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EDWARD SALISBURY DANA

1849–1935

BY

ADOLPH KNOPF

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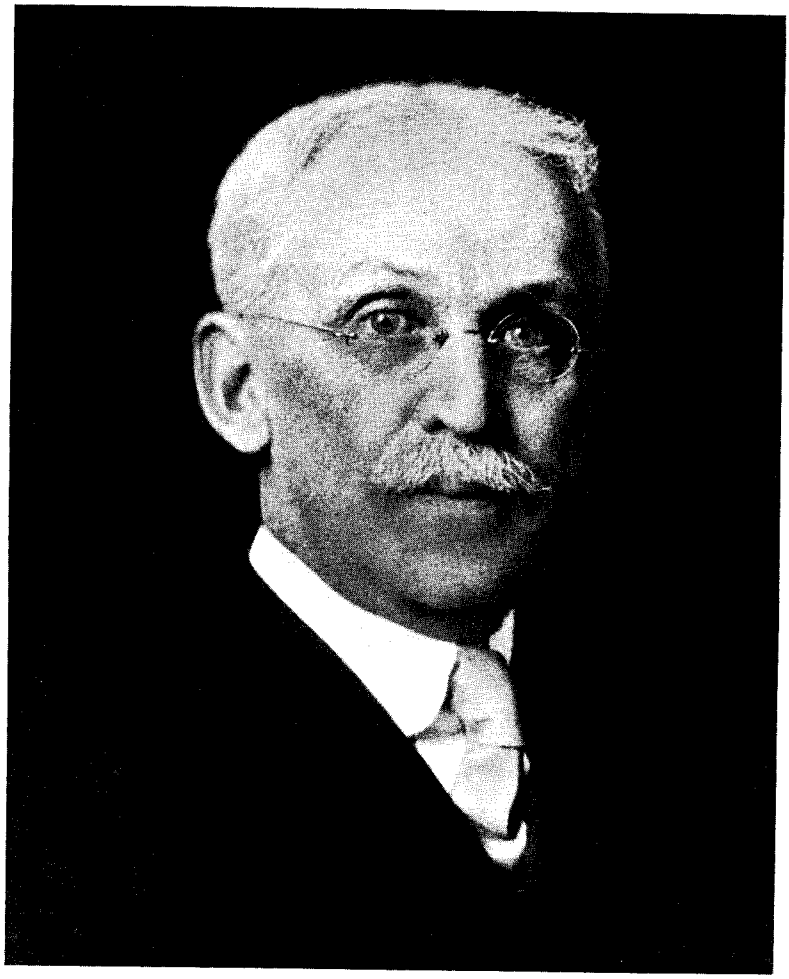

Edward S. Dana

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Edward Salisbury Dana, eminent mineralogist, was born November 16, 1849, in New Haven, Connecticut. That he should become an eminent scientist seemed foreordained by inheritance and background. On both sides of his family he came of distinguished scientific lineage. His father was James Dwight Dana, renowned in his younger years as a zoologist and mineralogist, from 1850 to 1890 Silliman Professor of Natural History at Yale University, and as time went on universally recognized as the foremost geologist of America. The elder Dana had entered Yale with the class of 1833, attracted by the fame of Benjamin Silliman, who was then in the prime of his powers as an inspiring teacher of chemistry and geology. During Dana's college days, and after his graduation, he had the good fortune to become associated with Professor Silliman. The tie was later strengthened by his marriage in 1844 with Henrietta Frances, a daughter of Professor Silliman. Six children were born of this marriage, and of these, Edward Salisbury Dana was the eldest. He was named in honor of one of his father's closest friends, Edward E. Salisbury, Professor of Sanskrit, who when it had appeared that James D. Dana would accept a call to Harvard had suggested the founding of a Silliman Professorship of Natural History at Yale and had generously contributed to it, with the understanding that Dana should be the first incumbent.

Edward S. Dana was prepared for college at Hopkins Grammar School in New Haven, and graduated from Yale College with the class of 1870. He continued his studies, chiefly in mineralogy, for the next two years under the guidance of George J. Brush, Professor of Mineralogy in the Sheffield Scientific School. He then went abroad for two years. During the first year he studied at Heidelberg, where he found the kindness of the professors "very great." During the first term he attended

Bunsen's lectures on Experimentalchemie and worked six hours daily in Bunsen's laboratory, learning analytical methods. Near the end of the term he did some original work also, such as measuring with W. G. Mixter the specific heats of silicon, boron, and zirconium, using Bunsen's own calorimeter. During the second term he attended the lectures of Leonhard on mineralogy, Kirchoff on physics, Kopp on crystallography, Neumayr on geology, Blum on lithology, and Klein on optical mineralogy; altogether he heard 300 lectures that semester.

In the summer of 1873 he went to Vienna chiefly to learn optical mineralogy and microscopical petrography, which were the principal objects of his trip to Europe. He studied under Tschermak and Schrauf. The young Dana was astounded to learn among other things that identical rocks should be given different names according to their geologic ages. "I am told," he wrote his father, "that it is absurd for me to speak of Triassic dolerite, for such a thing *does not exist,* the rock must be either diabase or augitporphyr." He thought this extremely illogical, if not absurd; and though sixty-five years have passed, the effects of the illogicality have not yet been entirely removed from the German literature. The instruction was largely on the let-alone principle. "The moral of it all is that one must depend after all upon himself if he will learn anything—which is no very new discovery in the world," Dana sagely concluded.

The extant letters of Dana written during his Wanderjahre contain many extremely interesting pen pictures of such famous leaders in science as Bunsen, Kirchoff, Kopp, Suess, Neumayr, and Tschermak. There are many incisive comments on methods of instruction, evaluation of lecture courses, and on text books: manifestly, the education of Edward S. Dana was proceeding apace.[1]

Long afterwards, when the close of the World War had reduced the scientists of Vienna to abject want, Dana put himself at the head of a movement to aid the mineralogists. From the summer of 1920 onward members of the Mineralogical Society

[1] The writer is greatly indebted to Miss Maria T. Dana, sister of Edward S. Dana, for access to the letters written by her brother and for other gracious aid in preparing this biography.

of America and others sent substantial pecuniary aid; it was particularly gratifying to Dana thus to help make more comfortable the last years of the life of Tschermak, who died in 1927, and of those of his wife. Dana had strong charitable feelings and was a heavy contributor to the Community Chest of his city.

Early in April, 1874, Dana returned from Europe to New Haven to continue his work at Yale. He took the M.A. degree in that year and continued his studies for the doctor's degree. During the summer of 1875 he was attached to the exploring party of Capt. William Ludlow, of the Corps of Engineers, U. S. Army. His classmate, George Bird Grinnell, was also a member of the party and reported on the zoology and paleontology. Both men were volunteers, traveling at their own expense, and received no compensation. It was evidently an exciting summer, for much of the country swarmed with Indians—with hostile or predatory Sioux and with Crows, who, friendly to the whites, were at war with the Sioux. Geology had to be done with hammer in one hand and rifle in the other. Buffalo and other big game were abundant on the plains, and the party was shocked by the reckless way in which the animals were being destroyed. At the Geyser basins, also, the party was appalled by the vandalism of the sight-seers, for although the Yellowstone Park had only been made known to the world a scant five years before, visitors were already numerous, and vandals of both sexes were busily chopping with axes and prying off the ornamental work of the geyser craters! The geologic results of this rapid reconnaissance trip were published in 1876 as part of Capt. Ludlow's report.

In 1876 Dana received the Ph.D. degree, his dissertation being on "The Trap Rocks of the Connecticut Valley." His graduate years had been a time of great research activity, and besides the geologic report on the Montana reconnaissance already mentioned he had published seven important mineralogic studies. One of the first of these, "On the Composition of the Labradorite Rocks of Waterville, New Hampshire," in 1872, dealt with the compositions of the individual components of a rock and was a pioneer in that branch of research in this country.

The chief rock was thought to represent a new type ("ossipite"), but on being thin-sectioned in Vienna, proved to be, as Tschermak had suspected, an olivine gabbro.

Although Dana was made Curator of Mineralogy in the Yale University Mineral Collection in 1874, yet on graduation there was no opportunity for him to teach mineralogy at the University, and he accepted a tutorship in mathematics, physics, and chemistry in Yale College. Soon we have the anomaly of a man internationally famous as a mineralogist, teaching physics and continuing to do so during the long span of his academic tenure. In 1879 he was made Assistant Professor of Natural Philosophy; in 1890 he became Professor of Physics; and he served in that capacity until he retired in 1917.

Professor D. A. Kreider, one of Dana's colleagues in the Physics Department, has given us this picture:

"Professor Dana was conspicuously successful as a teacher. From 1874 to 1917 he was in charge of the course in elementary Physics in Yale College, perhaps the most arduous course to handle successfully with the general student. In spite of the inherent difficulties encountered by beginners in the subject, combined with the mathematical requirements, the course in Physics under Professor Dana continued to draw large divisions even during the development of the elective system and its introduction of many courses in which the standards were much less exacting.

"Always bright and vivacious, Professor Dana took his position at the lecture table with a brisk step and pleasant smile. With a minimum of formality he picked up the threads from the previous exercise and proceeded without notes, at high speed, and with the rapt attention of the students to the end of the hour. His method was first, by a quiz, to locate the boundary between understanding and uncertainty, and to excite the student's interest. This led naturally to a discussion in which the class was induced to assist. Dana's own contributions to these discussions were marvels of lucidity. Dexterous with the crayon, he would, with the minimum strokes, clarify every essential detail. Finally, with the student prepared to comprehend what he was to see, there followed such experimental demonstration as the relatively limited apparatus of his day afforded. He was a master in every form of presentation. Admittedly his method was not economical of time or energy, but it was effective."

As a byproduct of his activities as a teacher of undergraduate Physics, he produced in 1881 "A Text Book of Elementary Mechanics for the Use of Colleges and Schools." It was an excellent book and was used successfully for many years.

As a member of the faculty of Yale College (be it remembered that in those days "Yale College" and "The Sheffield Scientific School" were practically autonomous units in Yale University) Dana became exceedingly influential and took the keenest interest in its administrative affairs. Dean Jones, in his annual report for 1916-1917, paid his tribute to Professor Dana:

"No member of the Faculty has been more influential in shaping the Course of Study. His services as chairman of that important committee, and as chairman of the Ways and Means Committee have long been recognized and appreciated by his colleagues. As the senior member of the Permanent Officers he gave his best thought and energy to the educational and financial problems of the College. Tolerant, sagacious, and tactful, with exact knowledge of the history of the growth and development of all departments of the University, he was an indispensable member of every committee which has had to do with interdepartmental relations."

Dana's main interest, however, was in mineralogy and especially in crystallography. In 1878 began appearing the celebrated Branchville papers, dealing with the remarkable mineral locality at Branchville, Conn. Four of these papers came out between 1878-1880, and the fifth and last in 1890. Fourteen minerals were described, of which nine were newly recognized species. These papers set a new standard for mineralogical research in this country. Notable is the skillful use of optical and microscopical methods that Dana made to supplement the usual mineralogical and chemical methods; in this he was in advance of his times, and the value of these auxiliaries was not generally appreciated until several decades later.

Dana's fame as a mineralogist, however, rests mainly on the books that he wrote. In 1877 appeared his Textbook of Mineralogy, which immediately took rank as the leading book in English. A revised and greatly expanded version appeared in 1898 and was distinguished among other things for a lucid

exposition of the principles of optical mineralogy, which was long without a peer. Subsequently two later editions of "Dana's Textbook of Mineralogy" were prepared by W. E. Ford, the latest having been issued in 1932. Other books of his are "Minerals, and How to Study Them (a book for beginners)," written in 1895, and "A System of Mineralogy," known to all mineralogists and geologists as "Dana's System."

The "System" will ever remain Dana's great monument. Let us consider briefly the history of the "System," the most influential work ever published in mineralogy. The first edition of this great book had been published by his father in 1837, a volume of 580 pages. In the fourth edition of the "System," published in 1854, J. D. Dana abandoned the classification of minerals that he had theretofore used, and proposed a classification based on chemical principles. This classification was universally accepted, and is essentially that in use today. Rossiter W. Raymond, writing of the days when he was a student at the Royal Academy of Mines in Freiberg, said "I remember well the thrill of patriotic pride with which I heard my instructor in mineralogy—himself a man of world-wide reputation—declare in that department that the best book ever published was the wonderful Mineralogy of Dana."

The fifth edition appeared in 1868, and was the most complete treatise that had ever been attempted. Edward S. Dana undertook the task of preparing the sixth edition, and it was issued in 1892. During the twenty-four years that had passed since the previous edition, the science of Mineralogy had progressed unprecedentedly. Nearly one thousand new names had been introduced during the interval: "Unfortunately," said Dana, "not all 'new species,' although this has been claimed for most of them." The importance of the optical properties of minerals and of optical methods of investigation, owing to the rapid growth of petrography, had become recognized. Chemical mineralogy had made great strides and the synthetic production of minerals had thrown much light on problems of genesis. The new edition, a volume of 1134 pages, contained half again as much matter as the previous edition.

The axial ratios of each mineral species were recalculated from the data of the original observer and from these the important angles of all the common forms were calculated—a herculean task in itself—and some 1400 crystal drawings were made. In these, and many other respects, the sixth edition was essentially a new book. Forty years of use have disclosed astonishingly few errors in it, even of a typographical nature. Considering that the work was done essentially single-handed, it was a supreme achievement. Three appendices have been issued (1899, 1909, and 1915) to keep the "System" up-to-date. At the present time the seventh edition is being prepared under the supervision of Professors Palache and Ford, for the content of mineralogy has become so great that no one man can hope to encompass the task of revision. Such a feat as Dana's we shall not see again.

The recognition accorded Dana's System has been world-wide. As Professor Charles Palache, of Harvard, has written: "The Dana System is the Bible of every mineralogical institute which I have ever been in," and this feeling is shared by all geologists as well.

Dana was married on October 2, 1883, to Caroline, daughter of William Brooks Bristol, a lawyer prominent in New Haven; she died in 1916. Three children were born to them: Mary Bristol in 1886, James Dwight in 1889, and William Bristol in 1896; both sons are lawyers.

The great task of bringing out the sixth edition of the "System," coupled with his many other activities, proved to be a breaking strain. His health gave way in 1894, and Dana was obliged to cease from his labors. Accompanied by his wife, he went to Europe to recover his health. Again, in 1902, he was obliged to seek complete rest for a year. In these later years the state of his health restricted his activities chiefly to teaching, administrative, and editorial work.

Dana became one of the editors of the *American Journal of Science* in 1875, and to the very end of his life it remained one of the prime objects of his solicitude. The *Journal* had been founded in 1818 by his grandfather Benjamin Silliman; from

1846 until the death of Benjamin Silliman, it was run jointly by Benjamin Silliman, his son, and his son-in-law, James D. Dana. In 1885 Benjamin Silliman, Jr., retired, and on the death of James D. Dana in 1895, Edward S. Dana assumed the full burden, editorial and financial. In 1926 a severe illness, during which his life was despaired of, made necessary a lightening of the load, and Dr. Ernest Howe generously consented to become co-editor; he relieved Dana of the heavier duties and ran the *Journal* with rare skill until his death in 1932. Dr. R. S. Lull then became co-editor and since the death of Dana on June 16, 1935, has become the editor. Thus up to the time of his death Dana was actively and keenly interested in the affairs of the *Journal.* With his passing there came to an end the longest scientific dynasty in America, extending from 1818 to 1935.

Many honors were conferred on him. He was a member of numerous mineralogical and geological societies. In 1884 he was elected to the National Academy of Sciences. In 1925 the Mineralogical Society of America made him Honorary President for life.

On the anniversary of his eightieth birthday, the Academy of Sciences of Vienna sent to Edward Salisbury Dana this message of greeting, simply and feelingly worded; it is in itself a noble memorial.

"To our highly honored Colleague:

"In accordance with a beautiful custom, the Academy of Sciences in Vienna sends to you the most heartfelt good wishes for the 16th of November, 1929, the day on which you complete your eightieth year in perfect physical and mental vigor. May the years that lie behind you so rich in scientific achievement be followed by a long and happy autumn, made beautiful and enhanced by the love and honor of all who are permitted to have a part in your life. Among these counts itself the Academy of Sciences in Vienna, which carries proudly the name Edward Salisbury Dana on the roll of its foreign members.

"Such an anniversary prompts us to look back into the past, and most would be inclined to consider the year 1876 in which you were awarded the degree of Doctor of Philosophy by Yale University as the beginning of your scientific career. Indeed from that year onward, the chain of well-wrought contributions

was forged link by link, which, dealing mainly with the varied minerals of your country, drew the attention of your fellow scientists and soon caused them to recognize you as the master and leader of American mineralogists.

"However, to us in Vienna the year 1876 does not have that significance. With joy we can establish through documentary evidence that forerunners of those distinguished contributions had originated three years earlier in one of the famous laboratories of Vienna, the old Hof-Mineralien Cabinet, and were published in the Vienna scientific journal, the "Mineralogische Mitteilungen gesammelt von G. Tschermak," 1874, as the first of a long succession of increasingly brilliant contributions. So far back extends the relationship of yourself to Vienna, and we of Vienna may rightfully claim Edward S. Dana as one of our own.

"As collaborator in the later editions of the widely celebrated 'A System of Mineralogy,' of your father James Dwight Dana, you were well prepared to revise this work and to recast it for a form suitable to modern times. This revision you completed in 1892 and have produced a fundamental treatise, which in uniformity of treatment, in authoritativeness, and in completeness is almost without a peer and which enjoys even in old Europe not only because of its careful accounts of American deposits the highest regard and the widest distribution.

"No less favorably than by your own contributions to knowledge have you influenced the progress of science in your country as the editor of the highly esteemed *American Journal of Science,* which presents to the scientific world the progress of your countrymen in the realm of the natural sciences, especially in geology. Because of the careful choice of articles, the accuracy of references, and the distinguished presentation, the readers of the American Journal have ever experienced profound satisfaction; and the position of the Journal as leader is unquestioned.

"The members of the learned circles of Vienna have yet another very special reason for remembering you with honor on this your anniversary. Since 1873 bonds of personal friendship have existed between you and a number of physicists and mineralogists in Vienna.

"With this circle of friends you have kept faith during one of the saddest times that has ever befallen Vienna and Austria. In the fatal years when the collapsing State was unable to keep Austrian scholars of world-wide fame and their families from bitter want, you have remembered your friends, and with the

courage of a kind heart have been one of the first to gather funds for your suffering colleagues and their dependents in Vienna in order to ameliorate their distress. The Academy of Vienna can not fail on this present occasion to acknowledge this publicly, and it asks you to accept its gratitude for the help and sympathy shown through these many years.

Vienna, November 16, 1929."

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