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PAUL FRANCIS KERR

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This issue of *The American Mineralogist* is dedicated to Paul Francis Kerr on the occasion of his retirement as Newberry Professor of Mineralogy at Columbia University. His friends, colleagues, and former students, by making this volume possible, recognize his contributions to mineralogy and geology during his forty-one years as a teacher and an administrator and his service to the Mineralogical Society of America in whose affairs he has long been influential.

Paul Kerr was born on January 12, 1897, in Hemet, California. His birthplace lies at the western base of the magnificent San Jacinto Range, almost directly on the San Jacinto fault, the southwestern branch of the San Andreas Rift. Movement along this fault on Christmas Eve in 1900 nearly flattened the neighboring towns of Hemet and San Jacinto. Although too young to appreciate this particular quake, Kerr recalls numerous others, some rather severe, that occurred during his boyhood. His father, Joseph Kerr, earlier a reporter on a San Francisco newspaper, founded the *Hemet News* some years before his son was born, but unfortunately died when Paul was only two. His mother's father, William Fowler, was a civil engineer who had migrated to California in 1850. It is probable that the maternal grandfather's calling may have inspired him to follow engineering, a decision that indirectly led him into geology.

Paul Kerr entered Occidental College in Los Angeles in 1915 with the intention of studying chemistry and mathematics. With $625 saved from work in the citrus orchards and bean fields of southern California, and later with the aid of an assistantship in chemistry he financed his undergraduate years. Although his college career was interrupted by a brief period of military service during World War I, he graduated in June, 1919 with the rest of his class.

Having secured an assistantship with Professor Theodore Hoover,

the brother of the President, at Stanford University, he began graduate work in mining engineering in the fall of 1919. Although he stayed with the mining course for two years, he became increasingly aware of his growing interest in geology. The reason is not far to seek, for the geology faculty at Stanford was unusually stimulating at that period, including such outstanding figures as Eliot Blackwelder, Bailey Willis, James Perrin Smith, Cyrus F. Tolman, and Austin Flint Rogers. Kerr soon came under the influence of Rogers who called his attention to the then little-known field of x-ray diffraction and introduced him to Professor D. L. Webster in the Physics Department. From Professor Webster he learned the basic theory and with his help constructed a multiple x-ray powder diffraction unit which, according to Kerr, "worked part of the time." This was certainly one of the earliest, if not the first, application of the powder x-ray diffraction method to strictly mineralogical problems, a technique now routine for mineral identification. Kerr began his study only about five years after Debye and Scherrer in Germany, and Hull in America, had shown for the first time that useful x-ray patterns could be secured from powdered specimens. His doctoral dissertation, completed in 1923, and based on this work, was entitled "The determination of opaque ore minerals by x-ray diffraction patterns."

Kerr's teaching experience began immediately after receiving his degree, at the summer camp maintained as a training school for Stanford students and familiarly known as the "Stanford Geological Survey." In the fall of 1923, he was appointed to a one-term instructorship at Stanford while Professor Rogers was on leave of absence. During this term, he was offered a position as Lecturer in Mineralogy at Columbia University for the spring term of 1924. This too, was described as a temporary position, and in accepting it, Kerr fully expected to return to California at the close of the term. Circumstances dictated otherwise, and now, forty-one years later, he is still a resident of New York although one might say that he has been a consistent seasonal commuter between the East and West coasts. His connection with the Stanford summer camp continued for eight years, and his field work has always been primarily in the West.

When Kerr returned to California in the summer of 1924, he and Helen Squire, daughter of a physician in Palo Alto and also a Stanford graduate, were married in the Leland Stanford Memorial Chapel. They had three children; Paul, the oldest, who died while still a

young man; Ruth (Mrs. William Jakoby), and Nancy (Mrs. Peter Del Grande). Ruth, a graduate of Barnard College and the College of Physicians and Surgeons of Columbia University, is a successful neurosurgeon in Washington, D.C. Nancy, a graduate of Mount Holyoke and Stanford, is a physicist in the Lawrence Radiation Laboratory in Livermore, California.

Kerr's long association with Columbia University has been a truly symbiotic relationship with both sides keenly aware of its value. Opportunities for study and research both within and outside the University as well as the stimulating influence of students and colleagues in a great institution have been and continue to be a source of inspiration and pleasure for him. He has been in charge of mineralogy for 41 of the 101 years that it has been taught as a distinct subject at Columbia and has held this position longer than any of his predecessors. He has launched a far greater number of students on successful careers than all three of his forerunners combined. His position in this regard merits a brief review of the development of the teaching of mineralogy at Columbia.

Mineralogy in some sense has been taught at Columbia since 1792 when Samuel Latham Mitchill was appointed "Professor of Natural History, Chemistry, Agriculture and the other arts dependent thereon" in Columbia College, then the College of New York. Systematic teaching of mineralogy, however, dates from the founding of the School of Mines in 1864. Its founder, Thomas Egleston, was a metallurgist with a deep interest in mineralogy. A Department of Mineralogy and Metallurgy was set up as one of the divisions of the new school and Egleston taught both subjects until his retirement in 1897. In 1866, a Department of Geology and Paleontology (exclusive of mineralogy) was established in the School of Mines, with John Strong Newberry as Professor until he retired in 1892. With the creation of the Faculty of Pure Science in 1892, mineralogy and geology were placed under its control, although the departments remained separate. In 1920, mineralogy ceased to be an autonomous department, being combined with geology under the title Department of Geology and Mineralogy which was shortened in 1938 to Department of Geology. On the retirement of Egleston in 1897, Alfred J. Moses followed him as Professor of Mineralogy. In 1902, Lea McIlvaine Luquer was added to the staff, and on the death of Moses in 1920, became Professor of Mineralogy. From 1920 to 1924, Luquer

handled mineralogy alone with the assistance of temporary aides of whom Kerr was the last. Shortly after Kerr's arrival in January, 1924, Luquer suffered a heart attack from which he never recovered sufficiently to resume his duties, and it fell to Kerr to carry on the work. From the position of Lecturer in 1924, he advanced steadily in rank, and was appointed Instructor in 1925, Assistant Professor in 1926, Associate Professor in 1932, and full Professor in 1940. Since 1959, he has held the title of Newberry Professor of Mineralogy. Kerr, as Luquer before him, handled mineralogy alone from 1924 to 1937 except for temporary aides. Ralph J. Holmes joined the mineralogy

HIGHER DEGREES IN THE GEOLOGICAL SCIENCES
COLUMBIA UNIVERSITY
(1864–1965)

Degree	Total Geological Sciences 1864–1965	Mineralogy 1864–1965	Mineralogy 1864–1924	Mineralogy 1924–1965
M. A.	604	87	4*	83**
Ph. D.	388	62	5*	57
Total	992	149	9*	140

* Maximum according to available records.

** 34 of these later obtained a Ph.D. under Kerr making the total number of individuals 106 although the number of degrees supervised is 140.

staff in 1937 and later during the period 1947–1951, J. Laurence Kulp was a member of the mineralogy division prior to the establishment of the separate geochemistry wing of the department. In retrospect it seems logical that Kerr should have come to Columbia as his mentor at Stanford, Austin F. Rogers, had been a student of Moses and Luquer and had served as a tutor in mineralogy at Columbia between 1902 and 1905.

Prior to Kerr's arrival, few higher degrees in mineralogy had been granted at Columbia, though a relatively large number had been earned in other branches of geology. University records show only four master's and five doctorates in mineralogy during the 60-year period 1864 to 1924, but it should be added that, with the exception of a few higher degrees granted earlier by the School of Mines, graduate work at Columbia dates primarily from 1892 when the Faculty

of Pure Science was set up. In contrast, the following 41 years, 1924 to 1965, under Kerr's direction, have been extraordinarily productive. There has been a spectacular rise not only in the actual number of degrees in mineralogy but also in the proportion of degrees in this field compared with the total granted by the Department in all other branches of geology. In this period, his students have accounted for 26% of the doctoral degrees and 17% of the master's degrees granted in the geological sciences. During the 101 year period (1864–1965), 14% of the advanced degrees in the geological sciences can be attributed directly to him.

More significant than the total number of degrees, perhaps, is the fact that nearly all of his former students are actively engaged in scientific work, and the great majority are in responsible positions in the academic world, industry, or government service. In the tabulation below, they are grouped according to employment. To the total shown there should be added seven current graduate students who as yet do not hold a higher degree. This raises to 113 the number of students whose graduate research, in whole or in part, has been carried out under Kerr's guidance. Another measure of Paul Kerr's success in the training of graduate students is the large number who have been recognized professionally by listing in American Men of Science. More than half have been so recognized and many of those who are not listed received their degrees too late to have been included in the most recent edition.

OCCUPATIONS OF RECIPIENTS OF DEGREES IN MINERALOGY COLUMBIA UNIVERSITY, 1924–1965

	Ph. D. or (M. A. & Ph. D.)	M. A. only	Total
Academic	18	10	28
Government	18	6	24
Industry	17	6	23
Self-employed	2	5	7
Students[1]		5	5
Inactive		8	8
Deceased	2	3	5
No data		6	6
	57	49	106

[1] Current Ph.D. candidates.

No reference to Paul Kerr and his students would be complete without mention of his legendary reputation for a genuine concern for their welfare. He could not and would not tolerate the lazy student or one who tried to "get by," but once convinced of a student's sincerity and diligence, there was nothing within his power to give that the student lacked. Around the department, a corollary to being one of Kerr's students was the assurance of a position when you finished. From his assistants Kerr expected, and received, a full measure of work, skill, competence, and unlimited time, whether it was getting out specimens for the next day's lecture or finding the answer to an unanswerable question. He invariably had no conception of the length of time required for a job and after spending hours or days on a drawing or a piece of writing you would not be surprised to have him ask whether you had done it in the past hour! The pages of the late informal departmental journal, "Dinosaur Dust," are sprinkled with light verse bemoaning the hard fate of being a PFK assistant. But the affectionate nickname of "Pappy" used by generations of students—among themselves—speaks most eloquently as a student appraisal.

Kerr's research has always been characterized by breadth of interest and balance between field investigation and laboratory study. His concept of mineralogy has been unusually broad as even a cursory examination of his bibliography reveals.

Rogers set him on the path of x-ray diffraction which virtually predetermined that he would be concerned with the fine-grained minerals that defy identification by other methods. His early and continuing interest in clays, a field in which he has truly been a pioneer, stemmed in large part from this beginning. At the time, clay mineralogy was in hopeless confusion. Attempts at classification on the basis of chemical data had not been successful, and optical identification was often impossible. Kerr, shortly after his arrival at Columbia, constructed an improved model of the x-ray apparatus he had designed and built at Stanford. About the same time Clarence S. Ross of the U. S. Geological Survey became interested in clays and submitted samples to Kerr for x-ray examination. The x-ray results confirmed Ross' optical data so well that a long continued cooperation and friendship developed between the two men. The results of these studies are classic and are cornerstones in the modern development of clay mineralogy. In spite of the crude x-ray apparatus then

available, many of the conclusions drawn by Ross and Kerr have stood the test of time. They were the first to successfully revise and simplify the classification of the clay minerals, considerably reducing the number of clay mineral names many of which, it was now obvious, had been applied to impure varieties of the same mineral.

Kerr has never lost interest in clays. Between 1947 and 1951, he directed an intensive study of clay minerals in cooperation with 23 specialists in 10 laboratories, under the auspices of the American Petroleum Institute. This comprehensive study aimed at correlation of the basic data—chemical, physical, optical, x-ray, etc. for each of the clay minerals by making all tests on a single sample collected from a particular locality. The results were published in eight volumes entitled "American Petroleum Institute Clay Mineral Standards Project No. 49." The continuing demand for these volumes is an indication of the value of the data provided by these studies.

Since 1960, his interest has extended to the intriguing and important clays known as "quick clay" and those found in the playa lake deposits of arid regions. These studies have received support from the U. S. Air Force which has a practical interest in such materials in connection with the location of air fields and landing strips. His investigation of the saline minerals, particularly those of the playa deposits, has, in a sense, been an outgrowth of his interest in clays, as these two mineral occurrences are often intimately related.

It is only a step from clays and other fine-grained minerals to the problems of rock alteration by hydrothermal and related processes—problems which have long interested economic geologists. His principal investigations in this area were first carried out at the great open-pit copper deposit at Santa Rita, New Mexico, and later at Silver Bell, Arizona. Such studies of hydrothermal alteration have a practical economic significance, for an understanding of the alteration halos that often surround metallic ore bodies can mean the difference between success and failure in locating ore.

In the early thirties, Kerr made detailed laboratory and field studies of the unusual ceramic materials referred to as the "spark plug" minerals. This work formed the basis of his well-known papers on the andalusite deposits at Mocalno in the White Mts. of California and the unique dumortierite deposit at Oreana, Nevada.

Another phase of mineralogy which Kerr encountered on coming to Columbia was that of gems and gem materials. A course in the

identification and evaluation of gems had been developed by Professor Moses as early as 1914 and is believed to have been the first systematic course in gemology offered in this country. The demand for such a course came from the jewelry industry in New York, one of the major jewelry centers of the world. Kerr's major contribution in this field was the development of a system for the evaluation of cut diamonds which he worked out for the Provident Loan Society in the early thirties, a period when, unfortunately, the pawning of diamonds was an all too common necessity in America. The course in gemology is no longer given, as the jewelry industry is now well served in this respect by the Gemological Institute of America. This organization, established in 1931 by Robert and Beatrice Shipley, owes much of its present success to the early support it received from a number of leading mineralogists of whom Kerr was one.

In the middle thirties Kerr became interested in tungsten through his friend Charles Segerstrom, President of the Nevada Massachusetts Company, a Boston group that operated the scheelite deposit at Mill City, Nevada. His initial investigation of this deposit, followed by numerous others, led to a study of the characteristics and modes of origin of tungsten deposits in general, the results of which appeared in 1946 as Geological Society of America Memoir 15 "Tungsten mineralization in the United States." An indirect consequence of his interest in tungsten was the establishment at Columbia University of the Li Medal in 1948. This award, for "meritorious achievement in advancing the science of tungsten," was made possible by the generosity of the late K. C. Li, former President of the Wah Chang Corporation, one of the world's principal processors of tungsten.

The earliest phases of the United States Atomic Energy Program took place at Columbia University. The first "exponential atomic pile," forerunner of the more famous pile at the University of Chicago, was set up initially by Fermi and others in the basement of Schermerhorn Hall, almost directly under Kerr's office (this was the one place on the campus that had the necessary ceiling height). But it was the field occurrences of uranium and the acquisition of supplies for the United States that held Kerr's attention. In 1943 he and Philip Merritt were sent to the Belgian Congo to evaluate the deposits in the District of Katanga and it was on their recommendation that the famous Shinkolobwe mine near Elizabethville was re-

opened. A similar assignment took him to the Canadian Eldorado deposit on Great Bear Lake. Kerr's association with the Manhattan Project and later with the Atomic Energy Commission has continued to the present. The multitude of uranium deposits on the Colorado Plateau has provided an inexhaustible succession of problems for him and his graduate students. The most elaborate of these studies concerned the complex geology of the Marysvale area in Utah. The still debatable question of the origin of the plateau uranium deposits has been one of his chief concerns and his investigations have supported the view that the original source is hydrothermal.

His broad experience with uranium ore deposits led to his being asked by the Carnegie Endowment for International Peace to head a committee in 1945 to investigate the problem of international inspection of fissionable materials. In 1955, for the same reason, he was appointed by the United Nations to set up a program and prepare the volume on uranium raw materials, for the First International Congress on the Peaceful Uses of Atomic Energy, held in Geneva that year.

Kerr has always been keenly aware of the potentialities for mineralogy in new equipment and new techniques, and has been quick to take advantage of them. This is exemplified in his work on differential thermal analysis. In 1947, he and J. Laurence Kulp developed a multiple differential thermal apparatus that was first applied to the study of clay minerals, a field in which DTA has proved to be a powerful adjunct to *x*-ray diffraction. Later the technique was extended to other mineral groups, and finally with the aid of Otto Kopp, the apparatus was modified for use with such highly corrosive materials as sulfides and arsenides. He also realized early the advantages inherent in such new techniques as infrared and ultraviolet spectroscopy, *x*-ray fluorescence, and electron microscopy.

In the field of mineral nomenclature, Kerr has had a part in the naming of at least eight minerals—alleghanyite, cattierite, dickite, hydrotungstite, sengierite, tungomelane, umohoite, and vaesite. Perhaps even more commendable, he has been instrumental in discrediting a number of mineral names, especially in the field of clay mineralogy, as mentioned earlier.

Kerr has published one textbook which has passed through three editions, and two of his scientific papers are of book length. The textbook, originally a joint effort with Austin F. Rogers, proved

highly successful. The first edition, entitled "Thin-Section Mineralogy" appeared in 1933; the second edition, re-titled "Optical Mineralogy," revised and with additional data tables, appeared in 1942. The third edition, under Kerr's name alone and again revised, and, in large part rewritten, was published under the same title in 1954. The two book-length papers are his memoir on tungsten mentioned earlier, and the 212-page volume based on his own work and that of several students in the Marysvale area, Utah. This appeared in 1957 as Special Paper 64 of the Geological Society of America.

An indication of the breadth and volume of Kerr's research efforts can best be gleaned from an examination of the 226 titles in the accompanying bibliography prepared by Marjorie Hooker, one of his former research assistants. Classification of his publications is difficult because many deal with overlapping aspects of mineralogy, as well as economic geology and other fields. In the following table the titles are grouped according to subject and provide a comprehensive view of Kerr's relative activity in the various aspects of mineralogy to which he and his students have devoted themselves.

PUBLICATIONS OF PAUL F. KERR
1924–1965

Uranium minerals and mineralization	52
Clays and related minerals	37
Alteration studies	22
Differential thermal analysis (other than clays and uranium mineral studies)	12
Tungsten, minerals and mineralization	11
Gems and gemology	10
New minerals	7
Evaporites	6
Refractory minerals	5
Special techniques and apparatus (x-ray diffraction, x-ray fluorescence, infrared spectroscopy)	11
Quartz	3
Textbooks	3
Miscellaneous	21
Non-technical papers (memorials, society reports, etc.)	26
	226

In the tabulation below an attempt is made to summarize his publications chronologically which provides a picture of Kerr's changing interests over the years. The order in which the fields are listed within each period is based on number of publications, but in a few cases, relative importance of the papers has been taken into consideration.

Only fields of major interest are indicated.

Chronologic Grouping of Publications:

1924–28	*X*-ray diffraction technique, gems.
1928–33	Clays, gems, refractory minerals.
1934–1946	Tungsten, clays, refractory minerals, quartz, gems.
1946–1950	Alteration minerals, clays, DTA (other than clays).
1950–1959	Uranium mineralization, alteration minerals, DTA (other than uranium and alteration minerals), clays.
1959–1965	Clays (especially quick clays), alteration minerals, evaporites, uranium mineralization, special techniques (Infrared, spectroscopy, *x*-ray fluorescence, DTA, pyrosynthesis, etc.).

In addition to his extremely active program of teaching and research, Paul Kerr has performed an unusual amount of administrative duties for the University. All who know him are aware that he is a born administrator. He can get things done, and usually with less fuss and in less time than others. He was selected as Departmental Chairman to complete Douglas Johnson's term of office at the time of the latter's illness and retirement in 1942, but prior to that he had been Acting Chairman several times when the occasion demanded. From 1944 to 1950, he served two three-year terms as Chairman. It was during this period that the extensive renovation of Schermerhorn Hall was carried out. It was Kerr's responsibility as Chairman to develop the plans and solve the many inevitable problems which he did with his usual aplomb and success. It was during this period, too, that Torrey Cliff, the estate of the late Thomas W. Lamont on the west shore of the Hudson, about twenty miles north of New York City, was acquired by Columbia University and it was Kerr who was largely responsible for the original negotiations and the securing of the property for the Geology Department. Here on a high point of the Palisades stands the Lamont Geological Observatory, which under Maurice Ewing's energetic and capable direction, has established itself as a leading institution of its kind. It almost goes without saying that Kerr had a hand in bringing Professor Ewing to Columbia. Following his years as Chairman, he has held the office of Research Coordinator for the Geology Department (1952–1962 and 1964–1965), an assignment for which he was admirably fitted.

His flair for administration has been also of great service to various professional organizations. In 1938 he was the Local Chairman for the Fiftieth Anniversary Meeting of the Geological Society of America in New York. From 1935 to 1944, he was Secretary of the Mineralogical Society of America, served as President in 1946, and has also headed numerous committees for the Society. He has also been, at various times, President of the New York Mineralogical Club, President of the Kappa Chapter of Sigma XI, Vice-President of the Faculty Club of Columbia University, Vice-President of the Geological Society of America, Chairman of the Section of Geography and Geology, and Vice-President of the American Association for the Advancement of Science, and Chairman of the Section of Geology of the New York Academy of Sciences.

A number of honors have come to Kerr. In 1957, he was the third recipient of the K. C. Li Medal in recognition of his contributions to the mineralogy of tungsten deposits. In 1960, Occidental College, his alma mater, conferred on him the Honorary Degree of Doctor of Science. As Newberry Professor of Mineralogy since 1959, he holds the position of highest distinction in the Department of Geology at Columbia. On two occasions, Kerr has been a Visiting Professor to foreign countries. In the spring of 1941 he was Visiting Carnegie Professor in South America, lecturing at several universities and visiting some of the more important mineral deposits and mining districts. In 1960, under the auspices of the North Atlantic Treaty Organization, he delivered a series of lectures at the University in Oslo, Norway.

On the evening of May 4, 1965, more than 250 guests assembled at a reception and dinner held in his honor at the Faculty Club of the University under the auspices of the Department of Geology. Major oil and mining corporations, universities, and professional and scientific societies were well represented. Among those present was Kerr's first doctoral student, Donald M. Fraser, now Chief Geologist of the Bethlehem Steel Corporation. A leather-bound volume of letters of appreciation and an appropriately housed manuscript copy of the papers in this special issue of THE AMERICAN MINERALOGIST were presented to him. The occasion was a fitting tribute for one who has done so much for so long for both the academic and corporate aspects of geological science.

Paul Kerr has had a long and enviable record of service and accomplishment and it is clear from his stated plans that he has no thought of retiring, in the usual sense. As Newberry Professor Emeritus, he will continue to guide those students who are already doing graduate work under his direction. With his many and varied interests, he will without doubt always be in the midst of some vital and significant geologic problem. To paraphrase what was recently said of the late Dean Carman of Columbia, "Nobody can retire Paul Kerr."