

A Brief History Of The Department Of Geology

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The geology of New Mexico is wonderfully varied. Through billions of years geologic processes have molded and remolded the structure and fabric of the earth's crust in our part of North America. A history of vast oceans, thick sedimentary deposits, gigantic volcanoes, transitory mountain ranges and unusual life-forms is preserved here. The shape of the landscapes we admire, the courses of rivers, the soils that nourish agricultural products, and the remarkable variety of mineral and energy resources that contribute so importantly to New Mexico's economic well-being are all products of this history. It is perhaps not surprising then, that the study of geology has been a part of UNM's research and instructional endeavors since nearly the time the University was established.

This brief history summarizes the evolution of the Department of Geology from 1897, when C. L Herrick arrived to assume the position of second president of UNM and its first Professor of Geology, to 1988. During this 90-year period the Department has grown to include 18 faculty members, several research scientists, more than 125 undergraduate, masters and doctoral students, and numerous staff members—mirroring the growth of the University from a small, mainly college- preparatory school of fewer than 100 students to the large, multi-faceted institution it is today.

Because of space limitations this account emphasizes trends rather than details. The development of Geology at UNM is traced both in the context of the University's growth and events external to the University that have affected this discipline. The history of the Institute of Meteoritics, a division within the Department of Geology but administratively independent in some respects, is discussed separately in the following article. Stuart Northrop (Professor Emeritus) years ago assembled a detailed history entitled "University of New Mexico Contributions in Geology, 1898-1964" (UNM Publications in Geology, v. 7, 1966), which I have relied on heavily for part of this account. Departmental and University annual reports and other records have also been helpful, as have the suggestions and comments provided by other members of the Geology faculty.

The Early Years, 1897-1946

When C. L Herrick arrived at UNM in 1897, he had already attained at age 39 a distinguished reputation as a scholar, with more than 100 publications in fields as diverse as geology, paleontology, zoology, neurobiology and philosophy. During his previous three years in New Mexico, after recovering from tuberculosis, Herrick had become familiar with the geology of his adopted state while making a living as a geological consultant and U. S. deputy mineral surveyor. His new administrative duties did not slow his research; within little more than a year after he assumed the UNM presidency he had published four papers on the geology of central and southern New Mexico and several

more on neurobiology and herpetology. His vision for UNM was for it to be a research as well as an instructional institution. Herrick lost no time in establishing UNM Bulletins in several sciences, including geology, for faculty research papers, and by 1899 had overseen the construction of the Hadley Climatological Laboratory (at a total cost of \$14,000!), an all-purpose science building with several laboratories and classrooms. His grand design also included the establishment of a state biological and geological survey, and the merging of the School of Mines in Socorro with UNM, both impractical ideas at the time.

Herrick was a dynamic and inspiring teacher. He became the mentor of Douglas Johnson, an undergraduate student who had also come west to New Mexico for health reasons. In 1899 Johnson was appointed university registrar, but his real job was to act as field assistant to Herrick on his frequent long geological excursions, as part of what Herrick optimistically called "the University Geological Survey." In 1900 the two men published a long research paper on the geology of the Albuquerque area, and Johnson graduated the next year with the first bachelor's degree in geology awarded by UNM or any other institution in New Mexico. Johnson earned a Ph.D. in geology at Columbia with a dissertation on the Cerrillos area of New Mexico, and went on to a distinguished career as a professor at M.I.T., Harvard, and Columbia. He was chief geological adviser to General Pershing during World War I, and advised President Woodrow Wilson at the Paris Peace Conference. At the time of his death in 1944 Johnson was one of America's leading specialists in geomorphology and military geography. Herrick also collaborated with two other students, Bendrat and Reagan, on studies of New Mexico geology.

When Herrick's health worsened, partly from the rigors of geologic fieldwork, he took leave without pay during 1900-01, left UNM in 1901, and died in Socorro in 1904, aged 46. Herrick was a versatile, multifaceted, highly productive scientist. Had he served a full career at UNM in good health, attracting and training many more students, continuing his high level of research and publishing, and perhaps eventually convincing the state to establish biological and geological surveys, the effect on the early history of the University would have been profound. UNM might well have become one of the premier institutions for the study of the natural sciences in the western U.S. by 1920.

W. G. Tight, a former student of Herrick's at Denison University, Ohio, and subsequently professor of geology and botany there, was named UNM President in 1901. Tight was not the scholar Herrick had been, and conducted little research during his eight years at UNM. On the other hand, he was a better administrator and advocate for the University. Tight managed to secure the 20th Annual Meeting of the Geological Society of America for Albuquerque in December, 1907, a notable coup for an isolated town of about 9,000 inhabitants, far from the eastern centers of the geological profession in the U.S. The 33 registrants were treated to several talks and a field trip through the Sandia and Manzano Mountains. Tight also taught geology courses and trained several students, who graduated about the time he left UNM in 1909. One of these students, Kirk Bryan, later obtained a doctorate at Yale, and from 1926 until his death in 1950 was a professor at Harvard. Like Johnson, Bryan became an eminent and internationally known

geomorphologist. These men, the first two UN M geology graduates, were both awarded honorary doctorates by UNM near the end of their careers.

After Tight's departure, the study of geology at UNM languished. One early setback was the burning in 1910 of the Hadley Laboratory, which housed the Geology Department, with complete loss of laboratory equipment and collections. John Clark, Professor of Chemistry, taught geology temporarily in 1909-1910. Jenner Pynch, Tight's replacement as geologist on the faculty, stayed only two years, to be followed by Charles Kirk for four years and John Gruner during the 1917-1918 academic year, in a temporary position as instructor of geology and German. Gruner, who graduated from UNM with a B.A. in German and a minor in geology, eventually became a Professor of Geology at the University of Minnesota and president of both the Crystallographic Society and the Mineralogical Society of America. Late in life (1956), Gruner produced what some consider to be the single most influential paper on the origin of the Colorado Plateau uranium deposits. UNM awarded him an honorary Doctor of Science degree in 1963. From 1911 through 1920 only two students graduated in geology and the faculty contributed only five publications, fewer than Herrick produced in a single year. Frequent changes in the single geology faculty member, and the slowdown in activity at the University during World War I were major factors in the decline of geology at UNM during this time.

In 1918 Robert W. Ellis was appointed Professor of Geology, at a salary of \$1,500 per year. He served also as State Geologist for several years, as Kirk had before him. During the first 10 years (1918-1927) of Ellis' tenure total university enrollment increased from 287 to about 900, but the number of geology majors remained small, only seven students receiving bachelors' degrees. During this time the UNM faculty grew slowly; in 1925, for example, there were only 29, and Geology, Biology, Mathematics and Physics were all one-man departments. Ellis had by present standards a crushing teaching load. The 1925-1926 catalog lists the following courses in the Geology Department: physical and historical geology, meteorology, geography of North America, mineralogy (2 semesters), economic geology, paleontology, petrology, New Mexico geology, geologic mapping, and advanced geology (reading and research). A bachelor's degree in geology required two years of general university coursework, 24 units of geology courses (not including physical geology or meteorology) taken during the junior and senior years, 12 units of a minor in a different department, one semester of biology and two semesters each of chemistry and civil engineering (surveying) courses.

Ellis was probably happy to see each academic year end. During summers in the 1920s he conducted field research and published several lengthy reports on New Mexico's geology and oil and gas resources. He also produced the first reasonably detailed geological map of the state with an accompanying report (1925), which was published by the University at a cost of about \$600. At this time the Geology Department occupied the west half of the old Science Building, a one-story structure northeast of Hodgkin Hall. The department had two small offices and three laboratories; a classroom was shared with the Physics Department.

In 1928 the Geology faculty increased to two for the first time with the arrival of Stuart A. Northrop, who had completed his doctoral work at Yale. Northrop came to UNM as acting, then permanent chairman of the Geology Department, a position he was to hold until 1961. Northrop immediately expanded the undergraduate curriculum; by 1930 a second course in economic geology and new courses in engineering geology, structural geology, stratigraphy (2 semesters) and physiography (2 semesters) had been added. A master's degree program in geology was also established, which graduated its first student, Eldred Harrington, in 1930. Harrington served for many years as science director and director of secondary education for the Albuquerque Public School system. The M.S. degree at that time required 30 units (just as today) — 18 in geology, plus 6 thesis hours and reading proficiency in French or German. Despite the onset of the Depression (Northrop's 1930-1931 salary of \$3,000 had dropped 9% by 1932-1933), the strengthening of the undergraduate program and addition of a master's degree attracted more students to geology than ever before. Between 1930 and 1936 22 bachelors' degrees and four masters' degrees were awarded, including the first bachelor's degree earned by a woman, Mary Hardin, in 1934.

Through the 1930s Northrop and Ellis devoted most of their time to teaching. A normal teaching load for a UNM faculty member was about 15 units per semester—four to five classes. In addition, during August UNM conducted summer field schools in anthropology, biology, and geology near Jemez Springs and also at Chaco Canyon. Northrop taught the geology field school and often other summer courses as well. Ellis continued to work primarily on New Mexico economic geology; perhaps his most valuable contribution was a long report of the state's mineral deposits exclusive of fuels, published as a UNM Bulletin in 1930. A move from the old Science Building to new quarters on the second floor, west wing of the Administrative Building (now Scholes Hall) occurred in 1936, after an unsuccessful attempt by the Administration to put the Department in the Stadium Building. New geology facilities included two offices, three laboratories, a research laboratory, a classroom, and a separate room for a real geology museum. Northrop obtained several specially designed aluminum-frame glass cases and began constructing exhibits of fossils and minerals.

Robert Ellis died in March, 1937, at age 69, and Vincent Kelley, with a doctoral degree that year from Caltech, was hired to replace him. It took Kelley a few years to complete research projects in California and develop new ones in New Mexico, but by the early 1940s he was beginning a broad range of regional field, structural, and mineral studies that was to establish him as one of the most active and productive geologists New Mexico has known. Northrop's research during this time was directed towards completion of his 300-page study of the paleontology and stratigraphy of part of the Gaspe Peninsula, Quebec, which was published as a Geological Society of America Special Paper in 1939. He also began a meticulously researched study of New Mexico minerals, published as a UNM Bulletin in 1942. This sold out quickly and was reprinted as a book, *Minerals of New Mexico*, by the UNM Press in 1944 (a second, revised edition appeared in 1959). The Special Paper and *Minerals of New Mexico* were the first books written by a Department of Geology faculty member. Both Northrop and Kelley's work in the late 1930s and early 1940s gained the Department national attention and

gave promise of a renewed effort in research. These two men formed the nucleus that shaped and guided an expanding Geology Department for the next 30 years, through the 1960s.

Interest and enrollment in the geology program increased in the late 1930s. The seven bachelors' degrees awarded in 1940 marked the largest yearly total ever for the Geology Department, and would not be exceeded until the post-war boom years of the late 1940s. Only one master's student, Leslie Murphey, graduated between 1937 and 1945, however. The geology curriculum in 1940 showed a remarkably broad range of courses for a two-man department. Northrop typically taught historical and structural geology, two semesters of stratigraphy, two semesters of paleontology, sedimentology, geomorphology and Geology of New Mexico during a two-year period. Ketley taught two semesters of mineralogy, two of economic geology, petrology-petrography, field methods, and petroleum geology. Both taught physical geology classes. J. L. Bostwick, Dean of Men, taught a geography course occasionally in the Department from 1936 to 1943. An undergraduate geology major needed 24 units in geology above physical and historical (two semesters of mineralogy and a seminar in either paleontology or economic geology were specific requirements), and 12 more units in a minor field; one semester of chemistry and physics were also recommended.

The faculty increased to three in the Fall of 1940, with the addition of Parry Reiche, who joined UNM after six years in the U. S. Soil Conservation Service. Reiche's interests were primarily in Quarternary geology and sedimentology, and he helped lighten the teaching load. The promising increases in enrollments, however, vanished quickly after the U. S. entered World War II in December, 1941. The armed forces depleted universities nationwide of male students; the burgeoning war Industries attracted some of the remaining men and many women as well. Total UNM enrollment in 1943 to 1945 hovered between 900 and 1300. For the first years since the late 1920s, not a single geology degree was awarded, and this happened twice, in 1943 and 1945. The study of geology benefited, however, from a heightened awareness of the wide range of geological resources required for a modern war. The U. S. Geological Survey intensified its efforts in mineral, oil and gas investigations, and turned to the universities for help. Both Northrop and Kelley spent summers doing field research in New Mexico for the U.S.G.S. during the war years, and this work continued long past the end of the war. Reiche left UNM in 1946, and Carl Beck, with a Ph.D. in mineralogy from Harvard, replaced him. One bachelor's and one master's degree (to Caswell Silver, of whom more later) were awarded in 1946. Then a flood of veterans and others, whose college education had been delayed by depression and war, descended upon universities and geology departments across the country.

The Post-War Boom, 1947-1 960

World War II transformed American universities and American science permanently. The rapid advances in technology during the war had created a need for new sources of previously little-used geological materials. Metals such as magnesium, beryllium, titanium, tungsten and molybdenum were required for components of the

missiles and high-speed aircraft that formed a major element of the nation's post-war defense effort. A massive exploration effort to find uranium for atomic weapons and nuclear power plants was encouraged by the government in the late 1940s and 1950s. Moreover, the expanding American economy and new obligations as the preeminent world power placed new demands on traditional resources, such as copper, iron, coal, oil, and gas. In New Mexico the total yearly production of metals, nonmetals and fuels, valued at about \$120 million in 1945, increased more than five-fold to \$650 million by 1960 as the state rose from 14th to 7th place among U. S. producers. Large increases in the number of geologists were needed, and many of the post-war generation of university students heeded the call.

Also important were fundamental changes in the way scientific endeavors were supported. Newly created agencies, such as the National Science Foundation, NASA and a number of government research laboratories began to support a wide variety of research projects at universities, especially after Sputnik went up in 1957. Science in America, and geology at UNM were to be strongly affected by these trends in the coming decades.

Increased interest in the geology program became apparent almost as soon as the war ended. Enrollments shot up rapidly and by 1949 the first of the post-war students were graduating — 20 bachelors' degrees were awarded that year, more than twice the previous high total for a year. In 1950 the number doubled again to 41, with an additional six masters' degrees. Even with the addition of Sherman Wengerd (1947) and Paul Fitzsimmons (1949) to the geology faculty, the increased demand for geological training placed strains on the faculty and facilities of the Department. Geology's space in the Administration Building became incredibly cramped; the ends of corridors had to be walled off for office space for the new faculty, and laboratories designed in 1936 for 20-25 students were holding 75-85 students by 1950. Other departments were experiencing similar growing pains, and In 1949 Dean Thomas Donnelly made a new building to accommodate the six science departments his top priority. By 1950, however, the Geology staff was beginning to plan instead for its own building.

The addition of new faculty and the need to provide students with the more rigorous training in geology required by the post-war job market led to changes in the undergraduate program. Prior to the war the student selected most of the geology courses needed to complete the specified number of units (24-30) required for a bachelor's degree. By 1949 the undergraduate program had become more structured, with two semesters of mineralogy and one each of meteorology, field geology, structural geology, paleontology and stratigraphy, plus six additional upper level elective units being required, for a total of 38 units. Two semesters of chemistry and one of civil engineering were also required; college algebra and trigonometry were strongly recommended. The new group of geology students was generally older, more mature and serious than previously. In the late 1940s and early 1950s more than 80% of UNM undergraduate geology majors scored above the national median on the subject part of the Graduate Record Exam. High student enthusiasm also led in 1953 to the founding at UNM of Beta Mu, the 46th chapter of Sigma Gamma Epsilon, the national honorary geological society.

University enrollment, which had passed 4,000 in 1947-48, stabilized after the initial post-war rush, and did not top 5,000 until 1955-56. The number of geology graduates declined to 16 in 1955, reflecting a Korean War slump, before beginning another rise to the end of the 1950s. Despite these ups and downs the Geology Department usually ranked first among the departments of the College of Arts and Sciences in the number of bachelors' degrees awarded, and during the period 1949-1960 accounted for 15% of all bachelors' degrees awarded by the College. The master's program also expanded, with an average of nearly seven M.S. students graduating yearly during the 1950's. An American Geological Institute study in 1956 ranked UNM 18th out of 189 schools in number of geology bachelors' degrees granted, and 23rd of 72 in masters' degrees that year, but only 64th out of 204 in number of geology faculty. Obviously the Department's educational productivity in training geologists was far greater per faculty member than most other schools having geology programs. UNM's location in a state of marvelous geologic diversity and expanding petroleum and mineral industries, the excellent career opportunities for geologists, and the faculty's dedication to high quality instruction all combined to maintain a high level of interest in geology among UNM students during the 1950s.

Growth of the geology student population provided the impetus for departmental growth in other areas. Three main objectives were pursued during the 1950s and eventually achieved by the end of the decade: construction of a Geology Building, addition of new faculty, and establishment of a doctoral program. Somewhat surprisingly, the new building came first. After the decision to construct a geology building was made in 1951, the faculty spent a good deal of time designing the facility, in consultation with the architects. Construction began in January 1952 and was completed in June 1953, at a total cost of \$912,000.

With admirable foresight the building was designed to be much larger than the current needs of the Department, which initially occupied only most of the basement and all of the first floor. The second and third floors were rented to the U. S. Geological Survey and Soil Conservation Service, whose commitment was essential to the decision to construct a geology building. During July and August the faculty and staff feverishly moved to the new building, in time for Fall classes. It required several more months for everyone to settle in, but by early May 1954 the Department was able to host the annual meeting of New Mexico Geology Society, and an open house for the public was held on May 20. The departmental museum, with Stuart Northrop continuing as Curator, was established in a large room with two dozen museum cases that provided a third of a mile of shelf and plaque space for the exhibition of fossil, rock, and mineral specimens. Each year since then the museum has been visited by several thousand people, including many school children.

Numerous donors provided funds for the purchase of 16 oak chairs and the large, truncated- diamond-shaped oak conference table around which the faculty still gathers today for its meetings. Judging from persistent pleas in the departmental annual reports, installation of permanent seating in the large lecture hall was apparently delayed until 1961. This building (now Northrop Hall) continues to serve as the "home" of the Geology Department, with some renovations and modifications since its construction.

The third floor, originally only on the south wing, was extended to the east wing in 1972 to allow expansion by the Institute of Meteoritics, and the Department moved into the second floor when the U.S.G.S. departed in 1976.

Plans for a doctoral program began to emerge as early as 1951, but the five-man department moved slowly, recognizing that such a program could only be viable with the addition of more faculty. The University, caught in stable and even declining enrollments during the early 1950s, delayed. Carl Beck's mineralogy position was filled by Abraham Rosenzweig when Beck left in 1954, but no new faculty position was added until 1956. Roger Anderson, originally a micropaleontologist whose interests soon turned towards small-scale sedimentation processes, filled this position and Wolfgang Elston, an economic geologist/volcanologist, arrived the following year. In Spring 1958 Northrop formally proposed the creation of the geology doctoral program and it was promptly approved by the University Graduate Committee and faculty. The first doctoral students entered the program in Fall 1958.

The growth of the faculty and their varied research interests in the late 1940s and 1950s resulted in a significant increase in scholarly publications. Kelley was especially productive, publishing numerous papers on the structural geology, tectonics, and mineral deposits of New Mexico and neighboring states. Two important contributions of book length were a study of New Mexico iron ore deposits (1949) and a geological study of the Caballo Mountains (with Caswell Silver, 1952); his studies of Colorado Plateau tectonics were also influential. Both Northrop and Kelley continued regional field studies in association with the U.S. Geological Survey. In 1950 the Department co-sponsored a field conference of the Society of Vertebrate Paleontology; Northrop co-edited and wrote a paper for the guidebook, which also featured contributions from such noted vertebrate paleontologists as G. G. Simpson, E. H. Colbert and A. S. Romer (UNM's third honorary doctoral degree in geology was awarded to Simpson in 1954.) Sherman Wengerd moved from an early interest in the geological applications of aerial photography to facies analysis and petroleum geology, becoming Editor of the widely read Bulletin of the American Association of Petroleum Geologists in 1957-1959, and serving on numerous other professional panels and committees. Beck often collaborated with Lincoln LaPaz, of the Institute of Meteoritics, on mineralogical descriptions of meteorites, and Rosenzweig described several new species of minerals in the late 1950s. Fitzsimmons began a long-term program of translating Russian geology books and research papers to English. During the uranium exploration boom of the early 1950s, which established New Mexico as the leading producer of that much-sought-after commodity, the Geology Department served as a clearinghouse for information about new developments in local exploration activities. Public interest was high; an evening course on geological prospecting taught by Fitzsimmons during the 1954-55 year attracted nearly 100 participants.

UNM geology faculty and alumni were also instrumental in establishing the New Mexico Geological Society, an organization that brings together geologists from the region for a series of professional talks each Spring and a three-day field conference each Fall. The Society was organized in 1947, with Kelley and alumni Caswell Silver and

Gordon Wood, Jr. as the driving forces, and has since grown into one of the most vigorous and long-lasting of all state geological societies. Since 1950, the Society has published a book on the geology of each year's field conference area, and after

37 years these guidebooks form an indispensable continuing reference series on the geology of New Mexico and neighboring areas of the Southwest. The UNM Geology faculty has always played a leading role in the Society. For example, faculty members have edited or co-edited 20 of the 37 guidebooks published through 1986, and have contributed probably 200 or more papers and roadlogs to the series. On numerous occasions Geology faculty has served as officers of the Society, including president six times (Kelley, Northrop, Elston, Callender, Ewing, and Grambling). The contributions of alumni, students and staff swell these totals even more. Five current or former faculty (Kelley, Northrop, Wengerd, Callender, Elston) are Honorary Members of the Society.

Through the 1950s the Department of Geology functioned as a relatively small, regionally oriented department with a strong commitment to teaching. Its research was largely field-based and dealt with local problems, and little capability existed in areas requiring the expensive analytical instruments that were beginning to appear in leading geology departments. Support of scientific research at universities by federal agencies began to accelerate, but except for a few small contracts that did not exceed \$10,000 during any year, Geology faculty research was not supported by outside funding during the 1950s. Other departments, such as Anthropology, Chemistry, Mathematics, Physics, and Psychology were each over the \$100,000 mark before the end of the decade.

In 1957 imports of cheap foreign oil and a decade of hiring by industry began to affect the geology job market. Fewer positions were available to graduates and this trend immediately affected enrollments, which declined significantly in 1958, 1959, and 1960. Geology majors who had begun in 1956 or earlier continued through the undergraduate program and graduated, but the number of new majors was way down. In 1960, 30 bachelors' degrees were awarded, but only 12, 10, and 8 the following three years. The number of bachelors' degrees awarded during a single year would never again approach the 1960 total. The master's program, however, was not as hard hit. One result of the late 1950s slump was the increasing prominence of the graduate program in the educational mission of the Geology Department. The post-war boom had ended, but new changes and opportunities were to challenge the Department in the 1960s.

Transition, 1961-1971

The Geology Department changed considerably during the 1960s, and by 1971 nearly all of the major elements that characterize the present department were in place. Seven new faculty positions were added during this period, doubling the Department's size and vastly increasing its diversity and research potential. Moreover, both Northrop and Kelley, who had guided the Department from the 1920s and 1930s, had retired by 1970, after a combined 74 years of service on the faculty. The Institute of Meteoritics was formally attached to the Geology Department and began an unprecedented expansion during a time when mankind first began the direct exploration of a large extraterrestrial

body, the moon. Enrollments rebounded from their late-1950s low point as the “Baby Boom” generation entered college. Improved employment opportunities in geology, and perhaps the intellectual excitement engendered by plate tectonics, a new unifying model for the earth sciences, also contributed to enrollment increases. The level of outside funding supporting faculty research increased dramatically during the decade, as did the Department’s instrumental analytical facilities and the strength of its master’s and new doctoral programs. The Department evolved more rapidly and profoundly during this 10-year period than during any other time of equal duration in its history. To some extent its growth mirrored the rapid expansion of the entire University, which increased its enrollment from about 8,000 to 18,000 from 1961-62 to 1970-71.

During 1960-61 Northrop served his 33rd year as chairman of the Department. He was honored by being selected to present the University’s 8th Annual Research Lecture on April 7, 1961, on the topic “New Mexico’s Fossil Record.” During the same year UNM offered Northrop his choice of becoming Dean of the College of Arts and Sciences or of the Graduate School. He chose the latter but served only the 1961-62 year, after which he returned to the Department as Research Professor until his retirement in 1969. Since then, with the exception of Rosenzweig’s term as Assistant Dean of the Graduate School (1962-65), Geology faculty has avoided administrative positions outside of the department, preferring to devote their time to teaching and research.

During Northrop’s year as Dean, Kelley became acting chairman, and assumed the chairmanship at the beginning of the 1962-63 year. He immediately began revision of the undergraduate curriculum, stimulated partly by recommendations made by an American Geological Institute study of the Department. By 1965 the revisions had incorporated greater flexibility in course options for students interested in various subdisciplines of geology, and a considerable increase in required chemistry, physics/biology, and math courses (one year of calculus and a semester of statistics were required of geology majors for the first time). In addition, the Department organized an equipment fund drive in 1961 that eventually brought in \$18,000 in donations from industry and alumni. This was augmented in 1963 by an NSF grant of \$39,000 to the Department for upgrading teaching equipment, based on a proposal submitted by Roger Anderson.

These additions came none too soon, because enrollments in geology courses and the number of geology majors had begun to increase again as job opportunities slowly increased. By 1964 most graduates were receiving more than one job offer. During the decade of the 1960s geology enrollments climbed rapidly every year except 1966-67, reaching an all-time high during the 1971-72 years, at which time nearly 2.5 times as many students were taking geology courses (primarily physical geology) as had during the mid-1950s. The number of undergraduate degrees remained fairly stable (usually 7 to 12 per year) but the proportion of graduate degrees increased, as the number of graduate students in residence climbed to about 45 by 1970. The growing importance of the graduate program is indicated by the fact that from 1949 to 1960 19% of the total degrees awarded in geology were graduate degrees, whereas in 1961-1971 graduate degrees accounted for 49% of the total. This increase was fueled by an influx of funding for

graduate students. Federally supported research fellowships were obtained by three graduate students in 1961, but by 1966 nine students were supported by full-time NASA, NSF, NDEA and Peace Corps Fellowships and three others had research assistantships. In addition, University teaching assistantships allocated to the Department had risen from four or five in the mid 1950s to 11 in 1966. The Department awarded its first two doctoral degrees in 1962, to Elmer Baltz and Durga Rimal.

As enrollments expanded, so did the faculty. In the middle 1960s new positions were added at the Assistant Professor level in geochemistry (Edgar Cruft, 1963), structural and field geology (Lee Woodward, 1965), stratigraphy-sedimentology (Ronald Gibbs, 1965) and igneous petrology (Albert Kudo, 1966). These new faculty members each represented important areas of specialization within geology, and were essential in the transition of a relatively small department to one that could provide expertise in most of the major areas of the discipline. Hydrogeology and geophysics were also identified as areas in which future faculty would be sought. However, the addition of a geophysicist was delayed until 1971, and the urgency of a hydrogeology position appears to have faded by the late 1960s. The stratigraphy-sedimentology position proved to be curiously unstable; Gibbs left UNM for UCLA after one year and his replacement, Raymond Murray also remained for a single year, resigning to become chairman of the geology department at Rutgers. Lawrence Frakes, the third in this succession, likewise stayed only a year (1969-70); by the end of 1971 Charles Siemers had filled the position.

In 1961 Roger Anderson was awarded the first major grant obtained by a geology faculty member, \$16,000 from NSF to initiate studies of climatic cycles in varved evaporites in the Permian basin. Three years later Wolf Elston began NASA-supported research, comparing terrestrial volcanic craters and tectonic depressions to lunar craters. Both projects had scientific significance that extended far beyond the boundaries of New Mexico (somewhat unusual for geology faculty research at this time), and both were subsequently renewed—Elston's into the 1980's with considerable changes in emphasis. Their success marked a broadening of research horizons and increasing national recognition for the quality of UNM's geological research. The beginning of grant-supported research, together with increasing external support for graduate students and the addition of new instructional and research equipment were interconnected trends that were to become ever more characteristic of the Department in future years.

The tremendous technological advances during and after World War II made possible the development of analytical devices that could be used in a wide variety of geological studies, ranging from geochronology to precise characterization of crystal structure and the elemental composition of minerals and rocks. By the 1960s such instruments were essential for research in some fields of geology. Rosenzweig had acquired an x-ray diffractometer for crystallographic studies in the 1950s, but the addition of analytical equipment really took off in the mid-1960s. The Department acquired two emission spectrographs in 1965-1966, one on loan from Sandia Laboratories, while Cruft spent much of that year installing a new mass spectrometer in a newly constructed laboratory on the third floor, which had been made available by the departure of the Civil Engineering Department. Atomic absorption spectrophotometer

was obtained on loan from the U.S. Geological Survey In 1966, and a new one was purchased soon afterwards. By 1967 Kelley was presciently suggesting the creation of a materials analysis center within the Department, a facility that gradually developed in the late 1970s and 1980s with the addition of other analytical instruments and personnel. The Department's analytical capabilities were further enhanced in 1968 with Kudo's establishment of an experimental igneous petrology laboratory and his success in obtaining \$55,000 from NSF (matched by an equal amount from the University) for an electron microprobe. The microprobe was destined to become a centerpiece in the Institute of Meteoritics, which was officially merged with the Department that same year.

Acquisition and utilization of these instruments created a need for technicians to operate and maintain them. It had taken several years of persistent effort to hire a preparator/handyman in 1964 as only the second departmental staff member (the other being a secretary). This preparator, Will Blair, was followed in 1966-1981 by Don Powers, and from 1981 to the present by George Carnako. The Department has had extraordinary good fortune in its choices of men for this key position. A mass spectrometer technician joined the staff in 1966, and John Husler began as analytical chemist spectrographer in March, 1967, a position he holds to this day. These additions to the staff began to provide capable technical support at a critical time.

Against this background of rapid growth, the Geology faculty continued research programs in many of its traditional areas. Most of the faculty contributed to the New Mexico Geological Society field conference and guidebook on the geology of the Albuquerque area in 1961; Northrop edited the guidebook. Kefley spent much of the decade studying the regional tectonics, structure and stratigraphy of south-central, southeastern, and east-central New Mexico, this work culminating in another N.M.G.S. guidebook in 1972. He also edited a large volume on the geology of the Grants uranium belt (1963) and wrote a popular guide to the geology of the Albuquerque area (1969), both published by the New Mexico Bureau of Mines and Mineral Resources. Elston concentrated on the volcanic geology and mineral deposits of southwestern New Mexico and began to focus on the structure and significance of volcanic features associated with extensive ash-flow tuft deposits in that area. Ultimately these studies led to recognition of numerous giant mid-Tertiary cauldrons. Woodward completed several studies of the structure/tectonics and Precambrian geology of New Mexico and neighboring states, while Wengerd continued his research in petroleum geology and in 1969 was elected president of the American Association of Petroleum Geologists, the largest organization of professional geologists in the country. In addition, information from the work of five faculty and 39 alumni of the Department was incorporated into the geological map of New Mexico published by the U.S. Geological Survey in 1965. Scholarly publications by the faculty increased during the 1960s and surpassed 40 in a year for the first time in 1969.

By 1967 the Department was growing rapidly in size of faculty and staff, number of under graduate and graduate students, outside research funding, analytical instrumentation, and its national reputation. In that year the Department, led by Elston and Kelley, negotiated the merger of the Institute of Meteoritics (then an independent

University entity housed in the Physics Building) with the Department of Geology. Some of the groundwork leading to this important move had been established through Elston's participation in NASA-funded research, his recent establishment of a Lunar and Planetary Geology course, and growing interest in the Department and society in planetary sciences as the nation's space program progressed. Originally this plan included only the transfer of collections and hiring of a new director, who would also be a member of the Geology faculty, but by the time of the merger it had expanded to include University matching funds for the microprobe, a probe operator, a research assistant, an operating budget, and expansion of the third floor of the Geology Building. During the search for a director, Elston managed the affairs of the Institute. The details of these events are discussed in the accompanying article on the Institute and will not be elaborated on here.

Of singular importance to the success of this venture would be the new director. The Department chose Klaus Keil, who although only in his early thirties had already established a distinguished reputation at the NASA Ames Research Center, and would receive the first National Academy of Sciences G. P. Merrill award for outstanding work in mineralogy in 1969. The timing of the transfer of the Institute to the Department in 1968, and the choice of Director, could not have been better. The following year three Americans landed on the moon; shortly thereafter studies of returned lunar rock samples at UNM and elsewhere commenced, and NASA funding supporting these and related studies mushroomed. Under Keil's leadership the Institute of Meteoritics was quickly transformed into an institution at the forefront of the nation's scientific effort to understand the evolution of the solar system.

The impact of the Institute on the Department's research productivity may be judged from the fact that in 1973, five years after the merger, the number of departmental publications had nearly tripled over the 1960-1968 average and the amount of outside funding had increased by a factor of nearly four over the 1968 figure (\$300,000). Substantial contributions by the rest of the Geology faculty certainly played a part in this growth, but the Institute led the way. Viewed from a vantage point more than 20 years later, the merger of the Institute with the Department ranks as one of the most important events in the Department's history.

Amidst all of this activity Stuart Northrop retired in 1969 and became the Department's first Professor Emeritus. The Geology Building, which he had convinced the University to build and had helped design, was renamed Northrop Hall. George Clark was hired to fill Northrop's position as paleontologist, although Northrop's interests had reached far beyond paleontology to encompass New Mexico minerals and earthquake history, fields in which he is an authority. Vin Kelley retired the following year, having had an enormous positive influence on the development of the Department during his eight years as chairman. Kelley was adviser to more geology graduate students during his 33 years on the faculty than any other faculty member. Selection of a new chairman began during Kelley's last year. The Department searched nationally but a candidate acceptable to both the Geology faculty and to the University administration could not be found. This left the Department in an unfamiliar situation. A new chairman from within the Department had to be chosen, but this had only been done once in the previous 42

years, and the choice of Kelley at that time had been obvious. After much vigorous discussion Lee Woodward emerged as acting chairman for the 1970-71 year and became chairman the following year.

Woodward's year as acting chairman was a busy one. He established several faculty committees to handle specific areas of departmental activity — an essential innovation for a faculty that was growing rapidly—and began a reorganization of the graduate program. Also, three new faculty members arrived in 1971. George Jiracek, a geophysicist, filled the Department's gap in this increasingly important field. Charles Siemers, a stratigrapher-sedimentologist, replaced L.A. Frakes. Douglas Brookins came to UNM as a Full Professor from Kansas State, with research interests in geochronology, strontium isotope systematics, low-temperature geochemistry, and sedimentary ore deposits, especially uranium. Keil and Brookins, both extremely productive in research, publishing, and obtaining funding for their research, served as role models for the younger faculty and helped fill the void in the senior faculty resulting from the retirement of Northrop and Kelley.

An Emphasis on Research: The Modern Department, 1972-1988

The profound changes of the 1960s formed the substrate upon which the Department built in the 1970s and 1980s. In some respects a period of consolidation and adjustment, the 1970s were also a time of impressive advances in many areas (notably grant funding, publications, and addition of analytical instruments) that had been stimulated by the growth of the previous decade. The number of Geology faculty positions only increased from 14 to 16 by 1981 but broadening of the Department's expertise, course offerings and research interests continued.

The composition of the faculty changed considerably during the 1970s and early 1980s. Kelley's position was filled in 1972 by Jon Callender, a structural geologist, and when Cruft resigned in 1973 to devote full time to his mineral exploration company, the Department hired Gary Landis to continue this geochemistry position. Landis devoted much of his time during the next three years to establishing a stable isotope and fluid-inclusion laboratory, but departed in 1979 for a better paying position with the U. S. Geological Survey. Crayton Yapp, from Caltech, replaced Landis in 1980 and continued the Department's work in stable isotope geochemistry. Two critical positions, in mineralogy and paleontology, were opened by the departures of Rosenzweig and Clark in 1974. These were filled by two new Assistant Professors, Rodney Ewing (mineralogy) and Barry Kues (paleontology). Charles Siemers, the stratigrapher-sedimentologist, left the following year for a petroleum company; Ray Ingersoll replaced him in 1976 but followed his TV newscaster/actress wife to Los Angeles in 1982, obtaining a position at UCLA. Robyn Wright succeeded Ingersoll in 1984, becoming the first woman on the Geology faculty.

Sherman Wengerd retired in 1976 after 29 years on the faculty, and became the Department's third Professor Emeritus. By hiring Stephen Wells to replace him, the Department expanded into geomorphology, a discipline that includes two areas of

geology that were becoming increasingly important – geohydrology and environmental geology. With the subsequent arrival of Les McFadden (interested in the geology and geochemistry of soils) in 1981, and the participation of Anderson and Yapp, an interdisciplinary Quaternary Studies Program was established in the Department in 1982 with funding from the State, UNM Foundation, and the U. S. Geological Survey. This program, which conducts studies and trains students in a broad range of recent geological processes and problems, has become very successful, attaining a national reputation and attracting excellent graduate students from the U S and abroad.

The Department's geophysics program was broadened in 1977 with the addition of Stephen Huestis to the faculty. Huestis, a theoretical geophysicist, complemented George Jiracek's more applied approach. The retirement of Paul Fitzsimmons (1979) allowed the faculty to add Jeffrey Grambling, whose interests in metamorphic petrology and Precambrian geology augmented the Department's traditionally strong capability in related fields such as structural geology and igneous petrology. By 1981, then, the faculty had increased slightly over its 1971 size, but its personnel had changed considerably. Moreover, its expertise in various areas of the geosciences had broadened, and with several young assistant professors replacing older men, the average age of the faculty dropped below 40.

Perhaps the most important trend influencing the profession of geology during the 1970s was the increasing attention paid to the nation's energy and mineral resources, especially petroleum. The formation of OPEC and drastic increases in the price of petroleum in 1973 and 1979 jarred the U. S. economy but also stimulated increased domestic exploration and production. Geology became one of the most attractive career options for university students. As in the mid 1950s, thousands of new geologists were absorbed by the petroleum industry, often with beginning salaries higher than those of the professors they had taken courses from a short time before. New Mexico's geology-based industries (chiefly oil, gas, uranium, copper, potash, and coal) shared in this growth. The value of the State's production of these commodities increased from about \$1 billion in 1971 to nearly \$6 billion by 1980, creating an unusual local demand for geologists that New Mexico's universities were hard-pressed to meet. Enrollment in geology courses at UNM reached an all-time high in fall 1971, and remained high through the early 1980s, while an average of 17 undergraduate and 13 graduate degrees in geology were awarded yearly from 1972 to 1981.

Many geology departments throughout the country used the hiring boom of the 1970s to inflate enrollments and budgets. The UNM Department resisted this trend and raised the standards for its students instead. Under Woodward's tenure as chairman the graduate program was reorganized, with entrance examinations in general geology, field mapping, and petrology now being required of new students. Rigorous oral comprehensive examinations for masters' candidates were also introduced; previously they were only required of doctoral students. Together with tougher admissions standards, these measures increased the overall quality of the graduate student population. A program of student evaluation of courses and instructors and an undergraduate honors' program were also initiated in the early 1970's. During this

decade the Department strengthened its already excellent reputation in the mineral and petroleum industries as a supplier of well-trained geologists at the bachelor's and master's levels. Virtually every graduate of the Department found employment as a geologist or continued on to obtain higher degrees at other universities.

The high price of oil and gas triggered national efforts to develop other energy sources, particularly coal, geothermal and nuclear energy, in order to decrease reliance on foreign petroleum. Simultaneously, a growing environmental movement demanded detailed impact and risk assessments of the effects of mining and related activities on the land and the people who lived on it. Many federal and state funds became available during the 1970s to address these concerns, significantly influencing the direction of the Department's research. Seven geology faculty members, for example, participated (1975-1977) in three complementary grants totaling about \$400,000 (funded by the U.S. Geological Survey and New Mexico Energy Research and Development program) to determine New Mexico's geothermal energy potential. Partly under this program Jiracek studied the geophysical properties of potential geothermal areas. Separately, Brookins investigated the geology of the Grants uranium belt and the suitability of various geological environments for radioactive waste disposal.

Jiracek studied the geophysical properties of potential geothermal area. Separately, Brookins investigated the geology of the Grants uranium belt and the suitability of various geological environments for radioactive waste disposal. Anderson, an authority on the geology of Permian evaporites, evaluated the potential of the New Mexico WIPP site near Carlsbad for nuclear waste storage, and Ewing worked on the effects of radiation damage on various materials being considered for nuclear waste disposal. Wells and Kues studied, respectively, the geomorphological/hydrological and paleontological impacts that would occur in the badlands of northwestern New Mexico if strip-mining for coal were greatly increased.

These and similar research projects, together with a high level of NASA funding to Keil and, to a lesser extent, Elston for studies relating to the geology of the moon, Mars and meteorites, accounted for the extraordinary increase in grant/contract funding flowing into the Department through the 1970s. This funding increased from \$700,000 in effect in 1971 to more than \$2.5 million during the 1978 calendar year. During the 1970's and 1980's the Geology Department has ranked at or near the top of all UNM science departments both in contracts/grants in effect and new ones obtained during a given year.

Increased activity on funded research projects during the 1970s by an increasingly young and research-oriented faculty had several other major effects on the Department. The number of scholarly publications, already increasing rapidly from the late 1960s, jumped dramatically from 74 in 1975 to 127 in 1976, and averaged 116 per year for 1976-1985. Research assistantships for graduate students increased; by the mid 1970s more than 30 geology students yearly were being supported in this manner, about one-third to one-half of the RA total for the College of Arts and Sciences. The number declined to 16-23 with restrictions in outside funding during the 1980s, but still accounts for a sizeable percentage of the College's total.

Research equipment grants, often matched with University funds, and funds from a five-year New Mexico State bond issue, made possible the purchase of new analytical instruments in the late 1970s and 1980s. These included a scanning electron microscope, analytical electron microscope, fully automated electron superprobe, two mass spectrometers, a new x-ray diffractometer and equipment for new stable light isotope and paleomagnetism laboratories. These instruments increased the potential scope and sophistication of faculty and student research, and with the extensive renovation of the Department's laboratories that began in 1980, resulted in an array of modern analytical facilities that is probably unequalled by any other geology department of comparable size in the country. Fieldwork has not been neglected; the first department four-wheel drive vehicle was purchased in 1964 and today the departmental fleet for teaching and research numbers seven vehicles.

Prior to the 1970s nearly all of the Department's academic endeavors had been conducted by the permanent faculty, although faculty associates such as Charles Read (paleobotany) and Fred Trauger (hydrology) had occasionally taught courses since the 1950s. One of the most important trends of the past ten years has been the Department's ability to add to the diversity and breadth of its research and instructional efforts by utilizing the talents of non-faculty geoscientists. Numerous adjunct faculties have taught courses within the Department in areas outside the expertise of the faculty. Of the present and past adjunct faculty, Frank Gorham (petroleum geology), Ed Beaumont (coal geology) and John Shomaker (coal geology and hydrology) are especially noteworthy for their contributions during the past decade. Visiting scientists, some from other countries, have likewise added their expertise to the Department's program for periods ranging from a few weeks to more than a year.

Support from alumni, research grants, and the University have been important in establishing two special programs that have considerably enhanced the Department. The first was the creation in 1978 of Energy Exploration Education, Inc. by alumni and friends in the petroleum industry, led by Frank Gorham and the Department's Lee Woodward. This non-profit corporation made possible the establishment of a "Distinguished Petroleum Geologist" position in the Department, which has been filled by four geologists (Frank Counselman, Sherman Wengerd, Claude Abry and Bruce Black) since 1979. They have offered courses of particular interest to students' intent on careers in the petroleum industry, which would not have been taught by any of the faculty.

A major contribution to the Department's programs occurred in 1980, when the Caswell Silver Foundation was formed. The Foundation was created through a generous endowment by alumnus Caswell Silver (B.S., 1940; M.S., 1946) who founded and was the president of Suridance Oil Company. The sole purpose of the Foundation is support of research and graduate education in the earth sciences at UNM. It supports an endowed chair, the Caswell Silver Distinguished Professorship, which beginning in fall 1981 has brought to the Department geoscientists of outstanding reputation. F. Donald Bloss (Virginia Polytechnic Institute and State University), William Holser (Oregon State), and

Ronald Vernon (Macquarie University in Australia) have each spent a year in residence involving research, graduate seminars, and other interactions with faculty and students. Dr. Gary Smith began a two-year tenure as Caswell Silver Research Professor in fall 1987.

The Silver Foundation also supports the Vincent C. Kelley and Leon T. Silver Graduate Fellowships (with generous stipends that have attracted several top geology graduate students to UNM so far), a Distinguished Lecturer series, and some faculty expenses, especially travel to scientific meetings. At about the same time as the Silver Foundation was created, a new program of financial support for graduate students was established through the efforts of Vin Kelley — an Alumni Fellowship Fund within the UNM Foundation. Earnings from the contributions of alumni and friends are used for graduate student fellowships. The Fund has grown to more than \$100,000 since its inception.

In addition to the special programs mentioned above, two staff positions filled by research scientists were added to the Department in 1984 (three other research scientists had worked in the Institute of Meteoritics for several years). Spênôer Lucas became curator of the Department's growing collections and added vertebrate paleontology to the spectrum of disciplines embraced by the Department until his departure in 1988. Ian Mackinnon supervised the Department's analytical electron microscope facilities and conducted research in mineralogy, crystallography, and materials science during his four years in the Department.

Post-doctoral scientists working with faculty members have also contributed to the Department's research productivity. Douglas Kirkland stayed on after receiving his Ph.D. in the Department to work with Anderson in 1963-64 as the Department's first post-doctoral scientist. Since then about 10 other post-docs have been in residence. The promising career of one, Rodney Rhodes, was cut short by his death in an auto accident in 1975; a scholarship fund for geology students bears his name.

During this period of growth and accomplishment the Department was led by three chairmen: Lee Woodward (1970-1976), Douglas Brookins (1976-1979) and Rod Ewing (1979-1984), with Wolf Elston serving as acting chairman in 1982, during Ewing's sabbatical. Each successfully translated the faculty's individual desires and aspirations into shared goals for the Department as a whole, and was untiring in their efforts to advance the Department towards these goals. Put simply, these goals were all parts of a single objective — to become truly excellent in all phases of activity, relative to other departments within the University and to geology departments at other universities. In the late 1980s this objective has not been completely achieved, and there are important external constraints that inhibit advancement in some areas, but progress has been made. Prior to the 1970s, however, such an ambitious objective could not have been seriously considered.

By the early 1980s the Department had become too large for a chairman to administer and still maintain a high level of scholarly accomplishment, a *sine qua non* of

the position. Ewing instituted an assistant chairmanship (Callender, Kues, and Wells have filled this position), and also convinced the University to add an administrative assistant to the staff. Marguerite Swanson served under five different chairmen or acting chairmen in this capacity during 1981-87, providing administrative continuity and a great deal of capable support in a wide range of departmental functions.

Departmental faculty and associated personnel were honored with several awards in the early 1980s. In 1981 Vin Kelley received the Regent's Recognition Medal, Don Powers (retiring preparator) and Klaus Keil received the Regent's Meritorious Service Medal, and Caswell Silver was made an Honorary Doctor of Science. Klaus Keil gave the University's Annual Research Lecture, entitled "Meteorites, the Asteroid Connection," the second Geology faculty member to be so honored. The Department of Geology and Institute of Meteoritics were also featured in UNM exhibits at the 1981 State Fair. A few years later, when the University's Presidential Professorships and Lectureships were established to recognize outstanding senior and junior faculty, Keil became one of eleven senior UNM faculty to receive a Professorship, and Jeff Grambling, Crayton Yapp, and Stephen Wells received consecutive Lectureships.

Two other accomplishments of the early 1980s also deserve mention. Transfer of the Harding pegmatite mine in Taos County to UNM was completed in 1982—about six years after Arthur Montgomery had initiated the process of donating it to the University. The mine is in a classic zoned pegmatite enriched in lithium, beryllium, and rare-earth elements. It is managed by the Department of Geology as a unique natural laboratory for student instruction and research and is visited by hundreds of people each year.

In addition, the Geology Department played an important role in the establishment of the New Mexico Museum of Natural History in 1980. Primary impetus for the museum had come from an increasing awareness of the scientific value of New Mexico's paleontological record. The Department's paleontologist, Barry Kues, had been involved from the beginning of the effort to establish the museum, and later served on its policy advisory committee. The Department's contribution to the museum increased in 1984 when faculty member Jon Callender resigned to become its director, and he presided over the opening of the museum early in 1986. An alumna of the Department, Kathleen Affholter, served as the first Curator of Geology and Spencer Lucas became Curator of Paleontology in 1988. As a major new scientific institution in Albuquerque, the New Mexico Museum of Natural History has the potential to complement UNM's instructional, public, and research activities in the natural sciences.

The Geology Department underwent a program evaluation in spring 1983, conducted by three external academic geoscientists, two UNM faculty in other departments, and the Office of Graduate Studies. The Department received a very positive evaluation and benefited greatly from the review panel's report. As a result, the Department was allowed to search nationally for a new chairman to succeed Ewing, who resigned in 1984 after five years of innovative and exceptionally productive leadership. Cornelis Klein, a distinguished mineralogist and member of an international team of scientists studying the Precambrian, was chosen as chairman. He came to UNM from

Indiana University in fall 1984, after negotiating a commitment by the University to an additional faculty position. That same semester John Geissman arrived to add paleomagnetism to the expertise of the Department; he replaced Ken Mahrer, who had served briefly as geophysicist following Jiracek's departure in 1980. In 1986 the Department filled Callender's vacated position in structural geology with Chris Mawer, and the new position with Laura Crossey (organic geochemistry), bringing the total number of faculty to its present 18. During the previous year a four-phase, five-year renovation of much of Northrop Hall (basement laboratories, lecture hall, departmental office and exterior) was completed. The Geology Museum and its exhibits were also thoroughly remodeled (supported by the UNM Foundation and College of Arts and Sciences), for the first time since the museum was established in Northrop Hall more than 30 years before. By request of the faculty, Klaus Keil became chairman of the Department in July, 1986, continuing also as Director of the Institute of Meteoritics.

During the early 1980s employment opportunities for geologists again declined, as the petroleum and minerals industries headed into their worst slump since the late 1950's. Fears about the safety of nuclear reactors after the Three Mile Island shutdown, and foreign competition severely curtailed New Mexico's once-flourishing uranium industry; copper, potash, molybdenum and other commodities were hard hit as well. A recession in the petroleum industry turned into a hemorrhage of laid-off geologists in 1986, as the price of oil plummeted to one-third of its value a few years before. As always, changes in the employment outlook have affected enrollments; the number of undergraduate geology majors, for example declined from 148 in 1981 to 66 in 1986. The number of graduate students, however, has increased to about 75, partly because more good students are seeking advanced degrees rather than employment. If the slump continues, the graduate population will probably begin to decline as well, reflecting a much smaller nationwide supply of undergraduate geology majors. Economies in government and industry are making the raising of outside research funds increasingly difficult, affecting both graduate students and faculty.

As the Department of Geology moves into its tenth decade these and other challenges will test its strength and versatility. Yet the record of the Department has been one of continuous advancement in all areas of its activity, and this may be expected to continue. Energy resources will continue to play an essential role in our technology-oriented society, and freshly trained geologists will continue to help develop old and new sources of energy, and discover and produce other important geological materials. An increased emphasis on environmental geology has resulted in a greater number of careers in that and related fields like geohydrology with state and federal agencies and consulting firms. More scientists also will be needed in materials characterization; several graduates of the Department are now working in that field with Sandia, Los Alamos, and other government laboratories.

As in the past the faculty has adapted to these changing trends in the science of geology, both in its instructional program and in its research, and looks forward with anticipation to the future. There is still much to be learned about the geology of New Mexico and the world. Study of fundamental large-scale geologic processes, such as plate

tectonics and regional volcanism and how these have affected the geology of the Southwest are ongoing. Ever more sophisticated analytical instruments will allow more detailed understanding of the properties of solid materials on a molecular and atomic scale, and simultaneously of their usefulness for such purposes as radioactive waste containment.

Determination of the effects of land use on erosion patterns, groundwater contamination and other aspects of the environment are becoming increasingly critical as population and land use expands. And we look forward in the coming decades to increased study of the geology of other planets, and ultimately to the opportunity for geologists to initiate field studies of the craters and lava flows of the moon, and the canyons and red deserts of Mars. It is the desire to contribute significantly to geological knowledge which, perhaps above all else, animates the faculty and research staff of the Department, and which it seeks to instill in its students.

The faculty and staff of the Department take pride not only in their own contributions to the science of geology, but in the contribution of alumni as well. A glance at the names of the more than 1100 UNM geology graduates (posted permanently in Northrop Hall) reveals many who went on to obtain doctorates and become geology professors at universities across the country. Some of what they pass on to their students and colleagues as teachers and researchers reflects their experience in the Geology Department at UNM. Other alumni have become successful in the U.S. Geological Survey, petroleum and mineral industries, and as independent consultants. One alumnus, Leon I. Sliver (M.S., 1948, now at Caltech), is a member of the National Academy of Sciences; another, P. B. Grant, Jr. (B.S., 1951), served as a New Mexico State legislator for several years. Some geology graduates pursued careers in other fields; A. E. Utton (B.A., 1955) for example, is now a Professor in UNM's Law School.

Concluding Remarks

There is no final history of any institution, for history differs in the minds of each individual who experiences portions of it or attempts to understand it in its entirety. The brief history of the Geology Department presented above is no exception. It does perhaps illustrate that the reverse of the famous geological dictum of uniformitarianism, "the present is the key to the past," is equally valid — understanding the past is essential for understanding the present. Today's Geology Department is what it is because of the actions, decisions, and efforts of all of the people mentioned in this account, plus numerous others whose contributions could not be acknowledged in the space available.

In addition to the facts, figures, and interpretations presented here there seem to me to be several less tangible qualities of the faculty that have contributed to the Department's success, at least in the past 14 years that I have been associated with it. Important among these is the relationship between the chairman and the rest of the faculty. Chairmen are chosen by the faculty with the expectation that they will be strong leaders and advocates for the Department, and are given wide latitude in handling interactions with other parts of the University, representing the faculty, defining goals

and courses of actions, and allocating resources. The faculty, in turn, preserves a strong democratic tradition in which impending decisions, goals, and commitments are fully and freely discussed, sometimes modified and occasionally rejected. A remarkable tolerance for varied points of view, and a pronounced tendency to evaluate ideas on their merit, not on their source, characterizes the faculty.

Out of this interplay, and despite the fact that individual faculty members work on an amazing variety of research projects (geology is an extremely broad discipline), a strong sense of dedication to the well-being and advancement of the Department as a whole is shared by all. Unity of purpose and action is easily achieved when challenges, crises, or opportunities loom. And the educational and professional backgrounds of the faculty and scientific staff are unusually broad, producing an intellectually enriching diversity of perspectives. The faculty/scientific staff is composed of individuals who received their training in the East (Harvard, MIT, Princeton, Columbia), West (California, Stanford, Caltech, Washington, Arizona, Wyoming), and central (Indiana, Michigan, Cincinnati, Rice) parts of the United States, and foreign countries as well (Germany, Great Britain, Australia). All of these qualities have made participation in the activities of the Geology Department over the past 14 years a most enjoyable experience for this writer.

One final note. In October, 1987, the Department and Institute of Meteoritics sponsored the largest gathering of present and past Geology Department people in recent memory. The occasion was a symposium in honor of Stuart Northrop's 60th and Vincent Kelley's 50th year of contributions to the Department of Geology and University of New Mexico. Many of the participants reflected upon the presence of these two Emeritus Professors as being a continuous reminder of the Department's history and growth, and of the inevitable and important connection between the present and the past.