SILVER ANNIVERSARY GUIDEBOOK

Ghost Ranch

CENTRAL-NORTHERN NEW MEXICO

LEE A. WOODWARD JONATHAN F. CALLENDER
Associate Editors

NEW MEXICO GEOLOGICAL SOCIETY

TWENTY-FIFTH FIELD CONFERENCE—October 10, 11 and 12, 1974
## CONTENTS

- President's Message .......................................................... vi
- Ghost Ranch Letter ............................................................. viii
- Committees ........................................................................ x
- Publications of New Mexico Geological Society ................... xii
- Field Conference Schedule .................................................. xiii
- Stratigraphic Column for Central-Northern New Mexico .......... xiv
- Reconnaissance Geologic Map of Nacimiento Uplift and Chama Basin in Rio Arriba and Sandoval Counties, N.M., by N. H. Darton, 1929 ................................................................. xv
- ERTS Photograph of Central-Northern New Mexico, with Sketch Map of Major Tectonic Features and Field Trip Routes .......... xvi
- Advertisers Index ............................................................... xviii

### ROAD LOGS

**First Day:** Ghost Ranch to Cuba and Nacimiento Mine and Return  

Lee A. Woodward, James E. Fassett and Lyle W. Talbott  

1

**Second Day:** Coyote Junction of U.S. 84 and N.M. 96 to Abiquiu, El Rito, Petaca, Tres Piedras, Hopewell Lake, Chama Basin, and Return to Ghost Ranch  

Richard L. Burroughs and Lee A. Woodward with Vegetation by Hobart N. Dixon  

11

**Alternate Road Log (Second Day):** La Madera Junction to Tres Piedras via U.S. 285  

Richard L. Burroughs  

31

**Third Day:** Junction of U.S. 84 and El Rito Turnoff to Espanola, Valle Grande, San Ysidro and Bernalillo; with optional trip beginning at mile 99.6 to examine Mississippian and Pennsylvanian Rocks at Guadalupe Box  

A. M. Kudo and Lee A. Woodward  

35

**Optional Trip (Third Day):** Beginning at mile 111.6 to examine Cretaceous and Tertiary at south end of Nacimiento Uplift  

Bruce A. Black, Lee A. Woodward and William L. Hiss  

51

### ARTICLES

**New Mexico Geological Society**

- Guidebook Economics—"The Incremental Book"  
  William L. Hiss  
  57
- New Mexico Geological Society—Twenty-Five Years of Progress  
  William L. Hiss and Lee A. Woodward  
  61
- Amendments to the Constitution and By-laws of the New Mexico Geological Society  
  William L. Hiss  
  65
- Scenes from the Past  
  William L. Hiss  
  67

**History and Archaeology**

- The Way of the Fray: A Pictorial Diary of the Escalante Expedition through North-Central New Mexico, 1776  
  Harold L. James  
  77
- The Los Alamos Archaeological Survey, Pajarito Plateau, New Mexico  
  Charlie R. Steen  
  83
- The Ancient Mineral Industries of Cerro Pedernal, Rio Arriba County, New Mexico  
  A. Helene Warren  
  87
Precambrian Geology, Structure and Geophysics

Precambrian Rocks of the Southern Sierra Nacimiento, New Mexico ................................. Lee A. Woodward, Ruben Martinez, Harvey R. DuChene, Otto L. Schumacher, and Richard K. Reed 95
Contrasting Types of Precambrian Granitic Rocks in the Dixon-Penasco Area, Northern New Mexico .................................................. Philip E. Long 101
Precambrian Rocks of the Tusas Mountains ................................................................. E. C. Bingler 109
Precambrian Metavolcanic Rocks of the Tusas Mountains, New Mexico: Major Elements and Oxygen Isotopes ............................................ Fred Barker and Irving Friedman 115
Summary of Recent Rb-Sr Age Determinations from Precambrian Rocks of North-Central New Mexico ................................................. Douglas G. Brookins 119
Tectonics of Central-Northern New Mexico ............................................................... Lee A. Woodward 123
Structure of the Guadalupe Box Area, Sandoval County, New Mexico ........................ Harvey R. DuChene 131
Geophysical Studies in the Jemez Mountains Region, New Mexico ............................ George R. Jiracek 137

Stratigraphy, Sedimentology and Paleontology

Biostratigraphy of the Arroyo Penasco Group, Lower Carboniferous (Mississippian), North-Central New Mexico ................................................ Augustus K. Armstrong and Bernard L. Monet 145
Pennsylvanian Rocks of North-Central New Mexico ...................................................... Harvey R. DuChene 159
Permian Rocks of North-Central New Mexico ............................................................. Donald L. Baars 167
The Upper Triassic Chinle Formation in North-Central New Mexico .......................... Robert B. O'Sullivan 171
The Triassic Paleontology of Ghost Ranch .................................................................. Edwin H. Colbert 175
Upper Triassic Plants of Cañon del Cobre, New Mexico ............................................ Sidney R. Ash 179
Stratigraphy and Sedimentology of the Morrison Formation (Jurassic), Ojito Spring Quadrangle, Sandoval County, New Mexico ............................................. Gary A. Flesch 185
Petrology of Morrison Formation (Jurassic) Sandstones of the Ojito Spring Quadrangle, Sandoval County, New Mexico ................................. Gary A. Flesch and Michael D. Wilson 197
Stratigraphy and Uranium Potential of the Burro Canyon Formation in the Southern Chama Basin, New Mexico .................................................. A. E. Saucier 211
Mesozoic Lake History of Northern New Mexico ....................................................... William F. Tanner 219
Cretaceous and Tertiary Rocks of the Eastern San Juan Basin, New Mexico and Colorado ................................................................. James E. Fassett 225
Cretaceous Rocks of the Tierra Amarilla Coal Field and Adjacent Areas, Rio Arriba County, New Mexico ...................................................... E. R. Landis, C. H. Dune, and W. A. Cobban 231
The Dakota Formation (Cretaceous) of the Southern Chama Basin, New Mexico—A Preliminary Report on its Stratigraphy, Paleontology, and Sedimentology .................................................. Keith Grant and Donald E. Owen 239
Correlation of the Gallup Sandstone and Associated Formations, Upper Cretaceous, Eastern San Juan Basin and Acoma Basins, New Mexico ......................................................... C. M. Molenaar 251
The Carlile-Niobrara Contact and Lower Niobrara Strata Near El Vado, New Mexico ............................................................................ Norman R. King 259
Macroinvertebrate Palaeoecology of a Transgressive Marine Sandstone, Cliff House Sandstone (Upper Cretaceous), Chaco Canyon, Northwestern New Mexico ........................................................................ Charles T. Siemers and Norman R. King 267
Age Relations of Upper Part of Lewis Shale on East Side of San Juan Basin

Dating Rocks of the Santa Fe Group: Programs and Problems

Outline of the Igneous Geology of the Jemez Mountains Volcanic Field

Neogene Volcanism in the Southern San Luis Basin

Economic Geology
Sandstone Copper Deposits of the Nacimiento Region, New Mexico
Nacimiento Pit, a Triassic Strata-bound Copper Deposit
Possible Source Areas for Sandstone Copper Deposits in Northern New Mexico
Uranium Occurrences of the Nacimiento-Jemez Region, Sandoval and Rio Arriba Counties, New Mexico
Uranium in the Petaca, Ojo Caliente, and Bromide Districts, Rio Arriba County, New Mexico
Metallic Deposits of the Tusas Mountains
Oil and Gas Development and Production, Eastern San Juan Basin
Upper Cretaceous Coal in the Cuba-La Ventana-Torreon Area, Eastern San Juan Basin
Humate Mining in Northwestern New Mexico
Ground Water in the Southwestern Part of the Jemez Mountains Volcanic Region, New Mexico
General Geohydrology of the Pajarito Plateau
General Geology and Ground Water Conditions in the Truchas-Espanola-Velarde Area of Rio Arriba County, New Mexico
Dry Hot Rock Project
Landslides on “Brazos Pass”
Structure and Stratigraphy in the Vicinity of the Shell Oil Co. Santa Fe Pacific No. 1 Test Well, Southern Sandoval County, New Mexico
Structural and Petrogenetic Relationships of Pegmatites in the Petaca District, New Mexico

ABSTRACTS
THE PRESIDENT'S MESSAGE

A YEAR OF RECORD ACCOMPLISHMENTS

The New Mexico Geological Society was founded in 1947. The year 1974, however, will long be remembered as the “Silver Anniversary” of the Geological Society in commemoration of the 25th consecutive field conference. The officers, committee members, and others associated with the activities of the Geological Society are invariably exceptionally dedicated and enthusiastic, but an additional stimulus during 1974 was provided by a pervasive Silver Anniversary spirit. Thus motivated, the individual volunteers responded harmoniously as a dynamic team to successfully confront the many challenges encountered. Much has been accomplished in the fleeting months of the past year.

In May, the Geological Society and the New Mexico Bureau of Mines and Mineral Resources jointly sponsored the Symposium on Base Metals and Fluorspar Districts of New Mexico at the New Mexico Institute of Mining and Technology in Socorro. Credit for the outstanding program and record attendance for an Annual Meeting (273 paid registrants) goes to Chuck Chapin, General Chairman, and Russ Clemons, Registration Chairman, who were generously assisted by many members from the staff of the Bureau of Mines and Mineral Resources. Abstracts of the papers presented at the Symposium are printed in this guidebook, along with several photographs taken during the field trip that followed.

Inasmuch as the money received from the sale of guidebooks constitutes the major source of support for the operations of the Geological Society, any budget prepared for the forthcoming year is always fraught with uncertainty. The year just completed was no exception. With substantial increases in publication costs predicted, the reprinting of several guidebooks in progress and others remaining to be reprinted, and an Annual Meeting and Fall Field Conference with a new guidebook in sight, a trial budget prepared near the end of 1973 rather ominously suggested that a deficit in excess of $20,000 could be incurred. The Executive Committee clearly recognized the danger signals and immediately chose a course of action designed to resolve the impending financial crisis stemming from a record budget.

Fortunately, our financial needs coincided with a renewed interest in the geology and natural resources of New Mexico and the surrounding States and the completion of a long-term program to reprint all out-of-print guidebooks. A modest advertising campaign was implemented to call attention to the guidebooks as a major reference series on the geology of the region. As a result of this program and the other efforts made by the Publications and Sales Committee, we are able to report that sales of guidebooks during the first 6 months of 1974 exceeded $21,000 and shattered all previous records.

Supplemental funds needed to finance the guidebook are normally derived from the sale of advertising space. This year a new approach to the sale of ads was initiated with the hope of obtaining more substantial funding for the Silver Anniversary Guidebook. Don Porter, Chairman of the Advertising Task Force, and his group of Marksmen really zeroed in on the targets. Result—ad revenues of more than $6,000—nearly doubling the previous record. In addition to the ads contained in the guidebook, two companies, Mobil and Exxon, contributed money instead of purchasing advertisements. The generous support of the many petroleum, mining, and service companies, consultants, independents, individuals, and others who, as advertisers, have helped to advance the objectives of the Geological Society is appreciated.

Jim Fassett, following the record setting program initiated by Russ Clemons last year, conducted a membership drive with extraordinary enthusiasm. Membership in our society now totals 520—another new record. Jim is now accepting dues for 1975, so as you congratulate him for a job well done, offer him a check for your dues with the other hand and help sustain the momentum of this continuing effort.

Again, as in past years, the Geological Society has been nurtured by the New Mexico Bureau of Mines and Mineral Resources, the U.S. Geological Survey, the Geology Departments at the University of New Mexico, New Mexico State University, and New Mexico Institute of Mining and Technology, other State and Federal agencies and institutions, and many companies within the energy and mineral industries, who have willingly made both professional talent and secretarial and technical services readily available.

The Silver Anniversary Guidebook edited by Chuck Siemers, Lee Woodward, and Jon Callender is destined to become the major geologic reference for central-northern New Mexico. Those who have helped with the guidebooks for prior years will appreciate the enormous effort required to produce this magnificent volume. The editors, authors, field trip leaders, road logging crews, and the many others who have given so generously of their time and talents can be justly proud of a guidebook that so appropriately commemorates the 25th field conference.

Registration for the Silver Anniversary Field Conference has been a particularly formidable task. If you are bunking with your favorite wife or colleague as planned, credit Jim Yarbrough with the arrangements. Jim is to be congratulated for successfully completing this short course of on-the-job training in hospitaly.

To the Reverend James W. Hall, we extend our thanks for permitting the New Mexico Geological Society to use the Ghost Ranch facilities and for being a gracious host to our conference.

Much of the success of this excursion into central-northern New Mexico is due to the tireless efforts and dedication of Lee Woodward and Harold James. As Co-Chairmen, they have planned and organized the 25th field conference. In addition, they accomplished much of the road logging and photography. Their work is interwoven throughout the guidebook and will become more evident as the field trip unfolds.

Welcome to the Silver Anniversary Field Conference. While enjoying this venture into the central-northern part of New Mexico, consult the list of committee members who have made this trip possible, seek them out and offer a grateful hand and words of praise, as this will be their reward for the knowledge, time, and effort they have so freely given toward the success of this mission.

A RESOLVABLE DILEMMA

A precautionary note—the views expressed herein are my own and do not necessarily represent those of the New Mexico Geological Society as a whole.
Many persons have expressed interest in the history of the Ghost Ranch land. Located as it is in northern New Mexico, it was first claimed to be part of the dominion of the Spanish conquerors of the original Indian inhabitants of the area. The first recognition of the particular acreage begins more than two hundred years ago with a grant of the Spanish King.

The Ghost Ranch is principally located upon the northern one-third of the "Las Casas de Riano" or "Piedra Lumbre" Land Grant. The grant was made February 12, 1766 by Tomas Velez Cachupin, Royal Governor and Captain General of the Province on New Mexico to Lieutenant Pedro Martin Serrano "for himself, his children and heirs that he may lawfully hold the same in fee and dominion." It was a purely private grant to Lieutenant Serrano alone and was never a community grant made to any group. Lieutenant Serrano was put into juridical possession on February 8, 1766 by Chief Alcalde Manuel Garcia Pareja.

At the close of the war with Mexico under the treaty of Guadalupe Hidalgo in 1846, the United States agreed to respect all titles which had been granted by Spain or the Republic of Mexico.

On August 25, 1893, the grant was confirmed to Pedro M. Serrano, his heirs and assigns, by the United States Court of Private Land Claims. That Court after a careful investigation held that the grant was a genuine private Grant within the provisions of the Treaty of Guadalupe Hidalgo.

The succeeding years saw the grant gradually divided, largely by the Spanish pattern of inheritance, under which the estates were divided equally among children of the immediate family. Serrano had died in 1813 leaving three sons and one daughter. His direct heirs conveyed to J. Patricio Chavez, Jose Maria Chavez, F. C. Chavez and Ramon Salazar. Small tracts in large numbers were then traded back and forth. Several elaborate partition suits, beginning in 1910, were filed in order to establish fee simple title to the northerly third of the grant. In 1929 all conflicting claims were bought in for a little more than $20,000 by the A. B. Renehan estate. Title can be traced directly from Mrs. Renehan to the Board of Christian Education, to whom the ranch was given by Arthur and Phoebe Pack in 1955.

Any conflicting claimants to the north one-third of the Piedra Lumbre Grant have had five opportunities to present their claims in court and a large number have done so. For a minimum of forty years since the last case, the Board of Christian Education and its immediate predecessors in title have held firm, adjudicated fee simple title to the premises and have been in actual possession all that time.

For over a hundred and fifty years, this area of the Great Southwest has suffered from periodic serious overgrazing combined with a prolonged period of below average rainfall (at best 10-12 inches a year). Therefore the Board of Christian Education is committed to a program of soil conservation and restoration in the hope that over the years the 20,000 acres of the ranch will become an example of what can be achieved in this region.

This commitment is not alone economical, but ethical and theological as well. Its roots are found in the "ecology" of the ranch. (Ecology is the science of the mutual relations of organisms with their environment and with one another.) Christian Education, in our understandings at Ghost Ranch, includes an appreciation of the natural processes by which the land and the living things upon it have achieved their characteristic forms. To know and to appreciate these processes is one of the major lessons to be learned from the Ghost Ranch. It suggests that to enjoy the gifts of God we need not possess, invade, or appropriate them.

Ghost Ranch is an antidote to the spiritual dangers inherent in a technologically oriented and mechanized society. Too many modern men are separated from the land by middlemen, and by innumerable physical gadgets. They have no vital relationship to it; to them, land is the space between cities. Turn such a man loose for a day on the land, and if the spot does not happen to be a golf course or a carefully organized "scenic area," he is anxious to be on to something more exciting. If crops could be raised in test tubes, it would suit him very well. Synthetic substitutes for wood, leather, wool, and other natural land products suit him better than the originals. In short, land is something that he thinks he has "outgrown." If he thinks of it at all, it is as an adversary—or perhaps an old fashioned taskmaster that keeps him in slavery.

Our philosophy refutes the idea that man has "outgrown" the land. Rather, it believes that men are only fellow-voyagers with plants and creatures in the odyssey of creation, and that man forgets at his own peril a sense of kinship with the nature which is his coterminous theatre.

A land ethic does not, of course, prevent the alteration, management, and use of our natural resources; but it can and does affirm their right to exist in continuous form, and at least, in some places, to exist in their natural state. In short, the Ghost Ranch land
ethic suggests that the role of *Homo sapiens* is not that of conqueror of the land community, but of citizen and intelligent members of it.

Beyond the commitment to education in this stewardship, the Ghost Ranch land serves as a specific educational aspect of the ranch’s program. One instance is the Animal Husbandry Education Project. Supported by a generous gift from a private foundation, the ranch offers opportunity to the small ranchers nearby, mostly Spanish speaking, to bring their cattle to the ranch for winter pasture and to participate in classroom and range workshop exposure to the most modern and progressive techniques of livestock management.

In an area where a 40% calf crop is common, where markets are limited, where supplementary feeding is almost unknown, this practical program offers opportunity for immediate improvement in animal husbandry with correspondingly real financial gain to the owners, most of whom live on the margin of poverty.

By our concern for and care of the land, our continued demonstration that land can be used productively and still continue to improve, and by our use in specific educational ventures, we hope our conviction that we are charged to live in this land guided by a trained and perceptive Christian conscience will be to the benefit not only of the thousands who visit the ranch each year, but perhaps more importantly to our neighbors in Northern New Mexico, and beyond this, to the generations yet to come.

James W. Hall, Director
Ghost Ranch, Abiquiu, New Mexico
COMMITTEES

EXECUTIVE COMMITTEE

W. L. Hiss, President ................................................................. U.S. Geological Survey
R. E. Clemons, Vice-President .................................................. New Mexico State University
J. E. Fassett, Secretary ................................................................. U.S. Geological Survey
J. L. Ahlen, Treasurer ................................................................. Consultant
C. E. Chapin, Past President ....................................................... New Mexico Bureau of Mines

FIELD CONFERENCE

H. L. James, General Co-Chairman .......................................... New Mexico State Highway Department
L. A. Woodward, General Co-Chairman .................................... University of New Mexico

GUIDEBOOK

C. T. Siemers, Editor ................................................................ University of New Mexico
J. F. Callender, Associate Editor ................................................ University of New Mexico
L. A. Woodward, Associate Editor ........................................... University of New Mexico

ADVERTISING

D. A. Porter, Chairman .............................................................. Continental Oil Company
P. C. Aguilar ............................................................................... U.S. Geological Survey
C. R. Appledorn ........................................................................ Consultant Engineer
W. W. Baltosser ........................................................................ Kennecott
Ray Beck .................................................................................... Yates Petroleum
G. K. Billings ........................................................................... Syn-An, Incorporated
B. A. Black ................................................................................ Consultant
C. F. Brown ................................................................................ El Paso Natural Gas
R. E. Clemons ............................................................................ New Mexico State University
Karl Elers .................................................................................. Duval Corporation
Ben Donegan ........................................................................... Consultant
David Fitch ................................................................................ Ranchers Exploration
Frank Gorham ......................................................................... Questa Petroleum
C. W. Hicks .............................................................................. Featherstone Development Corporation
W. E. King ................................................................................ New Mexico State University
Karl Klement ........................................................................ University of Texas-El Paso
J. L. Kunkler ................................................................................ U.S. Geological Survey
W. J. LeMay ................................................................................ Harvard Exploration
Ken Segars .............................................................................. Schlumberger Well Service
L. W. Talbott ............................................................................ Earth Resources Company
D. M. Van Sickle ....................................................................... U.S. Geological Survey

REGISTRATION

J. B. Yarbrough, Chairman .................................................. New Mexico State Highway Department
D. D. Sowle ............................................................................. New Mexico State Highway Department
R. D. Lueck ............................................................................. New Mexico State Highway Department
PUBLICITY

R. L. Borton, *Chairman* ................................................................. New Mexico State Engineers Office
H. L. James .......................................................................................... New Mexico State Highway Department
W. L. Hiss .................................................................................................. U.S. Geological Survey

PHOTOGRAPHY

H. L. James ....................................................................................... New Mexico State Highway Department

PUBLICATIONS

C. E. Chapin, *Chairman* ..................................................................... New Mexico Bureau of Mines
W. L. Hiss ................................................................................................ U.S. Geological Survey
R. W. Kelley .......................................................................................... New Mexico Bureau of Mines
F. D. Trauger ...................................................................................... Consultant

FIELD CONFERENCE "MINI SYMPOSIUM"

C. T. Siemers ....................................................................................... University of New Mexico

CARAVAN

J. F. Callender ....................................................................................... University of New Mexico

ROAD LOGGING

B. A. Black .......................................................................................... Consultant
R. L. Burroughs .................................................................................... Adams State College
H. N. Dixon .......................................................................................... Adams State College
J. E. Fassett .......................................................................................... U.S. Geological Survey
A. M. Kudo .......................................................................................... University of New Mexico
L. W. Talbott ....................................................................................... Earth Resources Company
L. A. Woodward .................................................................................. University of New Mexico

TECHNICAL ASSISTANCE

WELEX, a Division of Haliburton ......................................................... Mobil sound equipment
Schlumberger Well Services ................................................................. Beverages, en route
Hewlett Packard ................................................................................ Beverages, Wednesday evening
PUBLICATIONS OF THE NEW MEXICO GEOLOGICAL SOCIETY

FIELD CONFERENCE GUIDEBOOKS

<table>
<thead>
<tr>
<th>PUBLICATION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. San Juan Basin (covering south and west sides), New Mexico and Arizona, 1951, Clay T. Smith and Caswell Silver, eds., 163 p., 71 illus. Spiral bound. Second printing, 1971.</td>
<td>$ 5.00</td>
</tr>
<tr>
<td>7. Southeastern Sangre de Cristo Mountains, New Mexico, 1956, A. Rosenzweig, ed., 151 p., 61 illus.</td>
<td>$ 7.00</td>
</tr>
<tr>
<td>8. Southwestern San Juan Mountains, Colorado, 1957, Frank E. Kottlowski and Brewster Baldwin, eds., 258 p., 110 illus. Spiral bound.</td>
<td>$ 7.00</td>
</tr>
<tr>
<td>10. West-central New Mexico, 1959, James E. Weir, Jr., and Elmer H. Baltz, eds., 162 p., 91 illus. Second printing, 1974.</td>
<td>$10.00</td>
</tr>
<tr>
<td>14. Socorro Region (New Mexico), 1963, Frederick J. Kuellmer, ed., 204 p., 90 illus. Second printing, 1975.</td>
<td>$10.00</td>
</tr>
<tr>
<td>15. Ruidoso Country (New Mexico), 1964, Sidney R. Ash and Leon V. Davis, eds., 195 p., 64 illus.</td>
<td>$ 9.00</td>
</tr>
<tr>
<td>19. San Juan-San Miguel-La Plata Region (New Mexico and Colorado), 1968, J. W. Shomaker, ed., 212 p., 95 illus.</td>
<td>$ 9.00</td>
</tr>
<tr>
<td>20. The Border Region (Chihuahua, Mexico and the United States), 1969, D. A. Cordoba, S. A. Wengard, and J. W. Shomaker, eds., 228 p., 159 illus.</td>
<td>$13.50</td>
</tr>
<tr>
<td>22. San Luis Basin (Colorado), 1971, H. L. James, ed., 340 p., 226 illus.</td>
<td>$ 15.00</td>
</tr>
<tr>
<td>23. East-central New Mexico, 1972, Vincent C. Kelley and Frederick D. Trauger, eds., 236 p., 128 illus. Special publication No. 4 included with purchase.</td>
<td>$15.00</td>
</tr>
</tbody>
</table>

SPECIAL PUBLICATIONS

<table>
<thead>
<tr>
<th>PUBLICATION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bibliography and index of the New Mexico Geological Society Guidebooks, 1950-63; compiled by Sidney R. Ash, 31 p.</td>
<td>$ 0.75</td>
</tr>
<tr>
<td>2. History of the New Mexico Geological Society, 1947-1968; by Stuart A. Northrop, 78 p.</td>
<td>$ 0.50</td>
</tr>
<tr>
<td>3. The San Andres Limestone: a reservoir for oil, gas and water … (a symposium); F. E. Kottlowski and W. K. Summers, eds., 51 p., 35 illus.</td>
<td>$ 3.00</td>
</tr>
<tr>
<td>4. Subsurface geology of east-central New Mexico by R. W. Foster, R. M. Frettess, and W. C. Riese, 22 p., 11 figs. (includes 8 isopach maps)</td>
<td>$ 2.00</td>
</tr>
</tbody>
</table>

MAPS

- Geologic highway map of New Mexico (in color, 23 x 29 in.), compiled by Frank E. Kottlowski and others. Rolled, $1.25; folded $... 1.00
- Geologic map of the Sierra Country Region, compiled by Vincent C. Kelley, in Guidebook 6. Second printing, 1974. $ 0.50
- Tectonic map of the Ruidoso-Carizozo Region, by V. C. Kelley and Tommy B. Thompson; in Guidebook 15. Second printing, 1974. $ 0.75

COMPLETE SETS

Guidebooks 1-25 inclusive, Special Publications 1-4, and Geologic highway map of New Mexico (folded), postpaid. $225.00

All publications are available by mail from the New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801. (Please add 75 cents to the price of each volume or map for postage and handling.) Guidebooks, and the geologic highway map, are available over the counter at the New Mexico Bureau of Mines and Mineral Resources; the Department of Geology, University of New Mexico; Holman's, Inc. 401 Wyoming Blvd., Albuquerque; the Museum of Northern Arizona, Flagstaff; Pebble Pups Rock Shop, Las Cruces; and Roswell Map and Blueprint Co., 125 East 3rd St., Roswell.

A 30 percent reduction from the price of each publication is offered to students. Sales to students will be made only at the New Mexico Bureau of Mines at Socorro and the Department of Geology, University of New Mexico, Albuquerque. Student orders must be verified by the Department Chairman or another official of similar authority in the school attended. Only one copy of each publication may be purchased at the student price.
1974 FIELD CONFERENCE SCHEDULE

WEDNESDAY, October 9th
1:00 p.m.-6:00 p.m. REGISTRATION DAY
Registration at ranch headquarters.

6:00 p.m.-7:00 p.m.
"Get-acquainted" party (cocktails) at pool side-patio area.

7:00 p.m.-8:30 p.m.
Evening meal (mess hall) with conference orientation.

THURSDAY, October 10th
6:30 a.m.-7:30 a.m.
FIRST DAY FIELD TRIP
Breakfast meal (mess hall).

7:30 a.m.-8:00 a.m.
Boarding of buses (ranch headquarters). Charter to Cuba, New Mexico,
and return via Abiquiu Dam, Coyote, Gallina, and Regina.
Picnic lunch enroute.
Distance: 67 miles
Stops: 6

6:00 p.m.-7:30 p.m.
Outdoor steak-fry supper (south lawn-mess hall).

7:30 p.m.-9:00 p.m.
Geologic "Mini-Symposium".*

FRIDAY, October 11th
6:30 a.m.-7:30 a.m.
SECOND DAY FIELD TRIP
Breakfast meal (mess hall).

7:30 a.m.-8:00 a.m.
Boarding of buses (mess hall). Charter for circuitous tour of the Tusas
Mountains region via Abiquiu, El Rito, Petaca, Tres Piedras, and Tierra
Amarilla.
Picnic lunch enroute.
Distance: 150 miles
Stops: 4

6:00 p.m.-7:30 p.m.
Attitude adjustment hour (cocktails) at pool side-patio area.

7:00 p.m.-8:00 p.m.
Evening meal (mess hall).

8:00 p.m.-9:00 p.m.
Movie: "Continental Drift & Plate Tectonics" (mess hall).

SATURDAY, October 12th
6:30 a.m.-7:30 a.m.
THIRD DAY FIELD TRIP
Breakfast meal (mess hall).

7:30 a.m.-8:00 a.m.
Auto-caravan assembly (ranch headquarters). Caravan will tour the
Jemez Mountains region via Espanola, White Rock, Jemez Springs, San
Ysidro, and Bernalillo.
Picnic Lunch enroute.
Distance: 130 miles
Stops: 3

*Three concurrent sessions. Program in preparation. Schedule announced at conference.
ERTS photograph of central-northern New Mexico. Approximate scale is 1 inch = 16 miles.
ERTS (Earth Resources Technology Satellite) photographs and an ERTS mosaic of the State of New Mexico can be ordered from Technology Application Center, University of New Mexico, Albuquerque, N.M. 87131.
Sketch map of major tectonic features of central-northern New Mexico made from ERTS photograph. Field Trip Routes are also shown. Drawn by Lee A. Woodward.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe Oil and Gas Company</td>
<td>346</td>
</tr>
<tr>
<td>Jack L. Ahlen</td>
<td>294</td>
</tr>
<tr>
<td>Albuquerque National Bank</td>
<td>300</td>
</tr>
<tr>
<td>AMAX Chemical Corporation</td>
<td>328</td>
</tr>
<tr>
<td>American Stratigraphic Company</td>
<td>314</td>
</tr>
<tr>
<td>C. R. Appledorn</td>
<td>358</td>
</tr>
<tr>
<td>Arizona Public Service Company</td>
<td>304</td>
</tr>
<tr>
<td>Artesia Lumber Company</td>
<td>376</td>
</tr>
<tr>
<td>Atlantic Richfield Company</td>
<td>278</td>
</tr>
<tr>
<td>Ball Associates, Ltd.</td>
<td>376</td>
</tr>
<tr>
<td>Bank of New Mexico</td>
<td>66</td>
</tr>
<tr>
<td>Bank Securities, Inc.</td>
<td>224</td>
</tr>
<tr>
<td>Baroid Division, N L Industries, Inc.</td>
<td>376</td>
</tr>
<tr>
<td>Benson-Montin-Greer Drilling Company</td>
<td>218</td>
</tr>
<tr>
<td>Blue Jet, Inc.</td>
<td>350</td>
</tr>
<tr>
<td>John A. Blume and Associates</td>
<td>376</td>
</tr>
<tr>
<td>C. F. Brown et al.</td>
<td>336</td>
</tr>
<tr>
<td>Glenn A. Brown and Associates</td>
<td>346</td>
</tr>
<tr>
<td>Chace Oil Company, Inc.</td>
<td>322</td>
</tr>
<tr>
<td>Chapman Wood and Griswold</td>
<td>346</td>
</tr>
<tr>
<td>Chesney Drilling Company</td>
<td>196</td>
</tr>
<tr>
<td>Chevron Oil Company – Western Division</td>
<td>290</td>
</tr>
<tr>
<td>Chino Mines Division, Kennecott Copper Corporation</td>
<td>94</td>
</tr>
<tr>
<td>Coastal States Gas Producing Company</td>
<td>196</td>
</tr>
<tr>
<td>Colorado Plateau Geological Services, Inc.</td>
<td>294</td>
</tr>
<tr>
<td>Consulting Professionals, Inc.</td>
<td>316</td>
</tr>
<tr>
<td>Controls for Environmental Pollution, Inc.</td>
<td>136</td>
</tr>
<tr>
<td>Dowell Division of Dow Chemical Company</td>
<td>322</td>
</tr>
<tr>
<td>Dresser Atlas Division-Dresser Industries, Inc.</td>
<td>118</td>
</tr>
<tr>
<td>John C. Drissel and Associates</td>
<td>224</td>
</tr>
<tr>
<td>Dugan Production Corporation</td>
<td>114</td>
</tr>
<tr>
<td>Duval Corporation</td>
<td>364</td>
</tr>
<tr>
<td>Eberline Instrument Corporation</td>
<td>130</td>
</tr>
<tr>
<td>E G &amp; G, Inc.</td>
<td>278</td>
</tr>
<tr>
<td>Electrical Log Services</td>
<td>282</td>
</tr>
<tr>
<td>Elk Oil Company</td>
<td>346</td>
</tr>
<tr>
<td>El Paso Natural Gas Company</td>
<td>300</td>
</tr>
<tr>
<td>Exploration Surveys, Inc.</td>
<td>308</td>
</tr>
<tr>
<td>Falcon Research and Development Company</td>
<td>300</td>
</tr>
<tr>
<td>Federal Abstract Company</td>
<td>376</td>
</tr>
<tr>
<td>First National Bank in Albuquerque</td>
<td>166</td>
</tr>
<tr>
<td>First National Bank of Santa Fe</td>
<td>332</td>
</tr>
<tr>
<td>First State Bank of Socorro</td>
<td>350</td>
</tr>
<tr>
<td>Flag-Redfern Oil Company</td>
<td>218</td>
</tr>
<tr>
<td>Four Corners Exploration Company</td>
<td>170</td>
</tr>
<tr>
<td>Four Corners Pipe Line Company</td>
<td>224</td>
</tr>
<tr>
<td>Franklin, Aston and Fair, Inc.</td>
<td>250</td>
</tr>
<tr>
<td>Geochemical Surveys, Inc.</td>
<td>170</td>
</tr>
<tr>
<td>Geophysical Instrument and Supply Company (GISCO)</td>
<td>304</td>
</tr>
<tr>
<td>Go International, Inc.</td>
<td>332</td>
</tr>
<tr>
<td>Grants Radiotelephone Service</td>
<td>346</td>
</tr>
<tr>
<td>William F. Guyton and Associates</td>
<td>316</td>
</tr>
<tr>
<td>Hanagan Petroleum Corporation</td>
<td>304</td>
</tr>
<tr>
<td>Hanson Oil Corporation</td>
<td>364</td>
</tr>
<tr>
<td>Lawrence C. Harris</td>
<td>308</td>
</tr>
<tr>
<td>Harvard Exploration Company</td>
<td>316</td>
</tr>
<tr>
<td>Healy-Matthews Stationers, Inc.</td>
<td>316</td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>166</td>
</tr>
<tr>
<td>Holman’s Inc.</td>
<td>346</td>
</tr>
<tr>
<td>Hunt Oil Company</td>
<td>282</td>
</tr>
<tr>
<td>Hydrotechnics</td>
<td>336</td>
</tr>
<tr>
<td>International Minerals and Chemical Corporation</td>
<td>196</td>
</tr>
<tr>
<td>Jacobs Assay Office</td>
<td>294</td>
</tr>
<tr>
<td>Clyde L. Jones Drilling Company, Inc.</td>
<td>294</td>
</tr>
<tr>
<td>Justis Supply Company, Inc.</td>
<td>316</td>
</tr>
<tr>
<td>Keesee and Thomas</td>
<td>364</td>
</tr>
<tr>
<td>John M. Kelly</td>
<td>316</td>
</tr>
<tr>
<td>Claude C. Kennedy</td>
<td>364</td>
</tr>
<tr>
<td>Keradamex Inc.</td>
<td>354</td>
</tr>
<tr>
<td>Kerr-McGee Corporation</td>
<td>75</td>
</tr>
<tr>
<td>Linbaugh Engineers, Inc.</td>
<td>316</td>
</tr>
<tr>
<td>Charles C. Loveless</td>
<td>346</td>
</tr>
<tr>
<td>Charles A. Mardriostian</td>
<td>376</td>
</tr>
<tr>
<td>McClellan Oil Corporation</td>
<td>332</td>
</tr>
<tr>
<td>Jerome P. McHugh</td>
<td>250</td>
</tr>
<tr>
<td>Colin McMillan</td>
<td>346</td>
</tr>
<tr>
<td>Mesa Blueprint Company</td>
<td>354</td>
</tr>
<tr>
<td>Mesa Petroleum Company</td>
<td>290</td>
</tr>
<tr>
<td>Minerals Exploration Company</td>
<td>114</td>
</tr>
<tr>
<td>The Mine Supply Company</td>
<td>354</td>
</tr>
<tr>
<td>Thomas W. Mitcham</td>
<td>294</td>
</tr>
<tr>
<td>Mountain Fuel Supply Company</td>
<td>290</td>
</tr>
<tr>
<td>Mountain States Petroleum Corporation</td>
<td>332</td>
</tr>
<tr>
<td>National Ghost Ranch Foundation</td>
<td>122</td>
</tr>
<tr>
<td>New Mexico and Arizona Land Company</td>
<td>218</td>
</tr>
<tr>
<td>New-Mex Construction Company, Inc.</td>
<td>218</td>
</tr>
<tr>
<td>New Mexico Department of Development</td>
<td>136</td>
</tr>
<tr>
<td>New Mexico Landmens Association</td>
<td>170</td>
</tr>
<tr>
<td>Nine Star Trading Company</td>
<td>166</td>
</tr>
<tr>
<td>Nord Resources Corporation</td>
<td>308</td>
</tr>
<tr>
<td>Ormsbee Development Company</td>
<td>350</td>
</tr>
<tr>
<td>Willard Owens Associates, Inc.</td>
<td>350</td>
</tr>
<tr>
<td>Pearson-Paul and Associates</td>
<td>376</td>
</tr>
<tr>
<td>Pebble Pups Rockshop</td>
<td>118</td>
</tr>
<tr>
<td>Pennsylvania Drilling Company</td>
<td>196</td>
</tr>
<tr>
<td>Petroleum Information Corporation</td>
<td>266</td>
</tr>
<tr>
<td>Petty-Ray Geophysical, Inc.</td>
<td>304</td>
</tr>
<tr>
<td>Phelps Dodge Corporation</td>
<td>106</td>
</tr>
<tr>
<td>Plateau, Inc.</td>
<td>364</td>
</tr>
<tr>
<td>Henry F. Pohlmann</td>
<td>364</td>
</tr>
</tbody>
</table>
Post Aviation Service .......................... 346
Potash Company of America ..................... 346
E. L. Poteet .................................... 308
Quinta Minerals Corporation ..................... 350
Rainbow Resources, Inc. ......................... 316
Ranchers Exploration and Development
Corporation .................................... 278
Read and Stevens, Inc. .......................... 266
Ed L. Reed and Associates ....................... 316
Val R. Reese ................................... 332
Reliable Reproductions, Inc. ..................... 328
R. M. Richardson ................................. 358
Rogers-Bryant and Company ..................... 354
Rust Tractor .................................... 278
San Juan Reproduction Company ................. 308
Seven Bar Flying Service, Inc. ................. 122
Shell Pipeline Corporation ...................... 224
John W. Shomaker ................................ 316
Sky Choppers, Inc. .............................. 250
Southwest Mud and Chemical Company ......... 314
William R. Speer ................................ 364
Stewart Brothers Drilling Company .............. 130
Stitzer and Associates ......................... 316

W. K. Summers ................................ 308
Superior Oil Company ........................... 290
SYN-AN, Inc. .................................. 100
Technology Application Center,
University of New Mexico ....................... 314
Terradex Corporation ............................ 346
Texaco, Inc. .................................... 56
Frederick D. Trauger ............................. 322
Tyree Surveying Company ....................... 364
Union Oil Company of California ............... 346
Union Supply Company .......................... 218
Utah International, Inc .......................... 376
W. A. Wahler and Associates .................... 376
Bud Walter, Inc. ................................ 332
Walters Real Estate ............................... 376
George Warnock ................................. 336
Welex—A Halliburton Company .................. 314
Sherman A. Wengerd .................. ............ 350
Western Coal Company .......................... 300
Western Gasification Company ................... 170
Mark D. Wilson .................................. 376
Yates Petroleum Corporation .................... 100
Young Drilling Company ........................ 250
Zales Jewelry ................................... 316
Ghost Ranch. Oblique air view north. Bedrock units are Triassic Chinle Formation (Tc), Jurassic Entrada Sandstone (Je), Todilto Formation (Jt), and Morrison Formation, and Cretaceous Dakota Formation (Kd). Photograph by Dick Kent.