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MEMORIAL OF GURDON MONTAGUE BUTLER

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Gurdon Montague Butler, who died February 21, 1961, at the age of 79, more than any man was responsible for the growth and development of engineering education at the University of Arizona. Countless geologists and engineers trained under his guidance will remember Dr. Butler, many with affection, all with admiration. His impact on Arizona was great; educator, advisor, administrator, geologist, mining engineer, civic servant, "Monty" Butler was good at all.

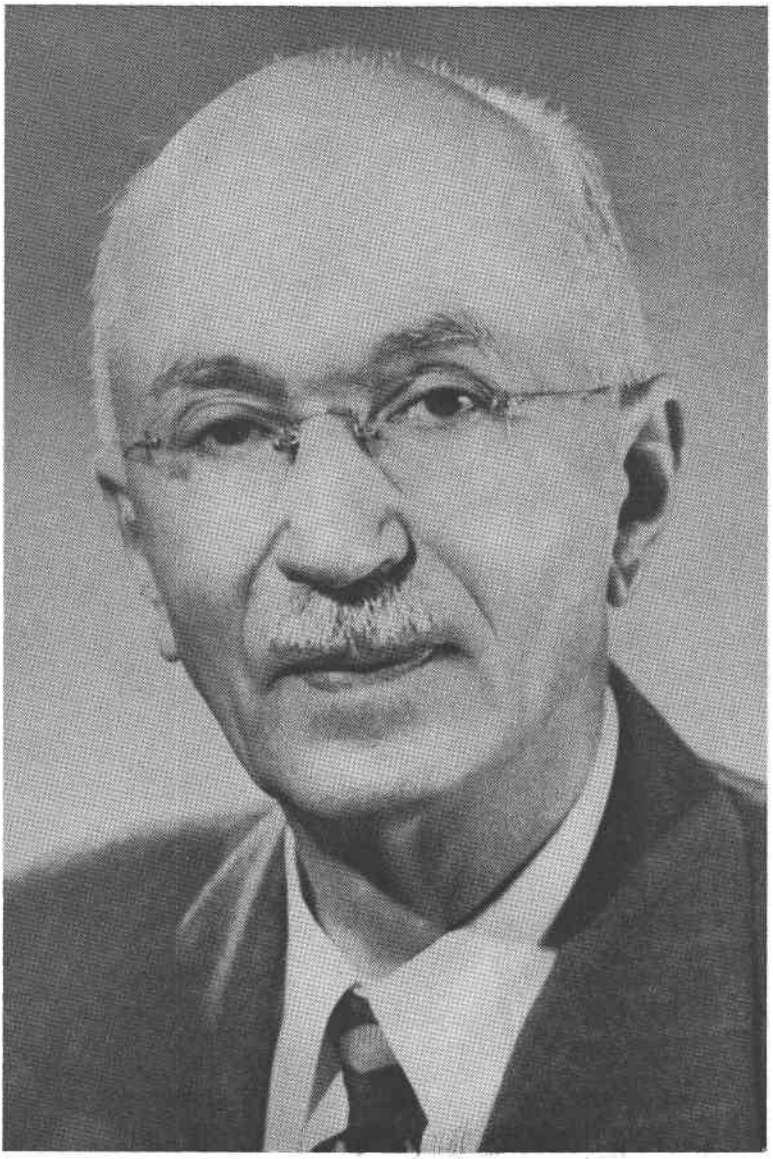
Dr. Butler was born March 26, 1881, in Lake Geneva, Wisconsin. He earned the E.M. degree in 1902 at the Colorado School of Mines, and in 1922 was honored by his alma mater with an honorary D.Sc. for his achievements in the field of engineering education. Butler was an outstanding student at Mines and played football there for four years. He continued on as instructor and rose to the rank of associate professor of geology and mineralogy, serving also as geologist for the Colorado Geological Survey. During this period he published papers on the economic geology of several mining areas of Colorado, as well as on the clays of eastern Colorado. During his tenure on the Mines faculty he originated and taught the first course in America on what was to be his life-long enthusiasm—gems.

He left Colorado in 1913 to become associate professor of mining engineering, later professor of geology, in the Oregon Agricultural College. He was also geologist with the Oregon Bureau of Mines and Geology.

Dr. Butler began, in 1915, his long and distinguished association with the University of Arizona. In that year he was appointed Dean of the College of Mines and Engineering, and Professor of Mineralogy and Petrology. His academic duties varied through the years and he was at various times also professor of mining engineering and of geology. Through his influence, geologists of the stature of Frederick Leslie Ransome, William Morris Davis, M. N. Short, B. S. Butler, and Alexander Stoyanow taught in the Department of Geology.

He assumed the Directorship of the Arizona Bureau of Mines in 1918. Butler was largely responsible for the production of the Arizona State Geological Map through his efforts in arranging liaison between the U. S. Geological Survey and the Arizona Bureau of Mines.

Butler's influence as a teacher was great. He had a special capacity, through the force of his personality, for persuading students to "put out" in the classroom and in research. This same forceful yet gentle manner was equally effective in drawing the most from his faculty and the staff of the Bureau. His own enthusiasm for hard work and getting things done



GURDON MONTAGUE BUTLER
1881–1961

rubbed off on hundreds of students and associates over the years.

Because of his abiding interest in improving engineering education, Butler was one of six original members of the committee, composed of representatives of the six national engineering societies, set up by the Engineers Council for Professional Development. He played an important part in the movement to raise the caliber of engineering education in the United States through the accreditation of engineering colleges and continued his active affiliation with ECPD for many years.

A similar concern for the development of professional standards brought him to write the first Arizona law on registration of engineers and architects in 1921. He was a vigorous member of the Arizona State Board of Technical Registration from 1921 to 1951, and was at one time president of the National Council of State Boards of Engineering Examiners. Butler held the first professional engineer registration in Arizona.

A very strongly developed sense of civic responsibility drove him to extensive participation in local and state affairs. When Dr. Butler employed his boundless energy and organizational skill in civic activities he succeeded in injecting purpose into group endeavors. His habitual workday of up to 16 hours made it possible for him to contribute so much. He was president of the Tucson Chamber of Commerce and a director for many years. He served on the boards of the Tucson YMCA and the local council of Boy Scouts of America, was chairman of Tucson's first planning commission and was largely instrumental in drafting the city's first zoning ordinance and getting it passed. A 33rd degree Mason and a Shriner, he was a Grand Master of the Grand Lodge of Arizona. Butler was also active in Rotary and served as governor of the 43rd Rotary district.

Dr. Butler had complete charge of engineering war work and training of military personnel on the University of Arizona campus during two World Wars. His work load was so heavy during the second World War that his health was impaired.

His professional affiliations and memberships in honorary societies were many. Dr. Butler was a fellow of the Mineralogical Society of America, the Geological Society of America, and the American Association for the Advancement of Science. He was a member of the American Institute of Mining and Metallurgical Engineers, the Mining and Metallurgical Society, the Society for Engineering Education, The American Association of Engineers, and was elected honorary member of the American Institute of Architects for "—distinguished service to the profession—".

His scholastic affiliations included membership in Tau Beta Pi, Phi

Kappa Phi, Sigma Xi, and Theta Tau; his social fraternity was Phi Gamma Delta.

During his many years as an administrator, the amount of time he could devote to research was limited. He did, however, publish a number of papers during those years and was active in mineralogy and gemology. He built up an excellent private collection of precious and lesser gems in which he took great delight and pride. He was a shrewd man, indeed, when it came to evaluating gems; he was never more delighted than when he saw the expression of the unsuspecting person into whose hands he dropped a diamond that "would choke a horse."

Probably his best known published work was his excellent "Handbook of Mineralogy, Blowpipe Analysis and Geometrical Crystallography," which has been widely used over the years since its publication in 1918. It is still to be found on the bookshelves of many mineralogists.

Throughout his career Dr. Butler was a trim, vigorous man. His early interest and excellence in football reasserted itself while he was Dean of the College of Mines and Engineering at Arizona. When the University failed to sponsor a football team in 1918, a University football club was organized and Butler played once again. He bore scars of these wild encounters with students on the rocky Arizona desert to the end of his days. He was proud of them and maintained that football playing was one of the most important aspects of his education because it had developed his aggressiveness and self-confidence.

As a gesture of esteem and friendship, Carl Lausen named one of the sulfates he described from the United Verde mine at Jerome butlerite.[1] Another associate, Eldred D. Wilson, geologist with the Arizona Bureau of Mines, named a previously undescribed mountain range on the Camino del Diablo in southern Yuma County, Arizona, the Butler mountains. Monty felt very honored by these namesakes, but seemed to favor butlerite over the Butler mountains, perhaps because it is less forbidding.

When, in 1940, the College of Mines and Engineering of the University of Arizona was divided into two colleges, Dr. Butler became Dean of the College of Engineering but retained an active interest in the Mines College. At this time he also relinquished the Directorship of the Arizona Bureau of Mines. He retired from the Deanship in 1951 and from active teaching in 1954, at which time he moved to California.

At the time of his retirement Dr. Butler said that "the most satisfying aspect of my professional career has been the opportunity to offer advice and to teach several thousand fine young engineers." The effectiveness of

[1] Lausen, Carl (1928), Hydrous sulphates formed under fumerolic conditions at the United Verde mine (Jerome, Arizona). *Am. Mineral.*, **13**, 203–229.

his "source of satisfaction" is measured by the successes of his many former students.

Monty Butler was a man of somewhat stern visage. He had an air, a manner about him that was noted by all who came in contact with him. But he was a kindly man who chose to remember only the good his students and associates did, never their sins. He was a man who, in exercising his exceptional talents to foster the education of others, and in building a distinguished record in this field, deliberately chose to relegate his own scientific career to a place of secondary importance.

Dr. Butler is survived by his widow, a son, Gurdon, and a daughter, Enid (Mrs. Thomas Helvey), all of California.

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MEMORIAL OF HUGH RICHARD GAULT

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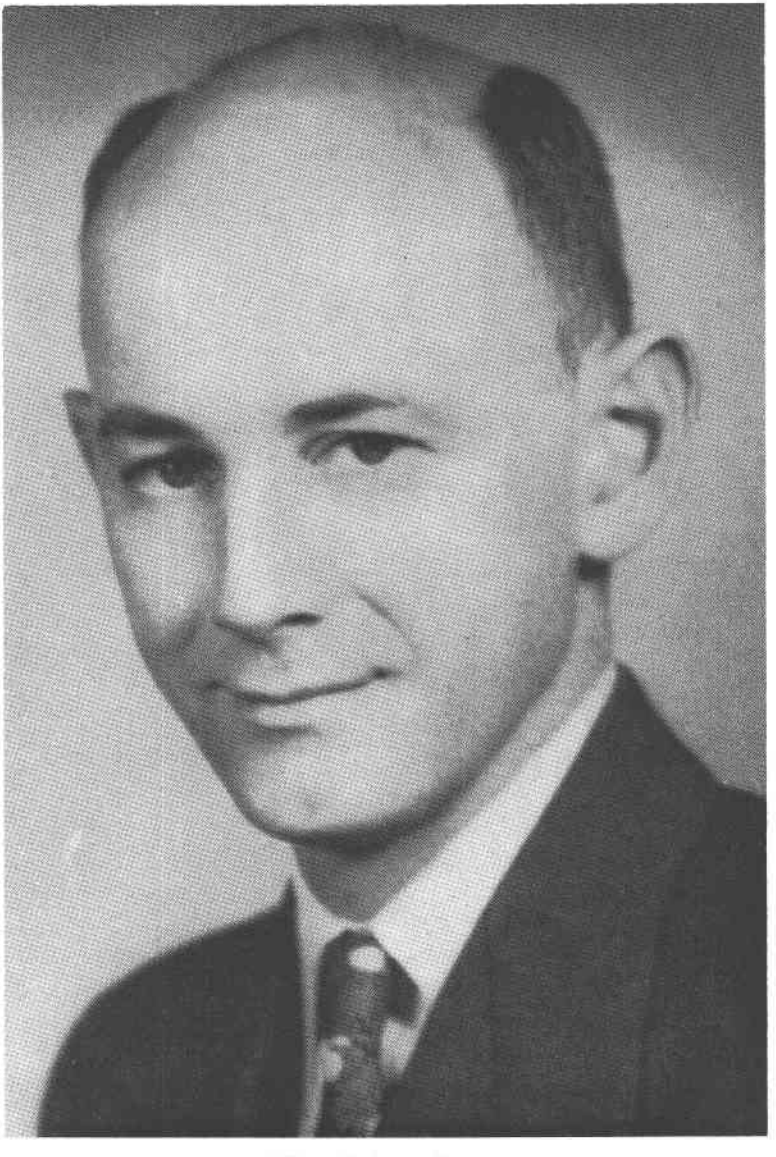
Hugh Richard Gault was born in Chicago, Illinois, on February 7, 1915. He received his early education at Belding Grammar School, Chicago; Ravinia Grammar School, Ravinia; and Deerfield-Schields High School, Highland Park, Illinois. In September 1932 he was enrolled as an Edward Rector Scholar at DePauw University. The Department of Geology at DePauw at this time consisted of one man, Professor E. R. Smith. "Rock" Smith made a geologist and a scientist out of Dick Gault and instilled in him high academic standards and a questioning mind, not only in geology, but also in related fields.

Dick received his Bachelor of Arts degree in geology from DePauw University in June 1936. From 1936 to 1938 he was a graduate student at the University of Missouri and he received his Master of Arts degree in geology in June 1938. During these two years he served as Graduate Assistant in Geology at the University of Missouri from 1936 to 1938 and at Central College from 1937 to 1938. The following year he devoted to graduate study at the Pennsylvania State College, where he also served as Graduate Assistant in Geology (1938–1939). The summers he spent working: in 1935 in the Black Hills, South Dakota, with a field party from the State University of Iowa, and in 1936 and 1937 as a Junior Highway Engineer with the Illinois Highway Department.

In September 1939 Dick entered the Johns Hopkins University. During his studies there he served as Graduate Assistant in Geology from 1939 to 1941. During the summers of 1940 and 1941 he worked in Alabama, in cooperation with the Alabama Geological Survey. Dick was particularly interested in the Pinckneyville quartz-diorite complex of eastern Alabama and performed a detailed study and systematic petrographic sampling of the area. Based upon field observations and thin-section petrofabric analyses, he showed that the Pinckneyville complex is a syntectonic intrusion. He also demonstrated that the igneous and metamorphic characteristics which he found the quartz-diorite to possess are due to the internal forces of magmatic flow and the external forces of folding. On this study, compiled under the title "The petrography, structures, and petrofabrics of the Pinckneyville quartz-diorite complex of eastern Alabama," Dick was awarded the degree of Doctor of Philosophy at the Johns Hopkins University in the spring of 1942.

Immediately upon completing requirements for his doctorate he



Hugh Richard Gault
1915–1961

entered on duty with the Alaskan Branch of the U. S. Geological Survey on May 1, 1942. During the following three years all summers and one winter were spent in Alaska. Here under most difficult field conditions, with what today would be considered almost primitive logistic support, he performed the most thorough and scientific examinations yet made in the area. In the Wrangell district of southeastern Alaska he studied extensively explosion breccias and lead-zinc deposits in the Groundhog and Glacier Basins. During the winter of 1942–43, in company with Dr. Clyde Wahrhaftig, he mapped and interpreted the complex geology of the Salt Chuck copper-palladium mine, Prince of Wales Island.

In 1945, when the Trace Element Investigation studies of the U. S. Geological Survey became active in Alaska, he was placed in charge of this program, primarily engaged in studies in eastern Seward Peninsula.

On February 1, 1946, Dick began his teaching career by joining the staff of the Department of Geology of Lehigh University as an Assistant Professor. He rapidly rose to Associate Professor, Professor, and finally, in 1959, Head of the Department.

During the academic year 1953–1954 Dick was granted leave of absence from his university duties in order to accept the position of Executive Secretary, Division of Earth Sciences of the National Research Council in Washington, D. C. Here he was responsible for the normal operation of administrative duties and for conducting the business of eighteen advisory and technical committees. The sharp increase in research in the earth sciences in the post-World War II period created problems in communication and storage of the enormous amounts of new data resulting from these investigations. In order to discuss these problems and eventually solve them Dick organized and conducted on May 1, 1954, a conference on "Problems of Communication and Storage of Information in the Earth Sciences," which was this division's annual conference for that year.

During his stay in Washington Dick, in addition to efficiently carrying out his duties at the National Research Council, also found time to stay in close touch with the geological research laboratories in the area. He kept himself informed about the most recent developments and even at times spent nights and weekends to familiarize himself with and to perform new laboratory techniques. After returning to Lehigh in the summer of 1954 he remained in contact with the research developments in Washington. He was particularly interested in research on ore deposits and in the following years made frequent visits to work on sulfide projects with us at the Geophysical Laboratory. In 1960 his enthusiasm for this kind of research was rewarded in the form of a grant from the Research Corporation enabling him to equip a laboratory for sulfide-type research at

Lehigh. Dick did considerable work on the ternary Pb-S-Se system and was planning to carry his studies into the complicated quaternary Pb-Bi-S-Se system when he became ill in the late spring of 1961.

At Lehigh Dick was tireless in his efforts to improve teaching methods and to give the students a broad background in the sciences. In the reorganization of the Department of Geology he eagerly sought to draw geology closer to the basic sciences by requiring the students to take additional courses in these fields and by modifying existing geology courses with a view to modern concepts of physics and chemistry. Dick also was tireless in his work to provide better laboratory facilities and equipment both for the staff and for the students. Several well-equipped laboratories now bustling with activity testify to the success of his efforts.

At Lehigh University Dick served on numerous committees, including that of Educational Policy, and on the Executive Committee of the Graduate School. The results of his labors on these committees have left lasting marks on the University.

In his busy schedule Dick also found time to consult for many of the Lehigh Valley limestone consumers. By adding the results of his extensive stratigraphic and structural studies of local limestones to his profound knowledge of the geochemistry of such rocks, Dick was of great help to numerous local cement manufacturers and to the Bethlehem Steel Co. Dick realized the importance of geological knowledge to the cement industry and sponsored evening courses designed for this explicit purpose.

Dick Gault was a fellow of the Mineralogical Society of America and of the Geological Society of America. He was a member of the Society of Economic Geologists, the Geochemical Society, the American Geophysical Union, the American Institute of Mining, Metallurgical and Petroleum Engineers, the Geological Society of Finland, the Pennsylvania Academy of Science, the National Association of Geology Teachers, the Lehigh Chapter of the Society of the Sigma Xi, and of the Geological Society of Washington. As a fellow or member of these professional societies Dick devoted much effort and time to committee, secretarial, and editorial work. He served on the Committee on Publications of the Society of Economic Geologists. The American Geophysical Union appointed him editor of the Section of Volcanology for a term of several years, and he was elected Secretary of the Section of Tectonophysics for the 1958–61 period. He was a former chairman of the Lehigh Valley section of the American Institute of Mining, Metallurgical and Petroleum Engineers and for several years served as representative of the Geological Society of America on the Committee on Government Rela-

tions of the American Geological Institute. Although he was not an official member of the Geochemical Society's Standard Committee, it was through his efforts that a dolomite sample was obtained and is now being processed into a rock standard.

Dick Gault entered college during the height of the depression years and literally worked his way through to his doctorate. In the words of his brother Donald: "His was not an easy way. There were many times when he did without meals. Dick claimed recently that this was good for him. Adversity and humility are often partners." This humility, which is such a desirable trait to the scientific mind, but unfortunately rarely found, was one of Dick's strong characteristics throughout his career as a scientist and scholar.

At the height of his career he fell the victim of cancer and died on July 5, 1961, in St. Luke's Hospital at Fountain Hill, Pennsylvania. He is survived by his wife, Annebelle; their two children, Nan Brannan and Hugh Richard, Jr.; his parents, Mr. Frank Leonard Gault of Richmond, Illinois, and Mrs. A. B. Gault of Marengo, Illinois; and his younger brother, Donald E. Gault of Los Altos, California.

With his death the field of geology has suffered the loss of an outstanding, versatile, and productive scientist and scholar.

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THE AMERICAN MINERALOGIST, VOL. 47, MARCH-APRIL, 1962

MEMORIAL OF ESPER SIGNIUS LARSEN, JR.

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Esper Signius Larsen, Jr. died at his home in Washington, D. C. on March 8, 1961. He had been in poor health for several years. The Mineralogical Society of America has lost one of its most distinguished fellows and productive investigators and one who will be always remembered with devotion by his colleagues and former students.

Larsen was born at Astoria, Oregon, March 14, 1879. His father had shortly before come to the United States from Bornholm, Denmark and was the first Danish Consul to be stationed in Portland, Oregon. Larsen attended public high school in Portland from which he was graduated in 1898. At this point his education was interrupted, and he spent the following four years working in a wholesale grocery in Portland to accumulate enough money to continue his studies. In 1902 he enrolled at the University of California with the intention of studying mining engineering. There, under the influence of A. C. Lawson and A. S. Eakle, he developed a lasting interest in mineralogy and petrology and abandoned his earlier thoughts of a career in mining. He received his bachelor's degree from California in 1906 and remained there the following year as an instructor. He returned for the academic year 1915–16 as acting professor of geology and in 1918 received his Ph.D. degree.

After leaving the University of California, Larsen's first professional job was as assistant petrographer at the Geophysical Laboratory. F. E. Wright had the year before been appointed petrographer, and the two men worked together to their mutual advantage. The work on *Quartz as a Geologic Thermometer* was done during Larsen's two years at the Laboratory, and the results were published in 1909 under their joint authorship. This paper was the first systematic attempt to establish criteria for determining temperatures within the earth and still stands as a monumental contribution to American mineralogy.

In 1909 Larsen joined the United States Geological Survey; first as Assistant Geologist, 1909–1914; then Geologist, 1914–1918; and finally in charge of the petrology section, 1918–1923. While at the Geophysical Laboratory, Larsen learned from Wright how to study minerals by the immersion method. He was fascinated by the procedure which enabled one, with the use of a polarizing microscope, to determine the optical properties of a tiny mineral grain which would uniquely characterize it. When he joined the Geological Survey this method was thoroughly familiar to him, and he became its foremost advocate in the United

Esper Signius Larsen, Jr.
1879–1961

States. At that time the published optical data on minerals were meager, and Larsen set himself the task of measuring the optical constants on all the authenticated minerals available. To do this was a difficult assignment extending over many years and involving determinations on over 600 minerals. It was, nevertheless, rewarding and in 1921 the data were published in a bulletin of the U. S. Geological Survey entitled *The Microscopic Determination of the Non-opaque Minerals*. This work, and the second edition in 1934 compiled with the aid of Harry Berman, is known and used by every student of mineralogy in the world. Its systematic listing of optical properties of minerals has made the petrographic microscope an indispensable tool in precise mineral identification.

After joining the United States Geological Survey, Professor Larsen spent nearly every summer in the field for the next 40 years. His field work while on the Survey centered about a study of the San Juan region of Colorado and New Mexico, one of the world's greatest masses of volcanic rocks. Whitman Cross had been working on the geology of this area for fifteen years when he was joined by Larsen in 1909. Until 1930, except for three years spent in a search for tungsten and molybdenum during World War I, Larsen returned for at least a part of each summer to his beloved San Juans. Many men had a part in this work but in addition to Cross, Clarence S. Ross was his chief associate. A lasting friendship and mutual respect grew up between the two men and on the occasion of the presentation of the Roebling medal to Larsen, Ross said, "We have worked together in the laboratory with microscope by microscope. . . . We have eaten camp fare together, traveled the mountain trails together, slept under the stars together. . . . We have traced lava flows and mapped boundaries together; in the laboratory or by the campfire we have had many discussions, some of them heated, but all of them friendly."

The investigations in the San Juan region resulted in a long series of papers, culminating in a United States Geological Survey Professional Paper on *The Geology and Petrology of the San Juan Region of Southwestern Colorado*. This monograph was Larsen's last major publication; it appeared in 1956, forty-seven years after he began his work in the area.

After joining the Harvard faculty in 1923 as Professor of Petrography, Larsen continued his work that he initiated with the Geological Survey and also embarked upon new projects. The first, beginning in 1930, was a systematic study of the complex batholith of Southern California. These rocks were not entirely new to him, for in 1906, as assistant to W. C. Mendenhall, he had been introduced to the area. Here, with graduate student assistants, field studies continued for several seasons and the laboratory work for many years. Several Ph.D. dissertations, one of which was the writer's, resulted. The accumulative results of the study

were published by Larsen in 1948 as *Memoir 29* of the *Geological Society of America.*

In 1933, supported by a grant from the Shaler Memorial fund of Harvard University, Larsen began his last major field project, a study of the igneous rocks of the Highwood Mountains and surrounding areas of Montana. This was Larsen's greatest training ground of students. Instead of being assisted by them, it was he that assisted the students in their mapping, their interpretations and their reports. Had he had fewer "assistants" the work might have been speeded considerably. Nevertheless, as the master coordinator, Larsen gathered together the results of these individual studies and in 1940 incorporated them with his own observations into the publication, *Petrographic Province of Central Montana.*

The last decade before his retirement from Harvard, Larsen became interested in the measurement of geologic time, and over a third of his publications from then on dealt with this problem. Although he had long been interested in the subject, his active participation began while determining the rare elements in the rocks of the Southern California batholith in which he found that the radioactivity was concentrated in the zircon and a few other rarer accessory minerals. Would it be possible, he questioned, to separate the zircon, determine its radioactivity by the measurement of alpha emanations and its content of radiogenic lead by spectroscopic means? If this could be done and a lead-uranium ratio obtained, the age of the rock could be determined. Aided by a generous grant from the Geological Society of America and after ten years of careful, painstaking and often frustrating work on the part of Larsen and several assistants, this supposition was confirmed. The *Larsen method* is today one of the standard procedures of age determination.

Larsen was recognized as a world master in descriptive and theoretical petrology. On the occasion of the presentation of the Penrose medal to Larsen, Ward Smith said

"As a geologist, Larsen has splendid ability as a field observer to combine with his talent for precise work in the laboratory. Consequently, Larsen's descriptions of rocks are unsurpassed for completeness and accuracy. . . . All who turn their attention to questions of petrographic provinces, of the nature of magmas, of the evolution of the igneous rocks, will find in Larsen's publications both solid evidence and persuasive, logical analysis."

In 1950 N. L. Bowen in his paper *The Making of a Magmatist* writes,

"He probably scorns a label, preferring to be regarded as one who keeps an open mind, as indeed he is (Larsen, 1950), but it is no great distortion of the truth to say that Professor Larsen is a magmatist. He would not, at least, regard this designation as a term of contempt, nor should he, for he acquired magmatist views as a result of long years of arduous field studies in difficult but rewarding terranes and of equally arduous investigation of materials and collation of facts gleaned in the field."

After reading Larsen's publications it is difficult not to agree with Bowen that Larsen was a magmatist. And yet in his last few years of formal teaching he gave evidence from his own field work that all "igneous" rocks may not have been formed in the same way and that granitization may have been responsible for some of them. His was not a closed mind; he insisted that for traditional thoughts and ideas to be acceptable they must be able to withstand the searching scrutiny of the advancing science.

He was also eager to try new techniques. H. W. Fairbairn wrote in the Larsen *Festschrift*

"It is a pleasure to acknowledge Professor Larsen's part in the development of the petrofabric background which has led to this paper. It was his scholarly interest in this field, then (1930) virtually unknown outside Austria and Germany, which first made me aware of its possibilities. Although not his own special interest, his encouragement at that time of this new work has in no small measure been responsible for my own continued interest in it."

Although Larsen's more lengthy publications, reflecting his lifelong devotion to field work, dealt with descriptive and interpretative petrology, his bibliography shows his keen interest in descriptive mineralogy. He was author or co-author of papers describing 24 new mineral species. Seven new minerals resulted alone from his study of the phosphate nodules from Fairfield, Utah. He had a keen eye for the unusual mineral whether in an igneous rock or a crust on a dry lake, and his collecting bag at the end of the day usually carried at least one such mineral brought into camp for more careful examination.

By the standards of the Harvard undergraduate Professor Larsen was not a good lecturer but at the same time he was one of Harvard's great teachers. He was never too busy to interrupt his work to talk with students about their professional and personal problems. In the introduction to the Larsen *Festschrift* in 1950 J. C. Rabbitt wrote,

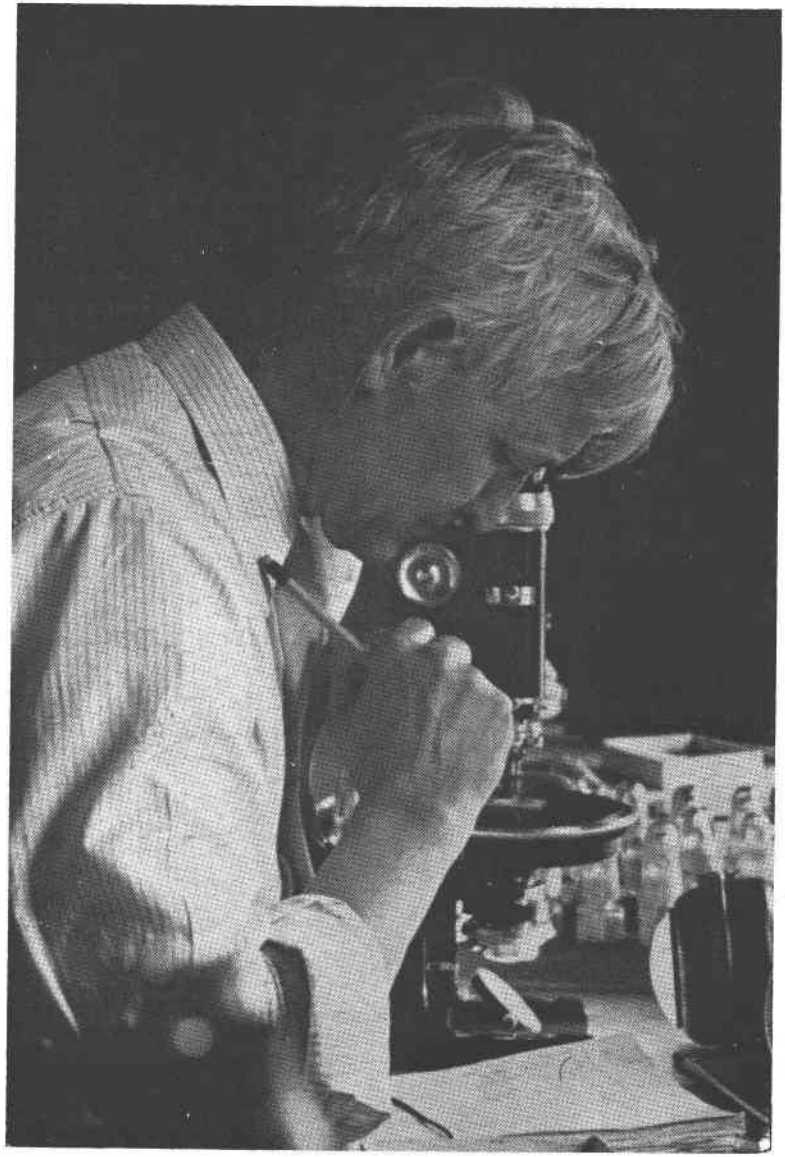
"As a teacher Professor Larsen's methods resulted above all in well trained students. He insisted on the proper balance in field and laboratory work, and he exemplified this in his own scientific career. He had infinite patience with all of his students, the brilliant and the mediocre, the hard worker and the loafer. . . . It was a privilege to the student to have those individual discussions with him in which his vast knowledge was made so readily available. Nor were these discussions ever on the plane of expert and tyro; rather, they were on a plane of mutual seeking of geologic truth. The student's ideas, ill-conceived as they often were, were considered with respect and thus mutual confidence was attained. In formal lectures, in the field, during demonstrations at the microscope, in informal talks in his office, at the luncheon table, or in his home, this relationship always held. . . . In all this there was a complete lack of professorial authoritarianism and orthodoxy and yet there was no doubt as to who was the leader but it was a leadership which was not based on affectations, histrionics, or a need to uphold a dignity which everyone took for granted."

Probably few professors at Harvard or elsewhere have had the deserved reputation for absentmindedness as Larsen. It was as much a part of him as his gentleness, thoughtfulness and kindness. Such things as reprimanding the wrong student, smoking another man's pipe, taking a wrong coat at the Faculty Club, boarding the wrong bus at Harvard Square, setting fire to kitchen matches in his pocket during a lecture, or losing his wedding ring were almost daily occurrences. Each of his students had his own favorite "Larsen story," oft repeated but never in derision. The story arising from an episode the student had observed at first hand, seemed with each telling to give him a feeling of closer friendship for and greater understanding of "The Professor."

Several years after going to Harvard Larsen's eyesight began to fail; he was told that he had cataracts on both eyes and that he would progressively lose his sight. This was a severe blow to a man so devoted to his work and for the practice of which the microscope was such an important tool. All that knew him at that time will remember his carrying a large magnifying glass which he used for reading; they will also remember that there was never a word of complaint or of self-pity. In fact many of his associates never knew of this cloud that was hanging over him. However, through treatment the cataracts not only became arrested, but his vision improved. The magnifying glass was discarded and microscopic work continued for the rest of his active career. The accompanying photograph on page 456 of Larsen at his microscope shows him in his most characteristic pose.

Larsen never took a vacation in the ordinary sense. When told he should take a vacation his reply was "I have two a year. In the summer I have a vacation from teaching and laboratory and in the winter I have a vacation from field work." In 1948, he attended the International Geological Congress in England. It was the only time he left the North American continent and this was done under protest and at the insistence of Mrs. Larsen. His one diversion and relaxation while at Harvard was found in his small flower garden at his home in Belmont, Massachusetts. Here he raised spring and fall flowers, but he took greatest pride in his tuberous begonias which he delighted in giving to his friends.

On his retirement from Harvard in 1949 Larsen returned to Washington, D. C. To him it was going home and back to the friends he had made in his early days at the Geophysical Laboratory and Geological Survey. These friends received him warmly, and he became a consultant to the Geochemistry and Petrology Branch of the U. S. Geological Survey. He thus had opportunity not only to continue his research but in a broad sense his teaching as well. There in collaboration with new and younger colleagues, several of whom were his former students, he remained



active until 1958 when poor health forced his complete retirement.

In 1910 Larsen married Eva Audrey Smith, daughter of Sylvester Clark Smith, of Bakersville, California, U. S. Representative from Kern County. For over fifty years Mrs. Larsen watched lovingly over her scientist husband, sharing in his successes and bereavements, at times annoyed by his absentmindedness but always subordinating her desires to his. To their union were born two sons, the elder, Clark Smith Larsen, died prematurely at the age of 36. Professor Larsen is survived by his widow and younger son, Esper Signius Larsen 3rd,[1] who, in the footsteps of his father, is a petrographer with the U. S. Geological Survey.

Professor Larsen's learned societies included The National Academy of Sciences, the American Academy of Arts and Sciences, the American Institute of Mining, Metallurgical and Petroleum Engineers, The Geological Society of America, The Mineralogical Society of America (a charter fellow and president in 1928), Society of Economic Geologists, Mineralogical Society of Great Britain and the Geological Society of London. He received the highest honors that can be awarded by American mineralogists and geologists: the Roebling medal of the Mineralogical Society of America in 1941 and the Penrose Medal of the Geological Society of America in 1953. In 1950 in Washington, D. C. a volume of *Studies in Petrology and Mineralogy* (*Am. Mineral.*, **35,** 619–958, 1950) dedicated to Professor Larsen was presented to him. From this *Festschrift* he derived greater personal satisfaction than from his other honors for over half of the scientific papers it contained were written by his former students.

The basis that future generations will have for the appraisal of the life work of Esper Larsen is his 130 published papers. This record is impressive but a contribution equally important is not in the printed record, it lives on in the several generations of men and women who were his students at Harvard and Radcliffe. Many of these students, now eminent in their own right, are professors in leading universities throughout the world and are passing on to their students a little of the scientific prowess, the methodology and the human kindliness that was Larsen.

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[1] Esper Signius Larsen 3d died on October 6, 1961, see p. 461.

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THE AMERICAN MINERALOGIST, VOL. 47, MARCH-APRIL, 1962

MEMORIAL OF ESPER SIGNIUS LARSEN, 3D

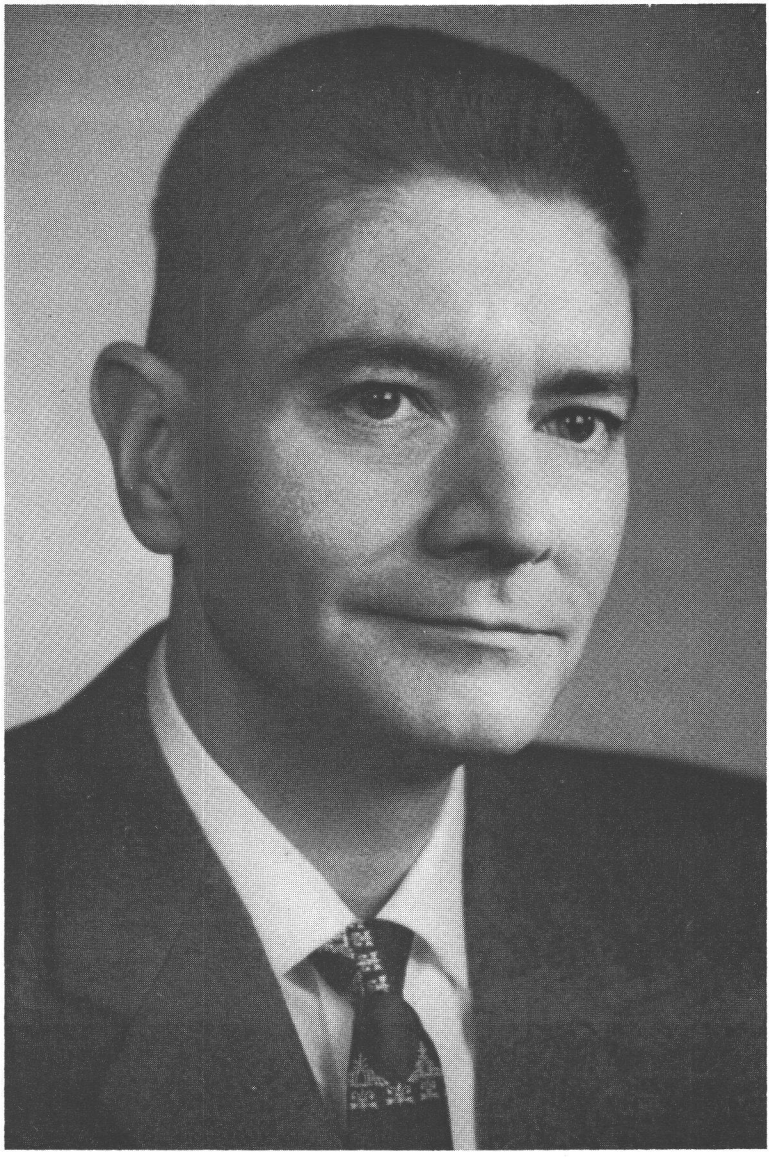
W. T. PECORA, *U. S. Geological Survey, Washington 25, D. C.*

Esper Signius Larsen, 3d died suddenly at his home in Bethesda, Maryland of a coronary failure, on October 6, 1961, just a few days short of his forty-ninth birthday. Throughout his professional career Dr. Larsen actively participated in basic research in the fields of mineralogy, petrography and geochemistry. He became a distinguished scientist-administrator in the U. S. Geological Survey.

He was born in Los Angeles, California, on October 10, 1912, the son of Eva (Smith) Larsen and Esper Signius Larsen, Jr. At the time of his birth, his father was a young geologist on the staff of the U. S. Geological Survey. His early years were spent in Washington, D. C., and later in Belmont, Massachusetts, where the family made its home as a result of his father's appointment as Professor of Petrography at Harvard University. He entered Harvard University in 1930 and received his B.S. in 1934, his M.A. in 1935 and his Ph.D. in 1940. Early in college he decided to pursue a career in physical sciences and therefore took several advanced courses in mathematics, chemistry, physics and geology. While in graduate school he served for three years (1937–40) as Professor L. C. Graton's assistant in ore microscopy. During this time also he contributed to research investigations on the mineralogy of the Tertiary volcanic rocks of the San Juan Region, Colorado. As his doctoral dissertation he chose to investigate the mineralogy and paragenesis of the complex suite of phosphate minerals from Fairfield, Utah. Many of the specimens for this investigation were provided by Arthur Montgomery.

In 1941–42 he served as Petrographer at the Saranac Laboratory for the study of tuberculosis in association with Dr. LeRoy Gardner. His principal inquiry was to study the nature and identity of minerals causing silicosis and asbestosis in industrial and prepared dusts and in autopsy materials. His research was cut short because of curtailment in research funds at the laboratory, although his preliminary work indicated that the fibrous and splintery habit of certain minerals might prove to be important factors in pneumoconiosis.

In 1942 he joined the U. S. Geological Survey in Washington, D. C., and remained a member of that organization until his death. His first work involved preparation of classified terrain and engineering geology intelligence reports for the U. S. Corps of Engineers. This unit of the Geological Survey became increasingly important during World War II in preparing classified reports and maps for use of military forces. In



Esper Signius Larsen, 3d
1912–1961

1943–45 he became assistant chief of this unit under Charles B. Hunt and W. H. Bradley, and in 1945–47 served as acting chief of the group. In 1947–49 he aided in the revision of the geologists' classification standards of the U. S. Civil Service Commission and became Head of the Petrology Unit of the Geologic Division. In 1949 W. H. Bradley, Chief Geologist, asked Larsen to serve as his Assistant Chief Geologist for Basic Research, a position which he occupied with great distinction until he was compelled in 1953 to relinquish his duties because of a severe heart attack. It was in this capacity that he proved to be an outstanding scientist-administrator, not only by his inspiring scientific leadership, but also by his skillful management of organizational and personnel matters.

From 1954 to the time of his death he participated in research in the geochemistry of uranium, thorium, and other minor elements. With R. H. Garrels and Alice Weeks he performed a searching inquiry on oxidation of uranium ores from the Colorado Plateau that led to the editing and compilation of *Professional Paper* **320.** He became closely identified as a research leader and advisor to a younger group of mineralogists and geochemists. By this association he also set the stage for a number of research papers that will appear in print posthumously.

Dr. Larsen was a Fellow of the Mineralogical Society of America, Fellow of the Geological Society of America, a member of many other professional societies and a member of the Cosmos Club of Washington, D. C.

In 1941, Dr. Larsen married Marjorie Ann Esters of Belmont, Massachusetts, who now survives him. The Larsens always travelled together and displayed a devotion to each other that was ever gratifying to their friends. That they were thoroughly happy with themselves and their place in life stands as a monument to all who knew them. We thought not of one without the other.

But how can I record the passing of a colleague and fellow scientist without recording as a close friend the impact of the scientist as a man. We were contemporary graduate students and long-time colleagues who shared many experiences and confidences. He was completely unselfish. Again and again he gave unstintingly of his time and effort in the service of professional colleagues. I have never seen him give hurt to a living thing or a worthy cause. I've seen him in anger; but only toward some malpractice, discrimination or cruelty displayed by others. I've seen him in joyous laughter, for his was a rich and full humor unfettered by bias or prudery. His clear logical mind probed directly into problems presented to him and came up with lasting solutions. He never interfered with the lives of others but was ready to lend his strong right arm at all times. His was the courage of truth. He wrote with a clarity that was the envy of

many, and thus became the critical reviewer of many scientific manuscripts and technical documents, for which acknowledgment rests only in the memory of his colleagues. He refused joint authorship on many papers where rightly his name belonged. In matters of scientific ethics his judgment was constantly sought; in battles on propriety he fought as the fair-minded liberal; in matters of organizational behavior, he was steadfast to loyalty and responsibility. And yet he was a humble man, so well-balanced that he never ceased to be amazed that his colleagues came to him for counsel in trust and implicit faith. Accepted as a scientist among scientists, respected as a wise leader among men, and held in love and affection by all, Ep Larsen indeed had a full and successful life.

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THE AMERICAN MINERALOGIST, VOL. 47, MARCH-APRIL, 1962

MEMORIAL OF HUGH EXTON MCKINSTRY[1]

C. S. HURLBUT, JR., *Harvard University, Cambridge, Massachusetts.*

Hugh Exton McKinstry, Professor of Geology at Harvard University, died on June 30, 1961, a year before his scheduled retirement. One of the ablest mining geologists in the profession, he had earned an international reputation. He was born May 5, 1896, in West Chester, Pennsylvania, the son of Edwin Lincoln and Loraine Stone McKinstry.

Early in life McKinstry became interested in collecting and studying minerals, and as a boy earned money selling minerals to Ward's Natural Science Establishment in Rochester, New York. Over the years he built up a valuable mineral collection and his early professional publications were devoted to mineralogy.

In Haverford College he was a leader in student affairs, editor of the Haverford (College) News, and was graduated Phi Beta Kappa. After graduation in 1917 he went to France to do relief work with the Red Cross (Friends Reconstruction Unit). Upon his return he entered Massachusetts Institute of Technology, where under the influence of Waldemar Lindgren, he decided on a career in mining geology, and for one year, 1920–21, was an instructor in this subject at M.I.T. After receiving a master's degree at Technology in 1921, he joined the geological staff of Cerro de Pasco Copper Corporation in Peru where, for three years, he devoted himself to mining geology in the high Andes. Here he laid the foundation for his subsequent career that led him to many parts of the world. In Peru, McKinstry became closely associated with Donald H. McLaughlin, Chief Geologist of Cerro de Pasco, and it was probably McLaughlin's influence that sent him to Harvard in 1924. For two years he was a part-time instructor and assistant to Professor L. C. Graton, of whom he wrote that his "challenging discussions compelled me to think about" mineral deposits. McKinstry was awarded the doctor's degree from Harvard in 1926.

In 1928 he married Elizabeth Farwell, a Colorado lady of charm and vitality with a venturesome spirit and great adaptability who learned to live happily in mining camps in many parts of the world. From 1926 to 1929 McKinstry roamed Mexico in the employ of a mining company, ex-

[1] The material in this Memorial has been taken largely from a Minute on the *Life and Services of Hugh Exton McKinstry* prepared by a committee of M. P. Billings, R. M. Garrels, C. S. Hurlbut, Jr. and Russell Gibson, *chairman*, and read before the Harvard faculty on February 13, 1962.

amining mines and exploring for mineral deposits that might justify development. Between 1929 and 1932, with L. C. Graton and others, he studied the geology of the Hollinger Mine in Ontario, one of the largest gold producers in Canada.

In 1933 he became associated with Case, Pomeroy and Co., an investment group in New York, and for the next four years visited the mining regions of South Africa, Australia, Canada, and the United States, seeking opportunities for the investment of venture capital. In 1937 he became a free lance consulting geologist with an office in New York.

During his many years in the field McKinstry accumulated a rich experience which, coupled with his excellent judgment and unquestioned integrity, increased the demand for his services. Busy as he was, he still found time to contribute technical papers that enriched our knowledge of mineral deposits and improved the interpretation of complex structural geology, especially of the Precambrian. He was regarded by the structural specialists as an expert in this field. He was especially skilled in mine valuation and could have become a wealthy man had he stayed in industry. However, at heart he was first a scientist and a scholar, and his brief teaching experience convinced him that he would be happier leading a life of research and teaching. Thus in 1940, when Professor C. K. Leith, of the University of Wisconsin, learned that McKinstry was interested in teaching, he brought him to Madison where he was a member of the geology faculty until 1945.

However, during this period he taught for only five semesters, for he was called to Washington during the War to serve first, as Chief of the Minor Ferro-Alloys Division of the Board of Economic Warfare (1942–44) and later, as Chief of the Minerals Division of the Foreign Economic Administration (1944–45). He served our Government well during the War, but did not enjoy the administrative work and was far happier in the field or at the university. At the end of the War in 1945, he came to Harvard as Professor of Geology.

As his courses at Harvard were rather advanced, his classes were small but always included several students whose primary interest was not mining geology. These students elected the courses just to learn more geology, for McKinstry's interests were wide, including mineralogy, structural geology and geochemistry. His previous and continuing experience with practical matters, plus his ability to integrate the findings of the mine geologists into the framework of theory, made him an especially effective teacher. His most recent publications on the phase relations of the sulfides marked the beginning of a break-through in the determination of the environment of ore deposition. He was assimilating the experimental work as fast as it appeared, and in many instances was

HUGH EXTON MCKINSTRY
1896–1961

well ahead of experimentalists. His lectures were carefully prepared; his examination questions searching and quite unpredictable.

Although he forsook industry as his chief occupation, the mining companies kept him busy with consulting work during the time he felt he could spare from teaching and research.

During his years in industry, McKinstry had been accumulating material from his rich experience for a book on Mining Geology. Such a book was published in 1948, and became immediately the leading text in the United States on that subject. It has been translated into Spanish.

Since his student days, during the time he called "vactions," McKinstry had maintained an interest in studying the Glenarm Series of rocks exposed in his native county of West Chester, and elsewhere in eastern Pennsylvania. This is a structurally complicated series of metamorphic rocks, the interpretation of which has been in dispute. His final conclusions on this subject were published in April, 1961. Correcting the proof of this article between two serious operations was his last professional activity.

McKinstry was a member of several learned and professional societies including the Society of Economic Geologists of which he was president in 1954, the Geological Society of America, the Mineralogical Society of America, the American Institute of Mining, Metallurgical and Petroleum Engineers, and the American Academy of Arts and Sciences. He was also a member of the Cosmos Club in Washington. He was a man of few words and plain speech; his letters were brief and to the point. He was shy and socially retiring, but was noted among his intimate friends and students for his dry, whimsical humor. Under the pseudonym of Nicholas Vanserg, McKinstry wrote several highly amusing brief articles critical of devious, pompous, or wordy papers that were published in technical journals.

When the present group of graduate students will have finished their doctoral dissertations started under McKinstry's direction, the total number of his doctoral candidates will be over 20, thus continuing the effective contributions of Harvard geologists to the mining profession.

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