

New Mexico Geological Society

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Front Matter

(Usually includes Dedication, President's Message, & Conference Organizer's Message.)

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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.

Free Downloads

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.

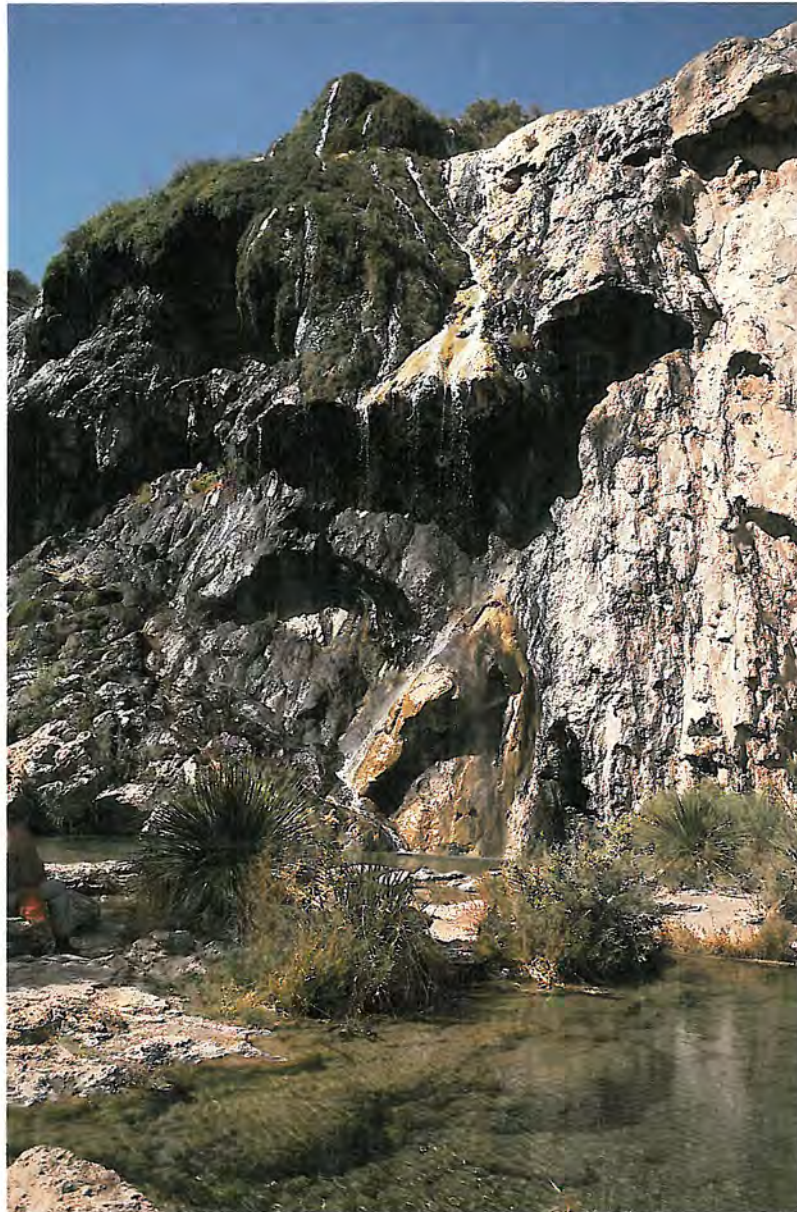
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Carlsbad Region, New Mexico and West Texas

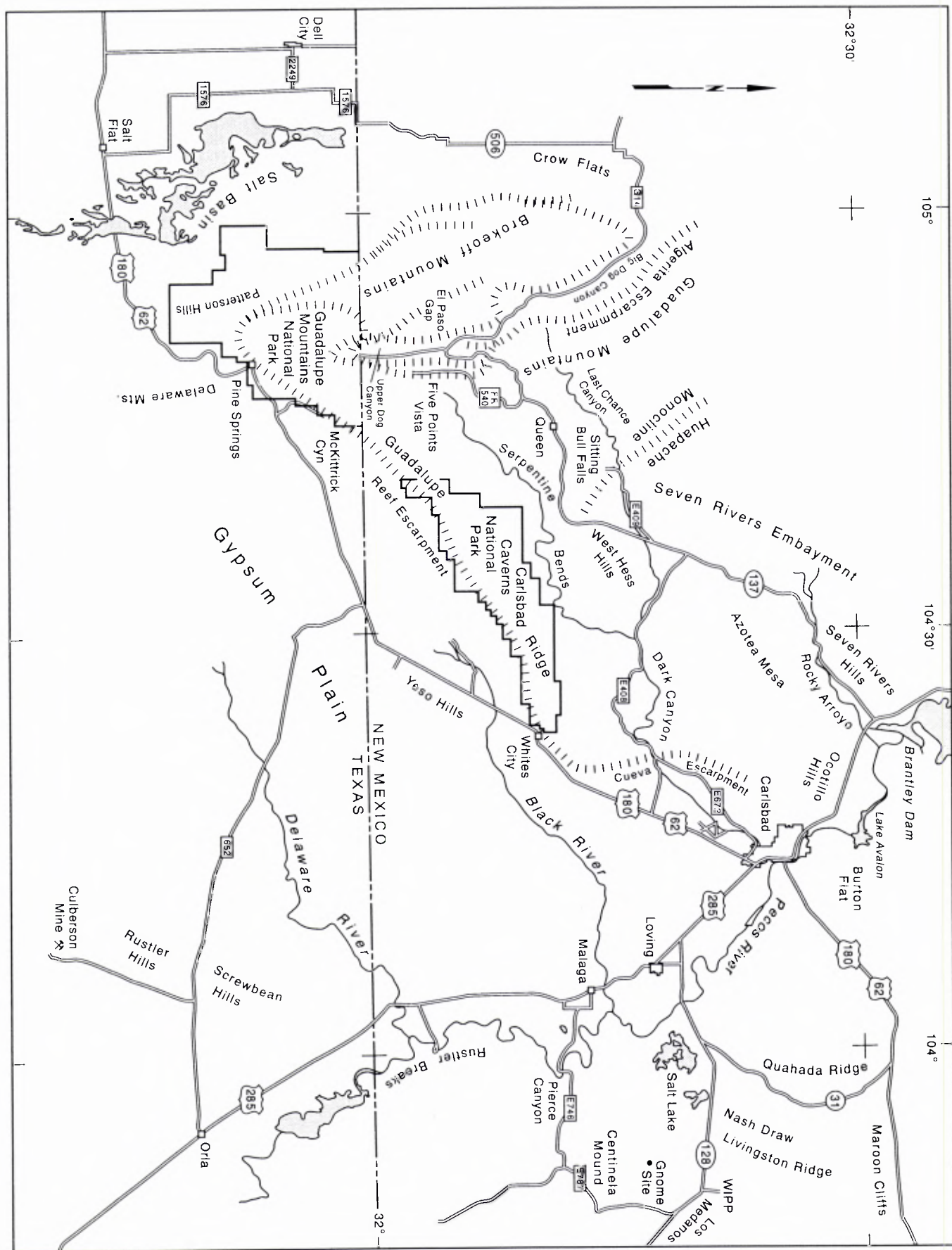


New Mexico Geological Society



1993







In 1924 the Federal Government began to take an interest in the Bat Cave, later named Carlsbad Cavern. In this photograph, taken on April 6, 1924, by W. T. Lee of the U.S. Geological Survey, naturalist Vernon Bailey is netting bats at the cave entrance that penetrates the upper Guadalupian Tansill Formation.

Carlsbad Region, New Mexico and West Texas

Editors

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New Mexico Geological Society
Forty-fourth Annual Field Conference
October 6–9, 1993

(In cooperation with the West Texas Geological Society)



Surface operations of the Potash Company of America following World War II. Photograph by Robert Nymeyer, c. 1948. Courtesy of Southeastern New Mexico Historical Society of Carlsbad.

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DEDICATION



The 1993 New Mexico Geological Society Guidebook is dedicated to George O. Bachman (right) and Philip T. Hayes (left), both retired employees of the U.S. Geological Survey, whose interest in and contributions to the geology of the New Mexico region span almost a half century. It is particularly appropriate that George and Phil be honored at the Society's 44th field conference because of the key roles that they have played in geologic studies of the Carlsbad area. Part of our field conference tour route was logged in 1954 by George Bachman for the last NMGS guidebook to the region. His extensive geologic studies of the WIPP site area are essential components of any current characterization of Delaware basin geology as it relates to environmental concerns. Phil Hayes' 1964 monograph on the geology of the Guadalupe Mountains (U.S. Geological Survey Professional Paper 446) is still the major map-based reference on the mountains and adjacent parts of the Delaware basin in New Mexico. Both George and Phil contributed guidebook papers and field conference committee service to the NMGS during its first 30 years; and Phil assisted in editing our Sixth and Seventh Guidebooks. Credits on the 1965 edition of the Geologic Map of New Mexico, compiled by the late Carl H. Dane and George Bachman, amply illustrate George's and Phil's early contributions to the geology of this state.

George Bachman and Phil Hayes have been close friends and professional associates since they attended the University of New Mexico after their military service in World War II. While not born in this state, their immediate families have roots in New Mexico dating back to Territorial days. George received his BS degree in Geology at UNM in 1948 and immediately started his Geological Survey career in the Albuquerque office of the Geologic Division, Fuels Branch. Phil became a full-time Survey employee in the same office after his graduation in 1949. He also continued as a graduate student at UNM and received his MS degree in 1951. His thesis research was on the "geology of the Precambrian rocks of the northern end of the Sandia Mountains, Bernalillo and Sandoval Counties, New Mexico."

George and Phil have worked in many parts of the world including Antarctica, the Middle East, and Africa (the photo shows them on a drilling platform off the coast of Liberia in 1971), but their lifelong professional interests have been primarily in the geology of New Mexico and its bordering states. A review of the NMBMMR Bibliography of New Mexico Geology series (1950-1986) shows at least 45 reports and maps on New Mexico area geology authored or coauthored by George O. Bachman and 25 by Philip T. Hayes. Their publications on the Carlsbad area are cited throughout this guidebook. Both were actively working in the area during the basic geology era of the 1950s and 1960s; and even though their formal Survey careers ended with retirement in 1978, they were back through the 1980s plugging away on geology and environmental concerns relating to WIPP and the Wilderness Study Area programs.

To slightly reword Matthew 7:16 and placing the expression in a positive context: *By their maps ye shall know them*. Several exemplary traits of our species characterize a successful geomap maker: scientific and artistic achievement, perseverance, chutzpah, and most important, a long-standing love affair with this planet. Making a four-dimensional conceptual model that accurately portrays the material, spatial and temporal attributes of the earth's outer crust is definitely not a trivial pursuit. George and Phil are obviously geomap makers *par excellence*. Their lifelong efforts in this fundamental area of geology are being especially honored here. For many of us, they are also longtime friends and professional colleagues, and we are particularly pleased to dedicate the 44th Annual Field Conference Guidebook of the New Mexico Geological Society to George O. Bachman and Philip T. Hayes.

John W. Hawley

PRESIDENT'S MESSAGE

With the passage of seasons comes one more New Mexico Geological Society Fall Field Conference. For this, our 44th conference, we return to the Permian Basin, a place we have not visited since the 5th Field Conference in 1954. This year, our Society has collaborated with the West Texas Geological Society to produce a splendid field conference worthy of its forty-three predecessors.

Unlike the passage of the seasons, NMGS Fall Field Conferences do not take course spontaneously. The preparation of this trip and guidebook is a Herculean undertaking that requires countless hours of work and sweat from the volunteers of the conference committees listed on p. viii. Please try to thank each of these people personally during this year's conference; they form the backbone of the Society. Special thanks go to John Hawley, Dave Love, Jim Adams, George Austin and Jim Barker for organizing and ramrodding this year's event. Please also thank our friends at the Los Alamos Geological Society for providing registration scholarships to worthy students. As always, we are beholden to Chuck Chapin and the New Mexico Bureau of Mines and Mineral Resources for continued unwavering support of the Society.

Economically, these are not the easiest of times for many of our fellow members. This has had a not-so-positive effect on publications sales, our main source of revenue. However, your Society continues to remain financially sound. Steps have been taken to ensure that our publications remain economically viable and attractive; the most noticeable of these measures is the soft cover on this year's guidebook. Publications sales are the lifeblood of the Society's finances and allow us to fully sponsor annual scholarships in the form of grants-in-aid, prizes at regional and state science fairs, registration scholarships to the fall field conferences, and the prestigious Kottlowski, Wellnitz, and Pipkin Fellowships to outstanding graduate and undergraduate students at New Mexico universities and colleges. We are also able to put on the Annual Spring Meeting in Socorro. Of course, we could not publish guidebooks without proceeds from publication sales.

The Geologic Highway Map remains our mainspring of revenue. It is an invaluable and enjoyable source of geologic information for professional geologists, students, laymen and tourists who grace our fair state. Future plans of our Society include reprinting an updated version in five to seven years.

Enjoy and learn on this 44th field conference to a land of oil, natural gas, potash, sulfur and splendorous caves. Avail yourselves of the expertise of our trip leaders and bask in the warm camaraderie of our fellow Society members. Above all, appreciate the fascinating geology and all of the economic and scenic wealth it provides.

Ronald F. Broadhead, President

EDITORS' MESSAGE

The 1993 New Mexico Geological Society/West Texas Geological Society joint Fall Field Conference tours the Permian-dominated landscape of southeastern New Mexico and adjacent areas of west Texas. This area is a common stomping ground for the West Texas Geological Society (WTGS), but the Field Conference is only the second one in the Carlsbad region for the New Mexico Geological Society (the first since 1954). We feel the collaboration between the two societies has produced a guidebook covering an extremely wide-ranging array of geologic interests, including Precambrian tectonics, Permian sequence stratigraphy, Triassic, Cretaceous and upper Cenozoic stratigraphy, Laramide structures, sulfur deposits in Neogene karst basins, Quaternary soils, overviews of potash and oil and gas resources, Guadalupe Mountain caves, the WIPP site and landfill locations.

The WTGS and Permian Basin SEPM have several excellent guidebooks to the area. We have included the WTGS field seminar book (88-84) with the packet of materials for our joint conference and encourage those with particular interest in sequence stratigraphy to obtain the Permian Basin SEPM Publication 91-32 (Meader-Roberts, Candelaria and Moore, editors) and WTGS Publication 92-91 (D. H. Mruk and B. C. Curran, editors). Even with nearly annual, excellent guidebooks from the WTGS, Permian Basin SEPM and WIPP site reports, as well as sulfur and potash industry tours, the pace of investigation is such that contributions based on much new research are included in this guidebook on such topics as the sequence stratigraphy of the Guadalupe Mountains and Northwest Shelf and the industrial-mineral and waste-disposal implications of relationships between Permian units and Gatifia Formation, Ogallala Formation, and inset Pecos Valley—border deposits.

We gratefully acknowledge the help of many contributors and would-he contributors to the guidebook. We are grateful for their patience, good will and perseverance. Besides the authors and reviewers of the articles, minipapers and road logs, we would like to call attention to those listed on the "Committee" page, particularly the logisticians, technical assistants, drafters and extraordinary helpers.

Our ties with the staff of UNM Printing Services have been strong throughout the history of the New Mexico Geological Society. We are fortunate to have worked with Jim Cheek, Frank Luna and Vangie Mares and will miss their able help in future years.

For the past thirty-one years, Lois Devlin interacted with and supported the New Mexico Geological Society while ascending to more and more responsible positions at the New Mexico Bureau of Mines and Mineral Resources. We grieve at her sudden loss, and would like to thank her for all her help, professionalism, honesty, good will and humor through the years.

Dave Love, John Hawley, Barry Kues, Jim Adams, George Austin, Jim Barker

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ROAD LOGS

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FIELD CONFERENCE SCHEDULE

Wednesday, October 6—Registration Day

4:00-8:00 p.m. Registration at Carlsbad Civic Center.
5:30-9:00 p.m. Icebreaker and exhibits at Carlsbad Civic Center.

Thursday, October 7—First Day

6:00-7:30 a.m. Breakfast at Carlsbad Civic Center.
7:45 a.m. Buses depart from Carlsbad Civic Center.
12:00 noon Lunch provided at Stop 4.
6:00 p.m. Return to Civic Center.
7:30 p.m. Banquet at Civic Center.

Friday, October 8—Second Day

6:00-7:30 a.m. Breakfast at Carlsbad Civic Center.
7:45 a.m. Buses depart from Carlsbad Civic Center.
12:00 noon Lunch provided at Stop 2.
5:30 p.m. Return to Washington Ranch for barbecue.
8:30 p.m. Return to Carlsbad.

Saturday, October 9—Third Day

6:00-7:30 a.m. Breakfast at Carlsbad Civic Center.
8:00 a.m. Buses depart from Carlsbad Civic Center.
12:00 noon Lunch provided at Stop 3.
3:30 p.m. Return to Carlsbad.

Sunday, October 10—Walking Tours of Carlsbad Cavern

8:00 a.m. Meet at Carlsbad Caverns National Park Visitor Center.

CREDITS

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