C. H. Clapp

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MEMORIAL OF CHARLES HORACE CLAPP

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Only a small percentage of men are endowed with any considerable executive or administrative judgment, ability, and vision. Smaller still is the group that possesses a penetrating intellect capable of sustained dynamic use in searching for truth in the realm of pure science. Add to these rare talents, moral and physical courage, rigid intellectual and personal honesty, keen artistic perception, and a deep generosity and friendliness, and the essential picture of Charles Horace Clapp is complete. When heritage combines such abilities to a high degree in one individual, his contributions form the milestones in the march of society. Of such men, it may be truly said: "The world is better for their having lived."

Charles Horace Clapp was born in Boston, Massachusetts, on the fifth of June, 1883, to Peleg Ford and Mary Lincoln Manson Clapp. His mother died when he was seven years of age, and his father two years later. Following his father's death, Charles Clapp was reared under the guidance of his older sister, Mary. He received his preparatory education at English High School in Boston. During his high school and undergraduate years at Massachusetts Institute of Technology, he became deeply interested in music, particularly voice, in which he obtained much valuable experience by taking "super" parts with the Metropolitan Opera Company, when it played in the old Boston Theater. Dean Charles H. Warren, of Sheffield Scientific School, refers to Clapp's love of music, saying:

"His one great hobby when I knew him was music. He was not only a good musician himself, but was always attending concerts and the opera when occasion permitted. He had an intimate knowledge of good music, and was a discerning critic."

This desire for good music, Clapp carried with him throughout his life, and many a time around campfires in the Rocky Mountains, at the end of a particularly significant day's field work, he would break forth in an aria from a favorite opera.

In 1905, Clapp was graduated from Massachusetts Institute of Technology, with the B.S. degree in mineralogy and petrology. Already the driving energy and great capacity for work which characterized his life were being felt by his colleagues. It was during those years that he was a student of Dean Warren, who, in a letter, recently said:

"Clapp was one of the ablest and most satisfactory students I ever encountered, and that is saying a good deal, for he was a contemporary of several men who have

made their mark in geology. Another striking characteristic of Clapp was his prodigious capacity for work. I have known few men who were able to do as much work without ever appearing to be in a hurry and who always had time for outside activities. Not only was he an able student and research worker, but he was an excellent teacher."

At the age of 22, and immediately upon his graduation, he went to the University of North Dakota, as an instructor in geology and mining engineering. In the summers of 1905, 1906, and 1907, Clapp first demonstrated his ability to do independent investigation. He was appointed Assistant State Geologist of North Dakota, and, during the field seasons of those three years, obtained sufficient data and information to publish three significant papers on the clays of that state.

Following his teaching and field experience in North Dakota, Clapp returned to Boston to continue his training in geology and mining. He was appointed instructor in the Geology Department of Massachusetts Institute of Technology, and held that position until he received the degree of Doctor of Philosophy in 1910. His investigation of the igneous rocks of Essex County, Massachusetts, formed the basis of his doctor's dissertation. An index to the thoroughness and high scholarly standards that characterized all of Clapp's research studies is the fact that, although he solved the problems of the general features of the igneous geology of that complex area, he was unable to do the enormous amount of detailed petrographic and chemical work necessary to complete the problem for publication while he was in Boston. Consequently, he withheld for ten years all publication of results, except the abstract of his thesis. Then, in 1921, the United States Geological Survey published his results as one of its bulletins.

A course in physical chemistry, under the inspiring direction of G. N. Lewis, awakened in Clapp a realization of the possibilities and significance of the application of this branch of chemistry to the origin of igneous rocks and mineral deposits. It was the mastery of physical chemistry and mathematics, in application to the genesis of ore bodies and to the function of metamorphism in mining, which gave Clapp his pre-eminent position and great success in solving practicably some of the most complicated problems in the Butte mining district, Montana, and which gave him a wide reputation in northwestern United States as a consulting mining geologist.

In the summer of 1908, Clapp was invited to work as geologist with the Geological Survey of Canada. At that time, he started his work on Vancouver Island, British Columbia. This work was continued during the summers of 1909 to 1913 inclusive.

At Devils Lake, North Dakota, on April 19, 1911, Charles Horace Clapp and Mary R. Brennan were married. This event was one of the most

significant in his life, because, in this girl, Clapp found not only a woman of fine character and social attainment, but one to whom he could bring many of his professional and administrative problems for constructive criticism and advice. But above all else, for him she created a home that remained always a refuge of charm and contentment against the cares of his professional world. Into this home during the 24 years of their married life, eight children were born: Daniel, in Ottawa, Canada; Michael and Marybeth in Arizona; and Francis, Lucy, Prudence, Paul, and Margaret in Montana. His home and family were the strongest force and greatest joy in Clapp's life.

Upon receiving his doctorate, Clapp joined the regular staff of the Canadian Survey. The fact that much of the work in western British Columbia was entirely back-packing for long periods of time, the party being largely dependent upon wild game and berries for food, is an index to the physical strength and endurance which Clapp possessed, and which he used unstintingly in his demands upon himself. Professionally, the years Clapp spent with the Canadian Survey were the most productive of his life. From the field and laboratory investigations of those years came a series of 22 papers, which remain as the standard and basic geologic literature of Vancouver and Queen Charlotte Islands. John A. Allan, of the Geological Survey of Canada, writes of Clapp's work in British Columbia, as follows:

"In these publications, accompanied by geological maps of high order, Clapp described with considerable detail the various coal basins and particularly those at Nanaimo, Comox, and Graham Island. The various small metallic and non-metallic mineral occurrences were described with the thoroughness so characteristic of all of his work. However, Clapp's contributions to geology in this Canadian field are of a much wider range, as will be apparent to anyone reading his reports. The broader principles in geology, petrography, and metamorphism are all considered, and on many points he did not hesitate to put forward his own views as to the principles involved. In this respect alone his personal contribution to the geology of western British Columbia is prominent, and at the same time clear and concise. The influence of Clapp's work was felt even after he left the field of geology in Canada. His contributions on the geology of Montana, both in the Great Plains and the Rocky Mountains, added much to our former knowledge of the geology of Alberta."

In order to study the complex geology in Arizona, Clapp accepted a call in 1913 to the University of Arizona, as professor and head of the Geology Department. He held that chair until 1916, when he resigned to accept the same position at the Montana School of Mines. Shortly after going to Arizona, he was appointed assistant geologist on the United States Geological Survey, an appointment which he held until 1925.

During his sojourn at the University of Arizona, Clapp's executive ability and his judgment and wisdom in educational problems first began to be recognized. He was made chairman of the curriculum committee of the University, and was soon involved in administrative duties to the

extent that his first love, geology, suffered thereby. Professor F. N. Guild, of that University, gives a clear picture of the situation, saying:

"Clapp's judgment in faculty conferences was especially valued as he seemed to appreciate the importance of sound foundations and a proper sequence of studies in all scientific work, points which seem only too often neglected in many mining schools. No less, also, were appreciated his broad scientific knowledge and honesty, as well as his attributes of friendship and good will."

The administrative duties into which he was drawn from 1913 to 1916 were the prime cause of his move to the Montana School of Mines. In Butte, Montana, he dreamed of, and began building solidly the foundations for, one of the significant mining schools of the world, located, as it is literally, in the middle of one of the richest and most extensively developed mining districts in the world. Again, however, recognition of his exceptional administrative ability intervened, and this time because of the World War. With his strength of character and strong sense of national, as well as personal, ethics, he could never have acted otherwise than he did. Immediately, he threw all of his experience in mining matters, the resources of his department at the School of Mines, and all of his time and energy into prospecting for important minerals needed by the government to carry on the war. This task required a high type of professional experience and training, and demanded much executive acumen in the handling of men. So well did he do that work, that in 1918 he was asked to take the position of Acting President of the Montana School of Mines. Clapp accepted the position in order to further his dream of a great academic mining institution.

In 1919, in spite of opposition from legislators who had no use for science in general or geology in particular, Clapp succeeded in having created what was virtually a state geological survey, although, for strategic reasons, he was perfectly willing to call it the "Bureau of Mines and Metallurgy." When finally passed by the two houses of the legislature, the bill provided that the Bureau should be administered by the School of Mines, and Clapp was appointed its first director, continuing in that capacity until he went to Missoula in 1921.

Immediately, the new Bureau started to work vigorously investigating the mineral resources of the State. Five bulletins were published from 1919 to 1921, and the eastern half of the State was mapped on a reconnaissance scale. One of the more significant results of Clapp's industry as director of the Bureau was the large, reconnaissance, topographic and geologic model of Montana, built on a scale of four miles to the inch. With the help of Arthur Bevan, J. S. Lambert, and Roy Wilson, the geology for much of the state model was compiled from published folios of the United States Geological Survey, manuscript maps of the Anaconda and other mining companies, maps of the transcontinental railroads that tra-

verse the State, and from maps scattered throughout geological literature. The remaining gaps were closed or narrowed by the reconnaissance mapping by geologists on the Bureau. Two finished models were made, one being in the School of Mines in Butte, and the other in the State University in Missoula. Entirely aside from the significant professional use made of these models by State and visiting geologists working in Montana, their value as an educational exhibit, in helping the citizens of the State to better understand the geologic relations and interrelations of the Rocky Mountains and the Great Plains to the east, is no less valuable but is more difficult to measure.

By 1920, Clapp's success as an educational administrator had become so marked, that the Chancellor and State Board of Education requested him to consider the presidency of the State University of Montana. In 1921, he was finally persuaded to accept this position, which he held for nearly fourteen years, until his death. Thus, he again found himself faced with executive responsibilities, but of larger and more pressing nature than those which motivated his resignation from the University of Arizona. That these duties seriously hindered his productiveness in geologic research is cogently indicated by comparing the five-year period of 1909 to 1914, during which he published 19 original papers, totaling 750 pages, with the same length of time from 1922 to 1927, when he published one abstract of two pages, and that in conjunction with Wilson and Lambert. However, during these years, Clapp managed, in the face of all administrative duties and responsibilities, to continue doing original work on some of the geologic problems of the northwestern Rocky Mountains, and to direct the field activities of reconnaissance parties, which, because of his vision, were mapping the Beltian rocks in particular, but in connection with the areal mapping of western Montana. In 1929, Clapp was able to resume his field work more intensively. From then until his death, he never failed to find time to get into the field for at least a month, and generally more, of intensive mapping, which was the basis of the contributions he again was producing up to 1934.

It was during these years that the writer first began to work with Clapp and to receive from him the rare training and experience in field methods of which Clapp was a consummate master. His standard and method were rigidly simple, with all of the power and effectiveness that accompany simplicity, and were commensurately difficult of achievement. His objective was always the same, rigid accuracy without compromise. The method was, get the facts, get them all, and check the correctness of the facts by every available method. Then, of paramount importance in the method was, register the facts of structure, stratigraphic sequence, areal distribution, and the interrelationships of these facts directly on the map in the field. This method is the only reliable way in which a sound basis for

conclusions can be made in complicated geologic areas, such as the Rocky Mountains. The demands of such a method upon the physical and intellectual stamina, particularly in high and rugged mountains, are severe, and often extremely dangerous. Many a time, after four o'clock and at the end of a normal day of 3000 to 5000 feet of climbing and 10 to 15 miles of walking, he climbed an additional 1000 to 1500 feet and walked 3 to 8 miles more, for the sole purpose of seeing a contact or getting a glimpse of an adjacent area that would help in understanding the structure or stratigraphic relationships observed during the day. In fact, at the age of 50, after traverse-mapping the Camp Creek valley in the Swan Range, made famous in pre-Cambrian literature by Walcott, at five in the afternoon, Clapp began a climb of 1400 feet to the highest peak west of the valley, in order to take advantage of the strong afternoon sunlight to map, with the plane table, the contacts between the Paleozoic and the Beltian formations to the east. To guess or to argue as to what the structural or stratigraphic situation might be on a mountain top ten miles away, held no charm for him; the first point in his method covered such situations; namely, get the facts. Discourse, regardless of its profundity or logic, was never a substitute for facts and realities for Charles Clapp.

When a condition arose in which the facts could not be obtained or understood, even by repeated examination of an area, there was never any hesitation on Clapp's part. A case of this kind arose when he and the writer were mapping the Coopers Lake quadrangle. It soon became clear that further mapping could not be done accurately until at least the major details of the stratigraphy of the Paleozoic deposits were worked out. However, the geologic structures in the quadrangle are too complex to lend themselves readily to solution of stratigraphic problems. Therefore, to find a contiguous area in which these rocks were relatively undisturbed and well exposed became necessary. Clapp immediately insisted that further mapping of the Coopers Lake area cease until the necessary stratigraphic information could be obtained. Conversely, as soon as these facts were made known the mapping was resumed, and this time successfully. Reciprocally, the mapping acted as an excellent check upon the correctness of the stratigraphic conclusions.

Upon completion of the correlation of the Beltian formations in northwestern Montana, and the rigid check upon the accuracy of that correlation imposed by the mapping of the Coopers Lake quadrangle, Clapp turned his attention to the larger, and to him more fascinating, problem of the origin of the stresses that had produced the Rocky Mountains of Montana and Idaho. The scope and mastery of Clapp's concepts can best be understood from the following excerpt from one of his unpublished manuscripts dealing with the structures of northwestern Montana in relation to the Idaho Batholith.

"It appears as if the forces causing deformation in western Montana acted from the southwest; first uplifting and folding the rocks, then breaking them along steeply dipping thrust faults. The western northeasterly dipping faults were probably formed somewhat earlier than the eastern southwesterly dipping ones, but together they made a series of huge downward pointing wedges. Somewhat later the deformation continued to such an extent that relief from the stresses came by the overthrusting of the elevated, deformed, and stronger Proterozoic and Paleozoic rocks to the east on to the much weaker Mesozoic rocks of the Great Plains region. In addition, the structure has been greatly complicated by the intrusions of the batholiths, which have themselves been faulted. It appears as if the folding and wedge-faulting preceded, and the overthrust-faulting followed, the intrusion of the batholiths, which may have made a place for themselves, partly by thrusting aside their confining walls.

"As a result of the work of the Idaho Bureau of Mines and Geology I can extend the general structural pattern into Idaho, but in the southeastern part of the State the overthrust faults had a northeast-southwest trend, dipped toward the northwest, and the overlying rocks had been overthrust to the southwest. Furthermore, these overthrust faults bordered the Snake River Valley, which nearly filled with basaltic lavas, forms a southward pointing arc clear across Idaho from Wyoming to Oregon. The faults extend northward into Montana where they have a north-south and northwest-southeast trend. Valleys follow the Montana faults, and although interrupted by high gravel ridges, they join the Snake River Valley to form in the middle of the rough surface of the North American Cordillera, an inverted question mark, 200 miles in width and 500 miles in length.

"The similarity between this structure and the Victoria disk of central East Africa is striking, but instead of a plateau of old crystalline rocks in the center of the (Montana-Idaho) disk, surrounded by 'rift' valleys, is one of the great batholiths of the world, the Idaho Batholith. It does look as if, perhaps by the rotation of its crystals, the Idaho Batholith has in some way or other affected or produced the overthrusting.

"I was trained by the originator of the stoping hypothesis, Reginald A. Daly, that batholiths were the result of the up-welling of magmas through a folded geosynclinal, working their way toward the surface in a manner analogous to the mining process known as overhead stoping. But in Montana, Idaho, and Washington the geosynclines occur to the east and west of the Idaho Batholith.

"Belief has tempted me to suggest that as a result of the deposition of the thick geosynclinals, the earth's crust was depressed on either side of the disk, resulting in a deep seated flow toward the center of the disk, and a compensating uplift. Perhaps as a consequence of the vertical pressure resulting from a great uplift, the crystals of the granite of the Idaho Batholith, were rotated and elongated horizontally, causing the pressures, radiating outward, that produced the rift valleys and surrounding zone of overthrust faulting. Belief also tempts me to suggest that the granite magma itself was squeezed upward by the closing in of the walls of its crucible. As the magma approached the surface, the region of lower pressures, it appears to have spread outward and made room for itself by thrusting the upper walls of the crucible apart, faulting, and overthrusting the folded sedimentary rocks of the surrounding geosynclinals."

Two seasons of detailed areal mapping in the contiguous ranges to the east of the Idaho Batholith were completed by 1934, and five additional years of similar field work were planned in order to obtain the necessary evidence for the completion of that one problem. It was at this stage in his life, and with great promise of more significant results than were

achieved from 1909 to 1914, that death cut short the professional life of Charles Clapp.

To visualize the man solely from his professional attainments is to see less than half of his true self. The latter third of his life, fully half of his mature years, was given largely to the passing, transient, but immediate, problems of academic administration. In this field, Charles Horace Clapp perhaps achieved results even greater than in his first chosen field, geology. Except for his work with the University of Arizona, previously referred to, Clapp's administrative life was devoted to Montana. President Francis A. Thomson, of the Montana School of Mines, recounts that when the President of the Montana School of Mines took leave of absence in 1918, Clapp, although one of the youngest men on the faculty in point of service, was the obvious choice for acting-president. A year later, when the president resigned, Clapp was appointed permanently to the chair. But geology was still his first love, and, with superabundant energy, he continued his teaching in conjunction with his administrative duties, finding time to inspire his associates with his zeal, increasing the appropriations from the legislature, straightening out the curriculum, and adding two new buildings to the campus. Meanwhile, the enrollment of the School of Mines had increased nearly a hundred per cent.

Such results were too conspicuous to escape notice, and, in 1921, when the presidency of the State University at Missoula fell vacant, the demand that Clapp move to the larger institution was insistent. Clapp's administrative problems and contributions to Montana during his 14 years as President of the State University are clearly portrayed in the following comments by Dean R. H. Jesse, who was intimately associated with him throughout that period.

> Clapp's scientific training made him a thorough advocate of the "scientific method": first assembling accurately all facts, then drawing generalized conclusions from the facts. He also firmly believed this method to be applicable to economics, political science, sociology, in short, to human relationships. Once the facts were assembled he believed they spoke for themselves and did not need added persuasion or argument. For example, in preparing university budgets and legislative requests, Clapp's carefully made and accurate estimates were facts to him. His high regard for fact and his inveterate honesty prevented him from padding these estimates against possible reductions. When such reductions were made, they consequently cut to the quick.
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> Clapp used much of his time during several years prior to 1928 assembling facts for a most elaborate and painstaking "Educational Statistical Survey" in which he compared, in many tables, the resources of twelve northwestern states, the amounts each spent for higher education, and the manner of this spending. He became the best authority in Montana on the amounts to be realized from taxes. His predictions on such matters were more accurate than those of any other State officer, or interested banker. One banker referred to this ability as "uncanny." To Clapp there was nothing mysterious in the method. It was simply the result of studying the pertinent facts exhaustively. The conclusions were inevitable.

In the latter part of his administration Clapp became convinced that many of the courses in our colleges and professional schools were over-specialized to the extent that they were not showing to the student the interrelationships of the different fields of knowledge, and therefore were not giving to the students an integrated picture of these fields. Clapp was harassed by the thought that a baccalaureate degree too often represented merely a collection of credits and grade points instead of a comprehensive understanding of some branch of learning and its relations to other branches. Accordingly, during his administration a rearrangement of the College of Arts and Sciences into a lower and an upper division was begun. The lower division was largely centered around four survey courses in the fields of social science, humanities, biological, and physical sciences. Even in the upper division and in the professional schools, Clapp believed that the best preparation consisted of thorough grounding in the broader fundamental aspects of any specific branch of learning. At the time of his death he was deeply concerned with the question of what the University might offer that would be significant to those students who did not seem to fit into the present university curricula.

Thus, in matters of educational policy, Clapp was not only in touch, but was independently testing and experimenting, with the most recent hypotheses and practices of education. This vision and independence of judgment placed him among the foremost thinkers on education administration in North America.

Among other contributions to the University and State are included Clapp's successful efforts in 1920, while he was at the School of Mines, for the establishment of the millage tax to support the institutions of higher learning of Montana, and, in 1930, to renew and enlarge this tax. During his administration, he acquired adequate land for the University's future needs, constructed eight new buildings, and reconditioned a ninth. At the same time, the student population increased from 1400 to more than 2000.

Some concept of Clapp's position with his colleagues at the time of his death may be formed from the words of Professor F. C. Scheuch.

"The best he possessed was given skillfully and unstintingly, that the higher aspirations of the University might be transformed into the realities of living men and women. Intellectually, he commanded the immediate respect of both his colleagues and students. His enthusiasms and almost infinite capacity for work carried him far beyond this campus into the affairs of the nation. He was the friendliest of men, in the finest sense, without effusion."

Thus, throughout his life as an educational administrator, as well as that of a research geologist, Clapp gave abundantly of his time, strength, and talents, not only achieving greatly himself, but inspiring others to high standards. All his work was characterized by the courage and vision of the pioneer, and, like all such leaders, he blazed new trails in education and science, thereby pointing the way for other workers in these fields. At the very crest of his power, with the promise of still more productive years ahead, death intervened. American education and geology are stronger and richer because Charles Horace Clapp lived, even though by his untimely death they lost immeasurably.

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