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Front Matter

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Annual NMGS Fall Field Conference Guidebooks

Every fall since 1950, the New Mexico Geological Society (NMGS) has held an annual Fall Field Conference that explores some region of New Mexico (or surrounding states). Always well attended, these conferences provide a guidebook to participants. Besides detailed road logs, the guidebooks contain many well written, edited, and peer-reviewed geoscience papers. These books have set the national standard for geologic guidebooks and are an essential geologic reference for anyone working in or around New Mexico.

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NMGS has decided to make peer-reviewed papers from our Fall Field Conference guidebooks available for free download. This is in keeping with our mission of promoting interest, research, and cooperation regarding geology in New Mexico. However, guidebook sales represent a significant proportion of our operating budget. Therefore, only *research papers* are available for download. *Road logs*, *mini-papers*, and other selected content are available only in print for recent guidebooks.

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Albuquerque Geology

Editors

Frank J. Pazzaglia
Spencer G. Lucas



George S. Austin, *Managing Editor*

New Mexico Geological Society
Fiftieth Annual Field Conference
September 22-25, 1999

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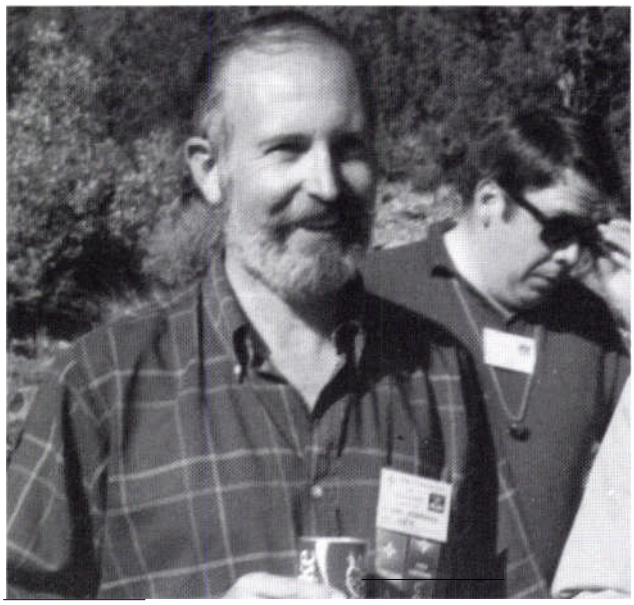
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DEDICATION

Lee A. Woodward



Lee A. Woodward has spent much of his professional career, since arriving at the University of New Mexico in the Fall, 1965, studying the pre-Quaternary geology of New Mexico, with emphasis on its structural history.

Born in Omaha, Nebraska, Lee spent some time as a young child in Panama, prior to moving to Mon.tana where he spent his formative years in hardscrabble mining towns. Anyone who knows Lee might also surmise that the language heard around war-era mining camps left a rather indelible impression. But his exposure to mining also impassioned Lee to study geology in college and he received his BS and MS degrees, in 1958 and 1959, respectively, from the University of Montana in Missoula. Notably, in 1998, Lee received the University of Montana's Distinguished Alumnus Award. He received his PhD from the University of Washington in 1962, where he was supervised by Peter Misch and studied the structure and stratigraphy of the northern Egan Range, in east-central Nevada. After employment stints with Pan American Petroleum and Olympic College, Lee was hired by Vin Kelley to join the UNM faculty in Fall, 1965, where he remained until his retirement at the end of 1997.

Lee will be remembered for his remarkable success mentoring a diversity of graduate students (a total of 41) and the projects they undertook. His commitment to mentoring students and dedicated search for basic facts as revealed through careful field geology is eloquently summarized by Wolf Elston, in his 1 February 1998 letter to the University of Montana supporting Lee's nomination for the Distinguished Alumni Award, "Although it is not listed in his resume, anyone who knows Lee is aware of his military service as a paratroop officer. It is reflected in his speech and manners and also in his attitude toward research. His place is with men at the front, not among the shakers and movers in a cushy chateau behind the lines. Dozens of maps and reports, co-authored with graduate students, constitute an invaluable depository of the basic facts of New Mexico geology. Lee led his student from the front, examining the outcrops and footslogging the contacts, mile after mile. The big thinkers in the chateau got the headlines, but their grand conceptual models were based on facts provided by Lee and his students." Lee authored or co-authored over 100 papers in refereed literature and produced over 20 geologic maps, many of which were on New Mexico geology. His seminal contributions to the geology of the Sierra Nacimiento reflect the high quality and thoroughness of his investigations.

Until the very end of his academic career, when he ceased to roll his own chair down the first floor hallway of Northrop Hall to room 146 for faculty meetings, Lee was exceedingly active in the Department. From 1970 to 1976, he was Acting Chair and then Chair of the Department. This time period was one of immense change in the tenor and activity level of the Department. He had the great fortune of hiring nine new faculty in the Department, resulting in many new directions in education and research, and all of the complexities attending such changes. In total, he taught a total of 12 different courses, from Physical Geology, to a recently organized and very popular New Mexico Field Geology course, to graduate courses in Tectonics.

Since retirement, the Big Sky of his beloved Montana has not pulled him completely away from continued geoscience activity. The past few years have seen Lee as active as ever in the ongoing discussion over the magnitude and history of Colorado Plateau translation. His contributions to this debate have focused on basic surface and subsurface field relations (what else?) and have fostered continued spirited argument in the literature (and most predictably at the 1999 Fall Field Conference!).

From a personal perspective, the authors of this dedication wish to recognize his genuine sense of compassion and understanding (despite that fact that he may have referred to us as "God-damned congenital idiots" on an occasion or two). Lee displayed a great ability to recognize when and how life may have been less simple and joyous for his colleagues, and was willing to offer a very open ear, along with needed advice and encouragement. His absence from the Department of Earth and Planetary Sciences is sorely missed. As a point of information, Lee's position has not been replaced.

John Geissman and Frank Pazzaglia

DEDICATION

John W. Hawley



The New Mexico Geological Society is pleased to co-dedicate its fiftieth field conference to Dr. John Hawley. During the course of his forty-year-long career in geologic research, the majority of which was spent in New Mexico, John has become recognized as one of New Mexico's foremost geologists. Indeed, for most earth scientists, and particularly those in this state, his name will be forever linked with New Mexico's Quaternary geology, soils, and groundwater. On the occasion of his retirement from the New Mexico Bureau of Mines and Mineral Resources, Frank Kottlowski and Dave Love co-authored a nice article for the February, 1999 issue of *New Mexico Geology* that provides a biographical sketch of the man, an excellent summary of John's career, as well as a bibliography with selected important publications. This piece very clearly illustrates the scope and breadth of John's research, a great deal of which is referenced and/or cited in many of the scientific articles that appear in this volume. I believe history will show that one of John's potentially most significant and lasting contributions has been his research concerning the Neogene–Quaternary stratigraphy and structures of continental basins associated with the Rio Grande rift, including the Albuquerque basin. John illustrated his genius by focusing on the geology of New Mexico's rift basins long before it was popular to do so. In many respects, this research has transformed our understanding of the nature of the groundwater resources of this region, demonstrating how previously poorly understood complex geologic relationships in these basins are critical in controlling the geometry, size, and location of important aquifers. In this largely arid state, ground water is a major source of fresh water, and consequently his research will help to provide the basis for enlightened stewardship of an economic resource critical to the future development and growth of this state. So in a real sense, although most of them may never realize it, the citizens of New Mexico (and not just geologists) owe much to John Hawley's dogged persistence and tireless efforts to understand better the Neogene geology of the Albuquerque region.

John, of course, has conducted important and highly regarded research elsewhere, but I must point out the huge impact that John's participation and research in the Desert Project (conducted in the region of Las Cruces in southern New Mexico) between 1962 and 1979 has had on desert geology and geomorphology and soils research. One of six soil geomorphology projects in the United States initiated in the 1950s by the Soil Conservation Service, the Desert Project, through the efforts of Lee Gile (the soil scientist) and John Hawley (and others), produced perhaps the greatest extant body of published research by a team of scientists concerning the evolution of desert landscapes and soils. Much of the success of this project owed to the strongly interdisciplinary research strategy employed in this project—and it was largely John Hawley who provided the essential geologic input. It must be said, however, that John also contributed greatly to our understanding of desert soil-forming processes, although you'll likely never hear him take credit for this aspect of the research. In 1981, the NMBMMR published Memoir 39, "Soils and geomorphology in the Basin and Range area of southern New Mexico—guidebook to the Desert Project," a beautifully_crafted work that describes the key findings and conclusions of this remarkable study, supplemented by detailed site maps, photographs and data tables. Recognizing the impact of this publication, Gile, Hawley, and Grossman were selected as recipients of the prestigious Kirk__ Bryan Award by the Quaternary Geology and Geomorphology Division of the Geological Society of America.

No dedication to John Hawley would be complete without noting something of the personality and character of the man. Those who have had the good fortune of making his acquaintance over the years know him to be a kind, generous, and enormously fascinating individual. At the drop of a hat, John is ready to discuss the geology of whatever part of the state, or indeed most of the Southwest, in which you might have some interest. But he's also ready, at any time of the day, to discuss world history, national politics, aspects of local rock and roll, and other assorted topics—and in an informed manner. Of course, many of us who have participated with John on various field trips have observed his remarkable song-writing and singing abilities. He has a keen eye for much that goes on during such field excursions that typically escapes most folks' attention, and lucky are those field leaders and other participants who have been targets of his wit and gentle__ barbs contained in those songs. And yes, John Hawley, to put it mildly, is somewhat of an extrovert, or "loquacious" as others have characterized him. But John Hawley does have much to say that we should listen to. One thing is for sure: once you meet John, you will never forget him. 1 know I won't.

Les McFadden

PRESIDENT'S MESSAGE

Half a century ago a fledgling organization of geologists gathered to enjoy each other's company, share knowledge, and learn new insights against a backdrop of mountainous landscapes and clear, crisp autumn skies. Thus was inaugurated the annual excursions of the New Mexico Geological Society that became known as the Fall Field Conferences. Notably, these are conferences, not simply field trips. Presentations, discussions and, sometimes, heated arguments unfold on the outcrop or at scenic overlooks—a far cry from the stalethrkened rooms of our typical professional meetings! As the Society celebrates its 50th field conference, its members relish the reputation of the conferences themselves and, especially, the legacy of the guidebooks, both of which are the envy of geological societies across the country.

For our golden field conference we assemble, for the third time, near the geographic center of the state and in the midst of its largest population center. Here, the principal physiographic elements of our region—Rocky Mountains, Basin and Range, Colorado Plateau, and High Plains—intersect. The richly diverse geologic setting offers everything from glimpses of the formation of our basement to the record of Quaternary climate change. Energy, metal, and industrial–mineral resources surround us; the latter, especially, becoming an important part of the near-urban landscape and the proximity of transport infrastructure that permits distribution. As true throughout the Southwest, Albuquerque and environs feel the stresses of depleting water resources and protecting the quality of those that remain. Geoscientists working in the Albuquerque area can, therefore, revel in the opportunities to pursue intriguing questions about the geologic history of our state or to provide information of extreme societal relevance. Not infrequently, these objectives are met simultaneously.

The Society is indebted to this year's conference chairs from the University of New Mexico, Frank Pazzaglia, John Geissman, and Les McFadden. They have planned a renarkable conference that will be full of memorable experiences. Guidebook editors Frank Pazzaglia and Spencer Lucas have assembled a vattiable suite of road logs and an even more valuable collection of papers that cover the full range of geological issues in the Albuquerque area. Managing Editor George _Austin, ably assisted by Jim Barker, has undertaken the staggering responsibility of doing the entire digital layout for the guidebook, so as to affect cost savings that should make the volume accessible to a wide audience. Prominent among the papers in the guidebook is results of geologic and geophysical mapping undertaken by the USGS-NMBMMR Middle Rio Grande Project. This ambitious five-year effort is generating remarkable new geologic knowledge that will be integrated into cruciallyneeded ground-water-tlow models for the greater Albuquerque basin.

On the occasion of the 50th field conference, I am pleased to assure the members that the Society is financially very healthy. This is particularly true of funds dedicated toward our key missions in promoting geoscience education and disseminating geological information. Our scholarship and research:grant awards to students are increasing. Support for undergraduate students has been awesomely enhanced by a generous bequest from the late Lucille Pipkin. Thanks to the tireless efforts, and also generosity, of Fred Trauger the Society maintains adequate funds to reprint guidebooks as inventories decline. We especially look forward to the release of an entirely new edition of the popular New Mexico Highway Geologic Map, which under the leadership of Frank Kottlowski and Bob Newcomer should be completed as we usher in the new millennium.

It is often said, but can never be said too often, that the Society succeeds because of the hard work of its volunteers. Those who serve on the Executive Committee, Grants-in-Aid Committee, manage publications and editing, take on the tasks of organizing the annual Spring Meeting and, of course, the field conferences are the people who make it all happen. The cooperative relationship of the Society to the NMBMMR, nurtured by recently retired Director Charles Chin, is another key to our success. Please extend your appreciation to these people and consider stepping forward to contribute your talents and time in the future.

Lastly, it is most appropriate on the occasion of the memorable 50th field conference to remember those who, during the previous 49 such efforts, established the tradition and the standard of excellence that allow us to continue enjoying these annual events. There were nearly 200 participants in the first conference, nearly half of who were from the oil patch. The directions of geoscience have ebbed and flowed during the subsequent half century but the field-conference organizers have always maintained broad appeal to the diverse geological aspects of the state so that conferences persistently attract a large, enthusiastic crowd. For those of us that have been relative newcomers to this institution of Fall Field Conferences, it is especially important that we appreciate those who got the ball rolling and, it seems, kept it moving uphill to accomplish ever higher standards. Be sure to read the contribution by Ed Beaumont and colleagues that chronicles the efforts of people and events that now seem remote, and are unfamiliar to many of us, but which in a very real way have brought us all to Albuquerque in September 1999.

Gary Smith

EDITOR'S MESSAGE

It is our distinct honor and pleasure to be the editors for the 50th anniversary field conference of the New Mexico Geological Society. We have envisioned our task to produce a guidebook and organize a field conference that upholds the standard of excellence so widely associated with NMGS. In this respect we have designed a conference with five, rather than the traditional three field trips, endeavored to incorporate maps and other data that will well-serve geological studies in New Mexico into the next century, and expanded the guidebook to include a section of special 50th anniversary contributions as well as a full 16-page color signature. It is our sincere hope that we have succeeded in our efforts.

Geology, perhaps more than any other natural science, is particularly respectful of its pioneers. This respect might be traced to a deep appreciation among geologist for ground-breaking field exploration in the face of hardships as well as the ingrained preoccupation for time and an organized history of events. Our work and new discoveries are always in the context of those who came before us and we rarely look upon previous work disparagingly. Such is the nature of a decidedly deductive science; ours is not the task to not find the absolute "correct" answer, just a "more correct" interpretation. We should consider ourselves privileged to inherit a rich geologic tradition and legacy in the state of New Mexico started in large part by the founding members of NMGS. Those founding members provide a physical link to the true geologic trailblazers in this state. Some of those founding members are still with us today. We honor their memory and contributions with this guidebook and field conference and encourage all participants to read the special paper by Ed Beaumont et al.

The contributions of a long-time NMGS participant is particularly noteworthy given the focus on the geology of the Albuquerque area. The 1982 Albuquerque Country II field conference dedicated the guidebook to a native son and New Mexico geologic pioneer—Kirk_Bryan. In 1939, Kirk Bryan sent a young student from New England out to Hagan basin with the charge to begin detailed geologic explorations and turn this research into a graduate degree. That student was Charles Stearns. This year's field conference begins in the Hagan basin and will display the geology and geomorphology first described by Charlie 60 years ago. In that first field season, Charlie stayed with the Cano family, one of several families trying to eke out a living on the marginal coal resources of the Hagan basin. In two years, World War II would put a temporary hold on Charlie's research, but he returned after the war to earn his doctoral degree and publish his research in two large papers in 1953, one in GSA Bulletin and the other in the American Journal of Science. They remain some of the most frequently cited papers for anyone doing research in north-central New Mexico. Apparently New Mexico became well-entrenched in Charlie's soul despite a career that saw him as a professor at Harvard (succeeding his mentor) as well as a professor and later Dean at Tufts University because he has chosen the Land of Enchantment as his re_tj.rement home. In his words, "even though there are rocks and landscapes everywhere, in very few places could you enjoy them as well as New Mexico, especially during long summer sunsets." His participation in the field conference reinforces our connection to the past and we encourage participants to seek out his opinion, rather than ours, when we are standing on outcrops and looking at rocks he first described over a half-century ago.

One final anecdote is worth re-telling. When we are in the Hagan basin, keep a sharp eye out for the Dakota Sandstone. Charlie has been looking for it for 60 years without much success. In 1939 he reported to Kirk Bryan that all of the expected Mesozoic stratigraphy was encountered in his first foray into the Hagan basin with the exception of the Dakota Formation, or at least, the easily recognizable and familiar Dakota Formation we know from many localities in New Mexico. Bryan briskly retorted that two generations of geologists before him had found the Dakota Sandstone throughout the entire western Cordillera and strongly suggested that his student should consider where his field observations had been in error. But following a visit to field check his student's progress, Bryan too came to the conclusion that the familiar Dakota Formation was "missing". He never again seriously challenged Charlie's observations.

Thank you, Charlie and all geological pioneers, for 50+ years of inquiry into Albuquerque Geology.

Frank J. Pazzaglia and Spencer G Lucas

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FIELD CONFERENCE SCHEDULE

Wednesday, September 22, 1999—Travel and Registration Day

5:30-9:30 p.m.	Registration and icebreaker, Hilton Hotel, University Ave., Albuquerque

Thursday, September 23, **1999—First Day**

6:30-7:30 a.m.	Registration, Hilton Hotel
7:30 a.m.	Bus caravan departs south side of Hilton Hotel parking lot
Mid-day	Lunch provided
6:30 p.m.	Bus caravan arrives at New Mexico Natural History Museum, barbecue dinner provided

Friday, September 24, 1999—Second Day

7:00 a.m.	Van caravan departs south side of Hilton Hotel parking lot for Trip 2 (Neogene stratigraphy of Albuquerque basin)
8:00 a.m.	Bus caravan departs south side of Hilton Hotel parking lot for Trip 1 (Sandia Mountains)
Mid-day	Lunch provided
6:00 p.m.	Day 2 trips return to Hilton Hotel
7:00 p.m.	Annual banquet, Hilton Hotel

Saturday, September 25, 1999—Third Day

8:00 a.m.	Car caravans depart south side of Hilton Hotel parking lot for Trip 1(Kinney Brick quarry) and Trip 2 (Estancia basin)
Mid-day	Lunch provided
2:00 p.m.	End of field conference. Participants depart field conference from the last stop of their respective field trip.

CREDITS

Front Cover: Oblique aerial photograph of Cenozoic strata north of Albuquerque, New Mexico; taken by John W. Estep.

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Vincent Cooper Kelley (1904-1988) was a native of Washington state who received his Ph.D. in geology from the California Institute of Technology in 1937. That year he joined the UNM faculty, becoming Professor of Geology in 1945 and retiring in 1970. Among his many contributions to our knowledge of the geology of New Mexico, Kelley published a geologic map of the Albuquerque basin in 1977 that synthesized decades of geologic mapping by him and his many students.