HUBERT ANSON NEWTON.

HUBERT ANSON NEWTON was born in Sherburne, N. Y., March 19, 1830, and died at New Haven on the 12th day of August, 1896.* He graduated at Yale, taking the degree of A.B., in 1850, and spent the next two and one-half years in mathematical study. He became tutor at Yale in 1853 and on account of the sickness and subsequent death of Professor Stanley, the whole work of the department of mathematics devolved upon him from the first. In 1855 his great ability was recognized in his election, at the early age of twenty-five, to a full professorship of mathematics at Yale, the duties of which he assumed after spending a year of study in Europe, where, under the inspiration of Chasles, he became especially interested in the subject of Modern Higher Geometry. He carried on most vigorously work and studies in various lines in addition to the duties of his professorship. Sometimes it was a profound study in pure Mathematics, sometimes a rich contribution to the education of the public, and sometimes an original investigation in the field of Astronomy.

He published in 1857 a paper on the Gyroscope in the *American Journal of Science*, and soon after, a paper in the *Mathematical Monthly*, in which he seems to have been the first to apply the principle of inversion in the solution of the problem of constructing circles tangent to three given circles. He showed how deeply rooted in his mind were the ideas of the Modern Geometry in his elaborate papers published in the same journal in 1861 on the geometrical construction of certain curves by points, where he extended the ideas of Chasles, of de Jonquières, and of Poncelet. The subject of transcendental curves he studied for a long time with great interest, and constructed a myriad of interesting patterns, but contented himself with publishing, in the joint name of himself and his pupil, the discussion of the single group of equations which he found would give the most beautiful and symmetric forms, and which he had set for his pupil to investigate.

Professor Newton was very active in securing the prompt adoption of the Metric System of Weights and Measures, both by the Connecticut Legislature and by Congress after the Conference of Nations on the subject, held in Berlin in 1863. He wrote a popular tract in 1864, giving an expla-

*Professor Newton was Vice-President of the AMERICAN MATHEMATICAL SOCIETY at the time of his death.—ED.

nation of the system. He contributed in 1865 to the Report of the House Committee on Weights and Measures at Washington, and also to the Report of the Smithsonian Institution on this subject. He prepared an appendix consisting of these tables in form for school instruction for one of the leading arithmetics, and interested the makers of scales and rulers in graduating their devices for weighing and measuring according to the Metric System. He gave his ideas to the public freely in reference to the graphical representation of all sorts of statistical information, and contributed lavishly his ideas to the authors of mathematical books used in school and college class-rooms, although he published no text-books in his own name. He was the joint author with Professor Loomis of a most elaborate paper on the climate of New Haven, which was published in the Transactions of the Connecticut Academy of Arts and Sciences. He prepared articles on the subject of Meteors for two leading cyclopædias and contributed the mathematical and astronomical definitions to Webster's International Dictionary. Professor Newton was one of the highest authorities on the subject of Life Insurance and, besides the important actuarial work which he did, computed valuable tables published by the New York Insurance Department in 1868, and later in the New Englander, a paper on the Law of Mortality that prevailed among former members of the Yale Divinity School, and still later, in Professor Dexter's Annals and Biographies, on the Length of Life of the Early Yale Graduates.

But the contributions to human knowledge, which most entitle him to fame, are those which he made on the subject of meteors, shooting stars and comets. The facts of the great star shower of 1833 had given to two New Haven men—Professors Twining and Olmstead—a clue to the true theory of the shooting stars, and this, together with the interest which the men of science at Yale had kept up in the subject of meteors, influenced Professor Newton to direct his studies towards these bodies as the time drew near for a possible recurrence of the great November shower of 1833. In 1860 he published his first paper on this subject in the *Journal of Science*, entitled "The Fireball of November 15, 1859," and this was followed by two other papers in the same journal, one on the great fireball of August 10, 1861, in which also the August group of meteors was discussed; and the other on the two fireballs of August 2 and August 6, 1860. Professor Newton had gathered a large number of observations made by persons in the localities where these bodies had attracted attention, and treated the subject with special reference to determining their nature and their velocity. Early in 1863, at the request of the Connecticut Academy, he prepared a stellar chart suited to observations at all times, which was distributed to persons at various stations for observing the August meteors. A vast amount of material was thus collected for computing the altitudes of the meteors and for obtaining some idea of their velocities. In July, 1863, Professor Newton published in the *Journal* a paper on the "Evidence of the Cosmical Origin of Shooting Stars derived from the Dates of early Star Showers," which not only established beyond question the fact that the star showers are caused by the entrance into the earth's atmosphere of bodies revolving about the sun, but gave the key to the complete solution of the problem of the November meteors. In May, 1864, he published the original accounts of thirteen remarkable displays of the November shooting stars, ranging from A. D. 902 to 1833, and in July of the same year he published a second paper in which he derived from these accounts the length of the annual period, the length of the cycle, the mean motion along the ecliptic of the node of the orbit of the group, and the length of the part of the cycle during which showers may be expected. He also showed that there were only five possible periodic times which could satisfy the observed conditions, and of these the true orbit was probably either one with a period of 354.6 days or one with a period of 33.25 years. The first of these two he thought the more likely, and computed the other elements of that orbit, but he pointed out at the same time a criterion for determining which was the true orbit when the position of the radiant should be more accurately established.

In August, 1864, Professor Newton presented to the National Academy of Sciences a comprehensive memoir on the Sporadic Shooting Stars. He had shortly before this compiled a table of computed altitudes of certain shooting stars which included substantially all that had ever been published. Using this table as a basis, he deduced the distribution of meteor paths over the sky in altitude and in azimuth, the number of shooting stars that come into our atmosphere each day, the mean length of the visible part of the meteor paths, and the number of meteoroids in the space which the earth traverses. He also deduced the remarkable fact that the mean velocity could be determined from the number of shooting stars in the different hours of the night.

These papers of Professor Newton aroused the greatest interest among mathematicians and astronomers in the subject of meteors, and especially in the star showers predicted for November, 1865 and 1866. The facts of these showers confirmed to a remarkable degree Professor Newton's theories. Leverrier and Schiaparelli, however, by independent methods showed that the period of the group was most probably 33.25 years, and Professor Adams, in 1867, by applying Professor Newton's criterion added the last link in establishing this as the true orbit of the November meteoroids.

Professor Newton, by his papers of 1863 and 1864, laid the foundation of the Science of Meteoric Astronomy. His subsequent papers, nearly thirty in number, cover almost every topic connected with the subject. Whether in his reviews of the facts concerning the November shooting stars in the successive years from 1864 to 1869, or in the discussion of the Biela meteors of 1872 and of 1885, or in his treatment of such topics as the origin of comets, the direct motion of comets of short period, the capture of comets by Jupiter, the effect upon the earth's velocity produced by small bodies entering the atmosphere, the relation to the earth's orbit of the former orbits of those meteorites in our collections, which were seen to fall, one prominent characteristic of his investigation was always its exhaustive character. For, whatever Professor Newton did, it was not worth the while of any one else to cover the same field.

Besides the papers which he published, his scientific activities outside the duties of his professorship were numerous and important. He organized a mathematical society in the early '60s to which he was the principal contributor, and to the successor of this society, the Yale Mathematical Club, organized in 1887, he contributed more than a score of papers. He was for many years a member of the Publishing Committee of the Connecticut Academy of Arts and Sciences. He was an associate editor of the *American Journal of Science* for thirty years. He was one of the principal founders of the Yale Observatory and practically its director till near the time of his death.

The appreciation in which his scientific ability and his labors were held is shown in the honors which he received. In 1862 he was made a member of the American Academy of Arts and Sciences. He was one of the original charter members of the National Academy of Sciences, founded in 1863. In 1867 he was made a member of the American Philosophical Society of Philadelphia. The degree of LL.D.

was conferred upon him by Michigan University in 1868. He was made an Associate of the Royal Astronomical Society in 1872. He was Vice-President of the American Association for the Advancement of Science, presiding over the section of Mathematics and Astronomy in 1875, and was President of the Association in 1885. He was made a Foreign Honorary Fellow of the Royal Society of Edinburgh in 1886, and a Foreign Member of the Royal Society of London in 1892.

At the April meeting of the National Academy in 1888 the value of Professor Newton's scientific work was publicly recognized by that body, in awarding to him the J. Lawrence Smith gold medal for his contributions to Meteoric Astronomy. His reply to the address of presentation reveals at once his modesty and his own true scientific spirit.

"Sir: I beg to express to the Academy my high appreciation of the honor you have conferred upon me. To discover some new truth in nature, even though it concerns the small things in the world, gives one of the purest pleasures in human experience. It gives joy to tell others of the treasure found. When, therefore, those best able to judge of the value of this addition to human knowledge say that it is worthy of their special public commendation, that joy is greatly increased.

I shall cherish this memorial also for that it bears the likeness of one whose true scientific spirit we all learned to admire, and whom, for his genial character, we all learned to love."

The achievements of Professor Newton, great as they were from a scientific standpoint, give no adequate idea, taken in themselves, of his power and influence. These, in the larger sense have become a part of the organic life of the University where his work was done. He built up, during a leadership of forty years, a strong and symmetrical department of Mathematics, by his comprehensive grasp of the trend of mathematical thought, and by his wonderful power of divining the paths which lead out to fruitful fields of research, both within the domain of pure mathematics and in its applications to other sciences. Nor was the best part of his academic activities merely in his own department of studies. In moulding the general policy of the institution his counsel was invaluable; in establishing and maintaining the moral and intellectual standards, his influence was preeminent; the University bears the indelible impress of a life consecrated to the development of the noblest ideals.

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