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ARNOLD HAGUE

1840-1917

BY

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ARNOLD HAGUE was born in Boston, Mass., on the 3d of December, 1840. His father, Rev. Dr. William Hague, was a Baptist minister, as was also his great-great-grandfather, William Hague, who was active in his pulpit at the age of 85, in his home in Scarborough, England. William Hague, the father of Arnold, was born near Pelham Manor, New Rochelle, N. Y., being a descendant, on the maternal side, of a Huguenot family which left France for Martinique, and later moved to New York State, and settled in the place afterward called New Rochelle. He was also descended from David Nimham, a North American Indian, who acted as guide for Washington's troops through the forests of Westchester, N. Y. Arnold Hague's mother was Mary Bowditch Moriarty, of Salem, Mass., a granddaughter of Deborah Bowditch and a relative of Nathaniel Bowditch, the mathematician. The family lived in Salem for three or four generations.

When Arnold was twelve years of age the family moved to Albany, N. Y., where his father was pastor of the North Pearl Street Baptist Church. In Albany Arnold attended the Albany Boys' Academy, from which he graduated in 1854, in his fourteenth year. He frequently attended meetings of the State legislature and took an interest in their proceedings, so that with a number of boy friends he took part in an amateur senate of their own and discussed questions that were interesting from the boys' point of view. In 1856 his father took the family to New York City, where he was instrumental in the erection of the Madison Avenue Baptist Church. During the next few years Arnold prepared himself for college, though a business

* This memoir is enlarged from a biographical sketch of Mr. Hague prepared by the writer for the Geological Society of America.

career had been urged upon him against his inclinations, and in the autumn of 1861, when the Civil War was in its early stages and he had failed to be accepted as a volunteer for physical reasons, he entered the Sheffield Scientific School of Yale at the age of 20. Having been admitted with advanced standing, he took up the studies of junior year in what was known as the chemical course, there being at that time only two others—the engineering and the general course. Chemistry was taught by John Porter and Samuel W. Johnson, with O. D. Allen and Peter Collier as assistants. Metallurgy and mineralogy were taught by George J. Brush; geology by James D. Dana, and modern languages by William D. Whitney. Theodore Woolsey was the President of Yale at that time. The attendance in college was so greatly affected by the war that Hague's class, which graduated in 1863, contained only four students; so that each student undoubtedly received very direct personal attention from his instructor, and one may imagine the inspiration which the student, Hague, must have derived from such men as Dana, Brush, and Johnson.

When Arnold Hague entered the scientific school Clarence King was in the senior class and O. C. Marsh was a graduate student, having graduated from the college in 1860 with the degree of A. B. and taking up courses in chemistry, mineralogy, and paleontology. Other students with whom Hague was associated, who were in the graduate school at that time, were J. Willard Gibbs and Ellsworth Daggett, who became a mining engineer. The acquaintance which began in this way with King and Marsh was destined to play a great rôle in the future life of Arnold Hague, especially the friendship with Clarence King; for while there is no record of Hague's experiences and aspirations during his college life, it is evident from subsequent events that the friendship for these two men influenced very much of his life's work.

After graduation, in 1863, with the degree of Ph. B., he again tried to enlist in the army and was rejected because of general physical deficiencies, when he determined not to remain in the country and went to Germany with a cousin, Lyman Nichols, spending a year in Göttingen familiarizing himself with the language and overcoming a defect of speech which

had been a source of embarrassment to him. The following year he studied in Heidelberg, in Bunsen's laboratory, where most of his time was devoted to chemistry and mineralogy. In 1851, after a trip to Iceland, Bunsen had suggested the hypothesis of a pyroxenic, or basaltic, magma and a feldspathic, or trachytic, magma as the sources of all intermediate volcanic rocks, which it was assumed might be formed by their mixture during eruption; and it is to be supposed that Hague became acquainted with this idea directly from Bunsen, which might account for the hold this hypothesis had on him in later years, as is shown in his discussion of the volcanic rocks of the Eureka district, Nevada.

At the end of his second year in Germany he again applied to enter the army service, saying he was entirely well and strong and felt an obligation to return. In reply he received a personal message from President Lincoln, saying in effect: "Stay where you are; we shall need such as you later." In the spring of 1865 he went to the Bergakademie, in Freiberg, Saxony, where he met S. F. Emmons for the first time, who had been there the previous year. This was the beginning of another friendship which was to continue throughout life and was to influence the careers of both these embryo geologists who were within four months of the same age. Emmons, having had a year's experience at the Bergakademie, became the adviser of Hague as to his best course and joined him in all the week-end excursions with von Cotta. They visited many parts of Saxony and studied petrology according to von Cotta's text-book. Their evenings were often spent studying the geological map of Saxony and in acquiring their first experience in geological cartography. In a reference to this experience Hague has said: "Both came to realize the influence of Cotta upon our future careers, as he gave us much of his time." *

Bernhard von Cotta was the author of a text-book on petrography, "Die Gesteinslehre," the second edition of which was published in 1862, and this book became Hague's guide and basis of petrography. In it all rocks were classified according

* Hague, A. Biographical Memoir of Samuel Franklin Emmons. National Academy of Sciences, vol. 7, 1913, p. 315.

to mode of origin, as eruptive, metamorphic, or sedimentary; and eruptive rocks were divided into two groups on a chemical basis: 1. Those poor in silica, or basic; 2. Those highly siliceous, or acid. Each group was divided further into volcanic and plutonic. The separation into basic and acid appears to have been made with Bunsen's two-magma hypothesis in mind, but not as a direct expression of it, for von Cotta, in 1858, had proposed the hypothesis that the solid crust of the earth consisted of highly siliceous substances, and that the fluid portion beneath had about the composition of the most basic rocks, and that the variations in composition of eruptive rocks were due to the variable amounts of the solid siliceous crust which was taken up by the basic magma during its passage toward the surface of the earth.

Although Clifton Sorby had made the first use of the microscope in studying sections of rocks in 1851, and Zirkel had published microscopical descriptions of rocks in 1863 and 1864, the application of the microscope to petrography had not attracted any attention when Arnold Hague was preparing himself for his geological career. It was not until seven years after his return to this country that microscopical petrography began to attract general attention among geologists.

In December, 1866, Hague returned to his home, which was now in Boston, Mass. He was just 26 years old and had had a liberal education in chemistry, mineralogy, petrography, and geology as they were taught in those days. A few weeks after his return he met Clarence King in New York, and had a chance to learn from him his plans for a geological survey across the western cordilleras along the line of the proposed transcontinental railroad. One who knew King in later life can imagine the enthusiasm with which, at the age of 25, he must have described this enterprise and the romance with which he must have enveloped it. He offered Hague a position as assistant geologist if the proposed plan for the survey should be authorized by Congress. Naturally, it was accepted on the spot, and Hague returned to Boston to find his friend Emmons and acquaint him with his good fortune. Soon afterward he introduced Emmons to King, and this led to the engagement of Emmons as another assistant, and was the commencement of

that geological triumvirate which accomplished so much for American geology through what was known as the Geological Exploration of the Fortieth Parallel.

On the 1st of May, 1867, Hague and Emmons, with several other members of the scientific party, sailed from New York for San Francisco by way of Panama, a three-weeks' trip, but much less difficult than the journey across the continent at that time, before the railroad to the Pacific coast was completed, when through travel was by Wells, Fargo and Company's stage-coach. After spending a few days in San Francisco, camp was established in the outskirts of Sacramento, where final preparations for field-work were completed. The party consisted of geologists, topographers, an ornithologist, botanist, and a skilled photographer, besides packers and cooks, for there were to be three parties in the field—one under Hague, another under Emmons—exploring separate areas, while the third was under King, who kept in touch with the work of the two assistant geologists, besides undertaking special researches by himself. Since the geological and topographical surveys were carried on at the same time in each district, there were no maps on which to plot the areal geology until the year after the work was done in the field. Moreover, the scale of the maps was 4 miles to one inch, and the geological work was naturally a reconnaissance.

The country explored was a wilderness, inhabited sparsely by Indians, and to a large extent desert. So it was thought advisable by the War Department to provide an escort of 25 cavalrymen, and occasionally a soldier accompanied the geologist into the mountains. The area to be surveyed was a belt of country 100 miles wide, extending from the California State line to the Great Plains of Wyoming and Colorado east of the Rocky Mountains, and embracing the line of the first transcontinental railroad, afterward known as the Union and the Central Pacific railroads. The work of the survey began at the western edge of the great sage-brush desert in the neighborhood of Pyramid and Winnemucca lakes, and extended through Nevada and Utah and parts of Idaho across the Rocky Mountains, although in the published report the region is described from east westward.

The field season of 1867 was spent in the Humboldt country, in western Nevada; that of 1868 in the remainder of the Great Basin as far as the western edge of the Salt Lake desert. The third season, in 1869, was devoted to the mountains and valleys of the Salt Lake region and the Wasatch Mountains east of it. During the three following seasons the exploration embraced the Mesozoic and Tertiary areas of Utah and Wyoming, the Laramie plains, the northern extension of the Front Range, and the eastern slopes of the mountains. In addition to the survey of the belt of the Fortieth Parallel, Hague explored Mount Hood, while King investigated Mount Shasta and Emmons Mount Rainier, each collecting the volcanic rocks and studying the glacial phenomena.

The geologists spent the winter of 1867-68 in Virginia City, Nevada, studying the Comstock Lode and the geology of the country immediately south of the Fortieth Parallel belt in this vicinity. In volume iii of the published report, entitled "Mining Industry," Hague contributed a chapter on the "Chemistry of the Washoe Process," which included a description of the mineral character of the ore, the chemical action of mercury and other reagents, and pan experiments, which were conducted at the Sheffield Laboratory of Yale College, with the assistance of Mr. Ellsworth Daggett. Hague also wrote a chapter describing the geology of the white-pine district. Subsequent winters were spent in San Francisco, Washington, and New Haven. After the completion of field-work, in 1872, the offices of the Survey were located in New York City, where the report and accompanying atlases were prepared. The collection of rock specimens was deposited in the American Museum of Natural History for safekeeping.

In 1874 Emmons was sent to Europe to study the methods of European geological surveys and to obtain the best and latest geological literature. He was instructed to confer with Professor Zirkel in Leipzig, who had just published his book on the microscopical characters of minerals and rocks,[1] and "to induce him, if possible, to visit America and study in the pres-

[1] Die Mikroskopische Beschaffenheit der Mineralien und Gesteine, von Ferdinand Zirkel, Leipzig, 1873.

ence of the collectors their collection of rock specimens, for at that time no American geologist had any practical knowledge of this new branch of geology. From this visit resulted Zirkel's volume on microscopical petrography, which marked the opening of a new era in geological study in the United States." [2]

It is interesting to note the phases of petrography through which the work of the Geological Exploration of the Fortieth Parallel passed, since this was the first of the larger surveys in this country that took a deep interest in the petrography of eruptive rocks. It began with King's interest in the lavas of the volcanoes of the Pacific coast and in the igneous rocks of the Sierra Nevada. This took definite form through his association with Baron von Richthofen during his visit to the Pacific coast, where he studied the Tertiary volcanic lavas and, observing their strong resemblance to those of Austro-Hungary, wrote his paper on a "Natural System of Volcanic Rocks," which was published in San Francisco in 1868. No doubt this gave King his definite conceptions of rock varieties and their order of eruption, which represented the most advanced views of pre-microscopical petrography and placed King in advance of his assistants of the von Cotta School. Under these influences the volcanic rocks of the region surveyed were studied and classified.

After the collections had been made and brought to New York, Zirkel, the young creator of microscopical petrography, was invited to study the specimens in the presence of the collectors, and we have been told he was much influenced by the eloquent and forceful exposition of King and his associates regarding the nature and occurrence of the rocks. We are led to believe that Zirkel's judgment was warped to some extent in determining the composition of some of the specimens, in particular what were at one time called propylites and trachytes. This opinion would seem to be justified by Zirkel's own statement in his letter transmitting the report to Clarence King. In it he wrote:

"You well remember that happy time in New York when for many weeks we made together the preliminary examination of that vast col-

[2] Emmons, S. F. Clarence King, Amer. Journ. Sci., 4th ser., vol. 13, 1902, p. 229.

lection of rocks. . . . You then enabled me to become acquainted with the geological distribution, relative age, and reciprocal connections of the rocks. . . . You know that when we examined the collection macroscopically I entirely agreed with the determination and nomenclature you and your able colleagues had already arrived at in the field. There were only some doubtful occurrences, whose true nature could not at that time be decidedly cleared up. Now, after having carefully studied more than twenty-five hundred thin sections under the microscope, I have only to testify again that your original designations should almost never be altered or corrected."[3]

The report written by Zirkel in English was edited by King and published as volume vi in 1876. Upon its receipt by the geologists of the Survey, appropriate notes regarding the microscopical characters of particular rocks were inserted in the reports of Hague and Emmons in volume ii, which was published the following year. In this manner were blended the best of pre-microscopical petrography with the earliest products of microscopical research.

The results of Hague's geological work in connection with the Exploration of the Fortieth Parallel are published with those of Emmons in volume ii, "Descriptive Geology," each describing those parts of the region specially studied by himself, in some instances with the aid of the other's field-notes or with those of Clarence King. Hague's comment on the volume may be quoted from his memoir of Emmons, prepared for the National Academy of Sciences (p. 321):

"It is a description of the country, treated geographically, beginning on the Great Plains and progressing westward across the widest part of the northern Cordillera. An endeavor is made to give the structural details and salient geological features lying between the meridian 104 degrees west and the meridian 120 degrees west, the latter being the eastern boundary of the State of California. The volume of atlas maps upon which the early geology was laid down, including the accompanying geological cross-sections, bears the imprint of 1876. . . . Nearly all the great divisions of geological time are represented on the atlas sheets, and in volume ii are described with more or less detail. In this volume the term Laramie formation is used in geological literature for the first time. The necessity for a formation name for a great series of beds covering many hundred square miles in area was

[3] Zirkel, F. Microscopical Petrography. U. S. Geol. Expl. of the 40th Par., vol. vi, Washington, 1876, p. xv.

readily recognized. The name was suggested by one of the authors of this volume and warmly endorsed by Mr. King, provided it would be acceptable to Dr. Hayden, who had, of course, observed the formation at a number of localities in the Rocky Mountains. Dr. Hayden cordially agreed to the adoption of the term Laramie. During the last thirty years probably no geological horizon has been more discussed from many points of view, with all the accumulated evidence brought to bear upon the study of this series of beds."

Mr. Hague is the geologist who first suggested the use of the term Laramie.

In 1877 Hague became government geologist of Guatemala, having been recommended by the Secretary of the Smithsonian Institution through the Department of State. He spent a year in that country studying its mines and volcanic districts, and upon completion of his survey was obliged to take his pay in silver, an inconvenient burden which he was glad to deposit safely in a San Francisco bank after a voyage up the Pacific coast. The following year he went to China, at the instance of Li Hung Chang, to study the gold, silver, and lead mines of North China for the Chinese Government. Owing to excessive conservatism on the part of some of the higher officials and to a conflict of authority, he was not permitted to accomplish much of economic value. However, he enjoyed excellent opportunities for visiting remote parts of the country under military escort and in native costume. Later he made a tour of his own, in European dress, and enjoyed some novel experiences. He left no record of his researches or observations during these years of service.

In the spring of 1879 the United States Geological Survey was established by act of Congress and Clarence King was appointed its Director. The first field parties were organized and began work the ensuing summer, and Mr. Hague was appointed a geologist, to enter upon his duties when he returned from China. He came back by way of London in March, 1880, and it was in London that the writer of this memoir met him by appointment on the way home from Heidelberg, where he had been studying with Rosenbusch, King having promised a position as assistant to Hague when Hague should take up his duties on the Geological Survey. The meeting took place most informally, in Hague's lodgings, while he was finishing his

morning toilet, and was followed by visits to the Museum of Practical Geology, in Jermyn street, where Sir Archibald Geikie and other members of the Geological Survey of the United Kingdom had their offices. The few days together in London and the voyage home to New York were the beginning of years of intimate association in office and camp life, to which the writer looks back with the happiest recollections.

Upon reaching New York, Hague proceeded to Washington to report in person to King and to take the oath of office, which happened on the 10th of April. The first duties of Hague and his assistant were to rearrange and catalogue the extensive collections of rocks made by the Exploration of the Fortieth Parallel, which had been deposited in cabinets in the American Museum of Natural History, in New York, but had become displaced, with respect to their labels, by the movement of the drawers containing them. This involved the identification of the specimens megascopically by comparison with descriptions in volume ii of the published report, and microscopically by a study of the rock sections described by Zirkel—a study of great value to the young assistant. This occupied a considerable part of the following three years, which, however, were devoted to a number of other lines of work.

The summer and autumn of 1880 were spent by Mr. Hague in the field study of the Eureka district, Nevada. His assistants were Charles D. Walcott, fresh from the Grand Canyon of the Colorado, and J. P. Iddings, fresh from laboratory and lecture rooms. The district, twenty miles square, embraced Paleozoic strata and volcanic lavas, with silver-lead mines and prospects, in the desert region of central Nevada. Almost the first night in camp came near being the last; for Mr. Hague, in trying to drive from his sleeping-tent a foraging mule, was kicked in the head above the temple and severely cut, barely escaping with his life. Fortunately, he recovered rapidly and the field-work proceeded normally.

Reference has been made already to his early acquaintance with Bunsen's two-magma hypothesis and the hold it had upon him in later years. In his report on the Eureka district, published in 1892, he recognizes the fact that all the varieties of volcanic rocks in the district "pass by insensible gradations"

from one extreme of composition to the other (p. 290), yet he says they clearly belong to two distinct magmas, a "feldspathic" and a "pyroxenic" (p. 255). He states that he "adopts the views of Bunsen as regards two great groups of lavas, but differs with him as to the origin of the varied transition products of eruption" (p. 273). He thinks they were derived from a common reservoir and says he agrees with King's hypothesis as to the origin of rhyolites and basalts. It is to be noted, however, that Hague included all the varieties of andesites in this grouping, whereas they were not so included in King's hypothesis.

It had been the intention of the Director of the Geological Survey that Hague should establish a branch office in San Francisco and should undertake a detailed study of the volcanoes of the Pacific coast, beginning with Lassen Peak. In fact, Hague had been appointed Geologist in charge of the Division of the Pacific. But a sudden change in King's plans, resulting in his resignation of the Directorship of the Survey in March of the following year, 1881, caused Hague to relinquish the position and return with his assistants to New York, where they established their offices in the American Museum of Natural History. Work on the Fortieth Parallel collection was continued in addition to the preparation of the report on the geology of the Eureka district.

No field-work was undertaken by Hague and his assistant, Iddings, during the two following years, 1881 and 1882; but a microscopical study of the volcanic rocks collected by King, Hague, and Emmons from the Pacific Coast volcanoes, and a further study of the igneous rocks of the Great Basin of Utah and Nevada in the collection of the Fortieth Parallel Survey were made by Iddings, and joint papers on the results were published by Hague and his assistant. In like manner a microscopical study of the collection of rocks used by Dr. George F. Becker in preparing his monograph on the Comstock Lode was made and a joint paper based on the results was published by Hague and Iddings as Bulletin 17 of the U. S. Geological Survey. A joint paper was also prepared on volcanic rocks from Salvador, which had been collected by W. A. Goodyear, a classmate of Hague at Yale.

In 1883 Hague was appointed Geologist in charge of the Survey of the Yellowstone National Park and vicinity, and began field-work in August of that year with a large party of assistants, including three assistant geologists—W. H. Weed, G. M. Wright, and J. P. Iddings—a physicist, William Hallock; a chemist, F. A. Gooch; a professional photographer, W. H. Jackson, and a disbursing clerk, C. D. Davis. The completion of the Northern Pacific Railroad later in the summer attracted general attention to the region and added to the interest taken in the natural phenomena for which the park has become famous. Besides the geological features of the region which were the special object of the Survey, the park was to be converted into a national pleasure resort for persons interested in geysers, hot springs, and natural scenery of a remarkable character; it was to be placed under guard as a huge game preserve, and was subsequently set aside as a forest reserve and a protected reservoir for the headwaters of the two great rivers—the Yellowstone-Missouri and the Snake, or Shoshone. In the prosecution and advancement of these diverse phases of development of the Yellowstone National Park, Hague took an active and prominent part, urging their importance upon the government authorities in Washington and advising as to the proper administration of the laws and regulations whereby the various features of the park could be preserved in the best manner, while its functions as a pleasure resort, game and forest reserve were properly maintained. He was an ardent advocate of the preservation of the striking features of the region in their natural state, for placing hotels and other buildings where they would not mar the attractiveness of the localities to which they were tributary. He was a vigorous opponent of the attempt to introduce a railroad in the national park.

In the study of the region he was especially interested in the geysers and hot springs, but maintained a general oversight of the detailed investigations of his assistants into the geological structure of the region, which consists mostly of igneous rocks, with several mountain ranges of stratified rocks. Portions of the area were investigated in detail by Hague himself. The region surveyed was more than 3,000 square miles in extent and the field-work continued for seven seasons, from 1883 to

1889. The following year Weed and Iddings, under the charge of Hague, explored and mapped the geology of the area north of the Yellowstone National Park, known as the Livingston quadrangle.

The descriptive geology, petrography, paleontology, and paleobotany of the park have been published as part 2 of the Yellowstone Park Monograph, in which the chapter on Huckleberry Mountain and Big Game Ridge was prepared by Hague. He made reports on the progress and results of the work from time to time in the Annual Reports of the Director of the U. S. Geological Survey, besides writing several special papers which appeared as presidential addresses before the Geological Society of America and the Geological Society of Washington—one on the early Tertiary volcanoes of the Absaroka Range and the other on the origin of the thermal waters in the Yellowstone National Park.

In 1897, with T. A. Jaggar, Jr., as an assistant, he studied the geology of the country east of the Yellowstone Park, which had been set aside as a forest reserve and had been annexed to the park forest reserve. He revisited the Yellowstone Park a number of times to continue his observations of the hot springs and geysers. A list of his scientific publications is given at the end of this memoir.

In 1885 Arnold Hague was elected a member of the National Academy of Sciences and served as Home Secretary from 1901 to 1913. He represented the Academy at the Quaternary celebration of the University of Aberdeen in 1906; at the Centenary celebration of the Geological Society of London in 1907; at the one hundredth anniversary of the University of Berlin in 1910, and at the 250th anniversary of the Royal Society of London in 1912. He was appointed a member of the Committee on the Inauguration of a Rational Forest Policy for the Forested Lands of the United States in 1896, and with other members of the committee visited all the forest reservations established prior to 1897, except six that were either well known to the members of the committee or were quite small. In this work he took an active part.

He was a Fellow of the Geological Society of London and of the Geological Society of America, being its President in

1910. He was a member of the American Philosophical Society; a Fellow of the American Association for the Advancement of Science; a member of the Society of Naturalists; the Institute of Mining Engineers; the Washington Academy of Science, and the Geological Society of Washington. He was a Vice-President of the International Geological Congress at Paris in 1900; at Stockholm in 1910, and at Toronto in 1913. In 1901 Mr. Hague received the honorary degree of Sc. D. from Columbia University, and in 1906 the degree of LL. D. from the University of Aberdeen. He was a member of the Century Club and of the University Club, in New York City, and of the Cosmos and Metropolitan clubs, in Washington. In 1893 he was married to Mary Bruce Howe, of New York.

Arnold Hague was at all times and under all conditions a gentleman, whether at home, in the social life of the Capital, or about the camp-fire in the mountains; considerate of the feelings of others; temperate in language and habits; by nature reticent and reserved, he was conservative in his opinions, cautious in his judgment, and deliberate in action. Possessed of normal human instincts, he nevertheless exhibited admirable self-control under what were at times most exasperating circumstances, as when upon one occasion his packer, with the mules and camp outfit, deserted him in the mountains and left him to the chance of meeting one of his other parties or of going without food for several days. Fortunately he encountered one of his assistants the next day, and though he was convinced of the treachery of his packer he retained him in his service until the end of the season as the most judicial procedure, it being very difficult to find a substitute.

Mr. Hague was a man of good taste in music and in art, with a fine appreciation of the beautiful in nature, whether the grandeur of mountains, the colors of a sunset, or the somber tones of an autumn meadow. He enjoyed the brilliant tints of the Grand Canyon of the Yellowstone and was particularly fond of the neutral tones and clear atmosphere of desert scenery, and though undemonstrative by temperament he occasionally expressed his enjoyment of beautiful scenery and his pleasure in sharing it with others in a most effective manner. The writer recalls with emotion the interest Arnold Hague

took in conducting his young assistant, with eyes shut, to the brink of the Yellowstone Falls, so that he might have the pleasure of a sudden view of the many-colored canyon beyond. Although Hague was greatly interested in the preservation of wild animals within the park, he was no sportsman, and said upon one occasion that he had never killed any game or fish in his life. He was not averse, however, to his assistants keeping the camp table well supplied.

As a geologist and explorer, Hague took a lively interest in discovery, whether a bit of geological structure or the lay of new or little-known country. He delighted to follow an elk trail through a difficult region as well as to unravel a complex piece of stratigraphy, but when he had solved the riddle his interest in it ceased, as he himself has said. He cared little to convey his discoveries to others, and in the matter of opinions or theories he seemed to care less as to what others thought; so that he made little or no effort to influence them, and in consequence was indifferent as to publishing the results of his researches. Moreover, he had high standards both with regard to the character of his work and the mode of its expression in print, and this, in conjunction with his deliberate habits of thought and action, may account for the length of time required for him to bring his reports to what he considered a proper finish.

As his geological assistant through twelve years of field and office work, the writer can testify to the kindly interest and cordial coöperation of Arnold Hague in the work of the beginner, and the writer wishes to take this opportunity to express his gratitude for valuable advice upon critical occasions, and for most liberal treatment in the matter of individual research and independent publication of material investigated under the charge of his chief while in the Yellowstone National Park and elsewhere.

The last years of Dr. Hague's life were spent quietly in Washington and in Newport, R. I., his health and strength declining gradually. At a winter meeting of the Geological Society of America in Albany, December, 1916, on a stormy night, when the pavements were covered with ice, he fell and struck his head, losing consciousness for some time. Although

he appeared to have recovered from this accident, his death came suddenly the following May, on the fourteenth, in the 77th year of his age. He was laid to rest in the Albany Rural Cemetery, with others of his family, and near by are the graves not only of his brother James, but of James Hall, Ebenezer Emmons, R. P. Whitfield, Charles S. Prosser, and other men of science.

The spirit of Arnold Hague seems to have been in accord with the tranquillity of a Chinese proverb he was fond of quoting when in the mountains:

> "He who dwells 'midst the turmoil of cities and towns
> Knows not the quiet of rivers and lakes."

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Utah Basin: Northern Wasatch Range, region north of Salt Lake. Ibid., pp. 393-430.

Nevada Plateau: Ombe Mountains to East Humboldt Range, East Humboldt Range, Diamond and Pinyon Ranges, Shoshone Range, and Carico Peak. Ibid., pp. 494-514, 528-569, 618-626.

Nevada Basin: Region east of Reese River, Fish Creek and Battle Mountains, Havallah and Pah-Ute Ranges, West Humboldt region, Montezuma Range and Kawvoh Mountains, Winnemucca Lake region, Truckee River region, and, with S. F. Emmons, region of the Mud lakes. Ibid., pp. 627-635, 660-817.

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