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History of the Institute of Meteoritics

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The story of the Institute of Meteoritics centers on the lives of two dynamic men. One of them, Lincoln LaPaz, founded the Institute. He grew up in Kansas, where he saw Halley's Comet at age 13 and where he gazed up at the night sky from the top of his house, studying meteors as they blazed through the atmosphere. While a student at Fairmount College in Wichita, LaPaz rode his horse, Belle, to class, letting her graze in a neighboring field while he studied mathematics. The other key figure in the Institute's history is Klaus Keil, Director since 1968. He grew up in what became East Germany, and escaped the stifling, totalitarian life behind the iron curtain when in his young twenties, carrying meteorite specimens with him. Though having vastly different roots, LaPaz and Keil share the same fascination with stones that fall from the sky. The Institute's story can be told in three parts: LaPaz's era, a period of transition, and Keil's era.

The Lincoln LaPaz Era:
Founding the Institute and Its Collections

The Institute of Meteoritics was founded officially on June 17, 1944, although it did not actually begin operations until November 1, 1945, as Dr. LaPaz was immediately given a leave of absence to continue war time work as the technical director of the Operations Analysis Section with the Second Air Force. After the war, Dr. LaPaz became the first Director of the Institute and the Head of the Department of Mathematics and Astronomy, leaving a position as Professor of Mathematics at Ohio State University. Although the Director was a Professor of Mathematics, the Institute was a separate entity within the university.

LaPaz set up shop in the Science Lecture Hall, first in the west end and then, after that space was reassigned to the College of Pharmacy, in the area occupied by the Department of Mathematics and Astronomy in the Science Lecture Hall. The Institute finally moved to the Physics Building on Lomas Boulevard in 1952.

To set a sound course for his Institute, LaPaz formulated five objectives for it. First, to promote the recognition and recovery of meteorites, which included arousing interest in the general public? Second, to provide for the preservation, public exhibition (without cost), and scientific study of meteorites and products of meteorite impacts on the Earth. Third, to provide meteorite specimens to scientists (without cost). Fourth, to advance not only pure sciences such as the study of meteors, but also to help stimulate the use of meteorites in practical sciences such as rocketry and metallurgy. Fifth, to provide publication facilities for reporting the scientific results of research on meteorites.

LaPaz was sensationally successful in pursuing these goals. Perhaps his greatest achievement was to establish a first-rate meteorite collection that is used to this day for research and education. The star of the collection is the Norton-Furnas County, Nebraska

stone meteorite, which fell in 1948. The collection contains thousands of pieces of this rare type of meteorite, including one huge boulder that weighs one ton. This impressive chunk of space rock, which is on display in the meteorite museum, was the largest single specimen of a stone meteorite until 1976 when a larger one fell in China. Still, for 28 years LaPaz and the Institute held the record for biggest stone meteorite!

LaPaz fostered collaborative studies with other scientists in the university. For example, the first staff of the Institute included Dr. Morris S. Hendrickson, a mathematician who later became chairman of the Math Department, and Dr. Carl Wellington Beck, a mineralogist in the Department of Geology. These scholars were not paid from the Institute's budget, however. The first permanent, fulltime staff member was James D. Wray, who came in 1962.

LaPaz and Beck collaborated on many projects until Beck left in 1954. One of their joint projects was an administrative effort: during the 1949-1950 school year, they forged an arrangement between Geology and the Institute of Meteoritics which allowed for master's research in meteoritics leading to the MS degree in Geology. This was the first formal link between the Geology Department and the Institute. Closer links would follow.

Although not a graduate student, the first product of the Geology-Meteoritics agreement was a young meteoriticist named William A. Cassidy, who received a BS in Geology in 1952. Cassidy had developed an Interest in Meteoritics early in his life, and the existence of the Institute of Meteoritics was one of the reasons he came to UNM. In 1953, Cassidy received the first Fulbright fellowship for study in meteoritics. Although Cassidy left UNM after receiving his BS degree and began to pursue a PhD at Penn State, LaPaz continued to list him as an Associate Member of the Institute until 1957. In 1956, LaPaz proudly noted in the Annual Report that Cassidy had received the first National Science Foundation fellowship awarded for the study of meteoritics. Incidentally, while at UNM, Cassidy must have caught the fever of meteorite collecting for scientific purposes as he has become one of the key players in an important program of meteorite collection in Antarctica, where meteorites are preserved on stark, frigid, ice fields even better than they are on the dry, hot plains of New Mexico.

LaPaz spread the gospel of meteoritics by writing numerous articles for Popular Astronomy and by helping establish the journal Meteoritics, which was originally published in 1953 by the University of New Mexico Press. He also wrote with his daughter Jean LaPaz (a graduate of UNM with a major in geology) a layman's guide to meteoritics, Space Nomads: Meteorites in Sky, Field, and Laboratory. LaPaz's exceptional ability to make written words jump from a page and seize a reader's attention aided him in educating the public and the general scientific community about meteorites and meteorite research. For example, in discussing the objectives of the Institute in an article in the inaugural Issue of Meteoritics, he explained why he engaged in an extensive publicity campaign to recover meteorites:

> Meteorite hunting, unlike pure mathematics, cannot be conducted with success solely by publicity-shy individuals comfortably seated in armchairs. Unlike the chemist, who buys his research materials from catalogs; the bacteriologist, who brews up his cultures at will in a laboratory; and the botanist, who finds the objects of his experimentation in conveniently located greenhouses and herbariums, the meteoriticist is in large measure dependent on the general public for the specimens with which he works. In meteoritics, as in perhaps no other science, rapid progress depends on the intelligent cooperation of the layman, that fortunate individual destined, because of his ubiquitousness, not only to witness all meteorites yet to fall, but also, sooner or later, to stumble upon many of those that have already fallen.

LaPaz's writing also reflects his sense of humor. For example, in a 1958 review article in Advances in Geophysics IV, he explained that between the years 2100 and 3300, it is practically certain that at least one person will be struck by a falling meteorite. He then added, "Inhabitants of this formidable world of the future, however, may regard this meteoritic danger as the least of the hazards to which they are subject." He went on in the same article to comment about the circumstances surrounding an Alabama woman's meeting with a meteorite in 1954 while she was lying on a couch: "even the Sylacauga meteorite did not score a direct hit on Mrs. Hodges, but rather clobbered her on the first bounce!"

LaPaz had many interests besides meteorites. While he and associates in the Institute of Meteoritics were studying Meteor Crater in Arizona, a hole six-hundred feet deep and three-quarters of a mile across formed when a house-sized chunk of iron crashed into the Earth, they discovered an ancient ruin. Not satisfied with simply noting its existence, LaPaz and Institute associates worked with Mr. Boyd Wettlaufer, an archaeologist, to completely excavate what turned out to be a pit house.

The Transition from LaPaz to Keil

Lincoln LaPaz retired from teaching in 1962, but remained Director of the Institute until 1966. During that time and during 1966 and 1967, when Dr. James Wray was Director, the fate of the Institute was discussed by two different committees.

In May of 1963, President Popejoy asked Stuart Northrop, Research Professor in the Geology Department, to chair an Ad Hoc Committee on the Institute of Meteoritics. Besides Northrop, the committee consisted of four other faculty members, Martin W. Fleck (Biology), Morris S. Hendrickson (Mathematics), Christopher P. Leavitt (Physics and Astronomy), and Keith R. St. Onge (Speech). The committee met several times during the summer and fall of 1963, and also asked advice from Professor LaPaz. In December 1963, they presented a set of recommendations to the President. One major conclusion of the committee's deliberations was that it would be better if the Institute became a part of another department, rather than existing, as it had been, as a separate entity in the university. Because the Department of Physics and Astronomy was going to

take over teaching astronomy courses formerly taught by members of the Department of Mathematics and Astronomy, and because Physics and Astronomy had expressed interest in developing the field of meteoritics, Northrop's committee recommended transferring the Institute to that department.

The Northrop committee recommended three options for dispensation of the meteorite specimens, with LaPaz as Curator, if he agreed. One was to establish a Meteorite Museum as a separate entity, run by a board appointed by the President. A second option was to transfer the Meteorite Museum to Physics and Astronomy, which would be logical since the Institute would be in that department. The third possibility the committee presented to President Popejoy was to transfer the meteorites to Geology, which wished to include some meteorites in its popular geology museum. Northrop himself seems to have been in favor of the third alternative: in the 1964-1965 Curator's Report for the Geology Museum, he wrote, "I would like to go on record as urging the Administration to add a room adjoining the Museum to the west in order to be able to exhibit the meteorites of the former Institute of Meteoritics, which are not at present accessible. These should be available for viewing by the public during the dawn of the space age!" Also, the Geology Department already had a small collection of 14 meteorites from New Mexico, which had been purchased in 1941 through the generosity of Joe Heaston of the Heaston Motor Company.

The recommendations were apparently not acted upon, although LaPaz stayed on as Director and continued to curate the meteorite collection. James D. Wray, a mathematician, became Director in 1966, but left a year later to take a job at Dearborn Observatory, Northwestern University. Wray's parting act was to recommend that the Institute be attached to the Geology Department. Vincent C. Kelley, Chairman of Geology in 1967, concurred with this idea and recommended it to President Popejoy, pointing out that the geology faculty as a whole favored it. Kelley appointed an interim committee whose main task was to find a top-notch scientist to direct the Institute. The committee was chaired by Kelley and composed of members of the geology faculty, Stuart Northrop, Abraham Rosenzweig, Wolfgang E. Elston, and E. F. Cruft. The university administration readily agreed to incorporate the Institute into the Geology Department and backed up their enthusiasm with matching funds to buy an electron microprobe, hire a director, a microprobe operator, and a research assistant. Space was also made available for equipment and personnel in the geology building.

Wolfgang Elston, an expert in planetary geology, handled the affairs of the Institute until the new director arrived. Elston helped write a new charter for the Institute, with enough flexibility built into it that additional staff members could be added. It was a new beginning for the Institute.

A nationwide search led to applications from some of the best meteoriticists of the day. The department offered the directorship to a meteoriticist by the name of Klaus Keil, then a staff research scientist at the NASA Ames Research Center.

The Klaus Keil Era:

Microprobes, Moon Rocks, and NASA Money

Before coming to UNM, Klaus Keil had established a shining record of accomplishment in the study of meteorites. One of those achievements was to vigorously use a gadget called the electron microprobe in his research. An electron microprobe is a complicated device that focuses a beam of electrons to a tiny spot (less than a micrometer in diameter) onto a polished specimen of a rock, mineral, alloy, or other material. Keil and his coworkers at NASA's Ames Research Center and before that at the University of California, San Diego, had aimed the sharp beam of electrons at meteorite samples and had discovered some remarkable facts about meteorites. The invention of the electron microprobe and its use on geologic samples marked a new, quantitative period in geology and meteoritics. All modern geology departments now have one. The university's promise to match funds for a microprobe was an essential ingredient in luring Klaus Keil to New Mexico.

Matching funds for the electron microprobe were raised from the National Science Foundation. A. M. Kudo, whose research into the origin of terrestrial igneous rocks also required the instrument, wrote the proposal to NSF. The Geology Department's and Keil's sound reputations led to a successful quest for the funds and the microprobe arrived slightly after Keil did. The instrument cost $100,000 in 1968, and was updated considerably with NASA funds in 1975-1976. A second microprobe was purchased in 1982 for $500,000: special university funds for research equipment were used to buy the new instrument, but NSF contributed a hefty $180,000, again showing its admiration for the Department and the Institute.

The Klaus Keil era is also the era of George H. Conrad, the first and only microprobe specialist in the Institute's history. Conrad was hired away from Sandia Laboratories where he had been working in the microprobe and other laboratories. He had been analyzing materials and fixing microprobes at Sandia since 1961, about the time Keil had begun to use them. Together, they have more than half a century of experience in microprobe analysis.

The Keil era has been one of dramatic growth of the Institute. Much of the growth has been fueled by grants received from NASA. The first NASA funds were obtained to study lunar samples, beginning with the first batch returned by the Apollo 11 mission. It was an exhilarating time in the Institute of Meteoritics, as Keil and Research Scientist Martin Prinz worked feverishly with collaborators Ted Bunch and K.G. Snetsinger from Ames Research Center on the fascinating and precious cargo returned by astronauts Armstrong, Aidrin, and Collins.

New Mexicans were not left out of the excitement. On December 6, 1969, about five months after the first landing, Keil spoke in Popejoy Hall to state legislators, regents, and news reporters about the samples and the work Institute scientists had done on the lunar samples. The following day the samples were displayed for the public. Over 4200 persons lined up outside the Fine Arts Center to look at a charcoal gray pile of dirt and a black rock that were collected on another celestial body by fellow Americans. Other

showings of the lunar samples occurred in March, 1970 in Farris Engineering Center and later that year in September at the New Mexico State Fair, where 69,000 New Mexicans peered at bits of the Moon.

That exhibit at the State Fair must have been memorable for Dr. Martin Prinz, the first Senior Research Scientist in the Institute's history and now the Chairman of the Department of Mineral Sciences at the American Museum of Natural History in New York. Each morning before the Fair opened, Prinz would go to the Institute, open one of the safes in which the precious lunar samples were stored, retrieve the samples for the display, and be escorted to the Fairgrounds by the New Mexico State Police. When the Fair closed each evening, the procedure was reversed. This was not the first time a member of the Institute was in the custody of State Police Officers. When Klaus Keil arrived at the Albuquerque airport with the first batch of lunar samples, he was greeted by officers of the law and escorted back to UNM.

With the Moon rocks came NASA money, which allowed the Institute to support additional researchers, besides Prinz, whose salary was picked up largely by the university. NASA funding has grown over the years and has been supplemented by other grants and contracts. The Institute has benefited from a succession of talented postdoctoral fellows and permanent staff members. Total outside funding has grown from about $100,000 in 1969 to more than $400,000 in 1986. A total of more than $5 million has flowed like a green river into the Institute during the Keil era.

All that money has been well spent. Quality research has flourished at the Institute of Meteoritics and continues to do so. Numerous significant papers have been published, as many as 40 per year. The papers are frequently cited and range widely in their subject matter. Besides lunar samples, Institute scientists have studied components inside meteorites called chondrites that existed before planets formed; impact processes on small bodies; heating inside small bodies; meteorites that might have come from Mars; the origin of the Moon; the nature of the Martian surface as determined by the Viking landers. Klaus Keil has also been actively involved in studying ways to safely dispose of radioactive waste in geologic environments. In a way, the term "Meteoritics" in "Institute of Meteoritics" is not general enough. It's really an Institute devoted to all of Planetary Science.

The accomplishments of Institute personnel have given it a national and international reputation. Since 1968, 164 scholars from throughout the United States have visited the Institute to give lectures and to collaborate on research projects. Another 72 scientists have visited from foreign countries. Institute scientists have also been asked to serve on and in many cases chair prestigious national committees such as the Lunar and Planetary Review Panel, the Lunar and Planetary Sample Team, the Antarctic Meteorite Working Group, and the Committee on Planetary and Lunar Exploration of the National Academy of Sciences, Institute scientists have also served as officers in national and International societies.

The Keil era has not emphasized meteorite collecting, though the collection has grown anyway. Meteorite specimens are traded to obtain pieces of important meteorites not in the collection and interested citizens bring in suspected meteorites for examination. One of these citizens is a remarkably keen observer named Ivan "Skip" Wilson, who has found almost a hundred meteorites on the plains of eastern New Mexico. Skip Wilson carries on one of LaPaz's missions.

The meteorite collection is also on display in the meteorite museum, located south of the recently-refurbished geology museum in Northrop Hall. Thousands of people visit the museum each year. The stunning and dramatic exhibit was formally opened in May, 1974, after years of negotiation with the university, first by Stu Northrop as Curator of the Geology Museum, then by Klaus Keil. The grand opening featured a keynote speech by Harrison Schmitt, the only geologist and only native New Mexican to have walked on the Moon.

The Present and Future of the Institute

We in the Institute still exploit in our research the wonderful collection Lincoln LaPaz began. We also use meteorites collected in Antarctica by the program started by LaPaz's student, Bill Cassidy. Lincoln LaPaz passed away in 1985, but his contributions live on.

Although we still vigorously pursue our studies of lunar samples and meteorites, some of us have become actively involved in planning future space missions, both piloted and robotic. These include automated, remote sensing missions to the Moon and near-Earth asteroids, automated missions to return samples from Mars, and missions to establish permanently-staffed bases on the lunar surface. We are even involved in studying ways of utilizing extraterrestrial materials in space; i.e., mining the Moon and asteroids. These are but dreams now, but we must look to the future the way Lincoln LaPaz stared at the sky from his roof and Klaus Keil gazed across a border to freedom.