets, of men of letters and seers of science, there must always be few and they are not likely to be understood or appreciated in their own day, though they have stood guard over the jewel casket of the race ("L'Île Percée," 1923).

Of the English yeomanry, and among the first to enter through Massachusetts Bay to humanize the wilderness of America, the ancestors of John Mason Clarke followed the path of empire westward for three centuries, until, settling at Canandaigua, they gave rise to a teacher of the plain people in Noah Turner Clarke. Never bounteously blessed with the goods of this world, but rich in lofty ideals, he raised a family of leaders,

and among them one of the greatest paleontologists of our time, a builder of museums, and a statesman of science.

Always a loyal son of New York, Clarke brought to the highest excellence the knowledge of its incomparable Devonian, and ever maintained the New York sequence of Paleozoic formations as the standard of comparison for eastern North America, and in general terms for all the world. But it would be a great mistake to think that his vision was limited to the Empire State, for his work in South America and above all in his beloved Gaspesia was no less significant than that in the land of his nativity. In Quebec also, as well as in New York, he was not only paleontologist and geologist, but preserver of scenic beauty and of wild life, recorder of pioneer work in commemorative tablets, and historian of early days.

Clarke's period of descriptive and faunal work attained its climax in 1908 to 1909, with the publication of his greatest memoir, "Early Devonian History of New York and Eastern North America," and during these protracted studies he was laying deeply the foundations of his belief as to what paleontology should mean in man's speculations concerning himself and his relation to the web of nature. Between 1908 and 1922, his philosophic period, he formulated these conclusions, the gist of which is that we are born free but not equal in ability or opportunity, that socialism and communism do not lead to the growth of the intellect, that all forms of human degeneracy should be carefully guarded by the State, and that the few seekers after knowledge, the guardians of the "jewel casket of the race," must ever be ready to sacrifice themselves for the uplift of the majority, who are leading the simple life, "the life that endures," though spiritually growing through slow accretion.

An intimate knowledge of the life of John Mason Clarke reveals that his path to eminence was hewn out with much labor, taxing to the full the many-sided training that was his from home, college, and environment. Gifted with marked intellectual powers, he used his talents to the full, steadily rising as paleontologist and stratigrapher, as museum administrator, as philoso-

pher and historian. Above all, his life stands out as one of continuous service, service to his family and State, to paleontology and Devonian lore, and to Gaspé, "Coast of the Mountain Ends."

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¹ Clarke wrote many reviews (76), most of which appeared, sometimes unsigned, in the *American Geologist* between the years 1893 and 1897, but only a few of the more important of these are included in the list below.