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Front Matter

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

in:
Defiance, Zuni, Mt. Taylor Region (Arizona and New Mexico), Trauger, F. D.; [ed.], New Mexico Geological Society 18th Annual Fall Field Conference Guidebook, 228 p. https://doi.org/10.56577/FFC-18

This is a section from the 1967 NMGS Fall Field Conference Guidebook.

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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GUIDEBOOK OF

Defiance - Zuni - Mt. Taylor Region

Arizona and New Mexico

FREDERICK D. TRAUGER
Editor

NEW MEXICO GEOLOGICAL SOCIETY

EIGHTEENTH FIELD CONFERENCE — OCTOBER 19, 20, AND 21, 1967

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PRESIDENT'S MESSAGE

BIENVENIDOS! Welcome to the Eighteenth Annual Field Conference of the New Mexico Geological Society. We are privileged this year to visit three areas of distinct economic importance in northwestern New Mexico and northeastern Arizona, where the surface exposures of geologic features are unsurpassed and the beauty of the scenery unequalled.

The Dinch bi Keyah oil field is one of the most important oil discoveries in the western United States in recent years and it is unique in that the oil is produced from a sanadine-rich syenite sill. The spectacular increase in the demand for uranium as a power source has focused the attention of the nuclear power industry on the Gallup-Grants-Laguna area where over 41 percent of the nation's uranium ore reserves are located. In addition, the recently increased industrial demand for domestic fluorspar has brought new interest to the deposits in the Zuni Mountains. Many of you will be visiting these areas for the first time or after long absences and I hope that this Guidebook and the Eighteenth Field Conference will add to your knowledge and understanding of the geology and your appreciation of the natural beauty.

The Eighteenth Field Conference is a result of the combined efforts of a great many people who gave unselfishly of their time and energies. Special recognition is given to Frank B. Titus for his work as general chairman, and to Frederick D. Trauger for his many hours as editor of the Guidebook. E. C. Beaumont, Dale F. Kittle, and Charles B. Read helped plan the conference, headed the road logging, and acted as trip leaders; much of the success of the Conference is due to their hard work.

During the first day of the Conference we will be guests of the Navajo Tribe and I gratefully acknowledge the assistance and co-operation of Chairman Nakai, thc members of the Advisory Committee, the Navajo Tribal Police, and everyone on the Navajo Reservation who helped make this day a success.

In past years much of the material on this page has been devoted to lamenting the lack of new, unvisited areas within New Mexico in which to hold future field conferences. There have even been suggestions aimed at eliminating the conferences altogether due to the lack of financial success attributed to them. These suggestions not only betray a lack of confidence in the future but a lack of confidence in the interest of all Society members in adding to their knowledge of the geology of New Mexico and adjoining states as well. The conferences always have been self-supporting and, with good management, will continue to be financially successful. Past field conferences have not usually shown significant profit, nor can a substantial profit be expected on future conferences, but we should always remember that the New Mexico Geological Society is not a profit making organization.

There is no finer opportunity for learning first-hand about the geology and natural resources of a given area than by participating in a field conference such as this. In addition, there is no better way of making contacts which lead to the free interchange of ideas concerning local geology. The general area of this field conference was last visited by the Society in 1951 and many of you were present on that trip. Yet here you are again and you have been joined by many new faces. The continuing search for oil, gas, uranium, and other economic resources is constantly bringing renewed interest to many areas of the state either through the testing of new environments, as at Dineh bi Keyah or through changing market demands, as with uranium. At the same time we see continuing progress in the study of the geology of any given area resulting in new concepts and new dimensions of understanding.

We must also remember that, since we last visited this area, schools all over the country have been producing large numbers of geologists, many of whom are with us today. These men need an opportunity to study the geology of the state with geologists who can provide them with background information and encouragement as well as contacts for the future.

I take pride in my profession and I look forward to these annual excursions which give me an opportunity to meet with other geologists who feel the same way. It is my sincere wish that the conferences continue for many years to come.

Thank you again for joining us.

LARRY L. WERTS,
President

COMMITTEES

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* Out of Print

*1. San Juan Basin [covering the north and the east sides], New Mexico and Colorado, 1950, Vincent C. Kelley, ed., 152 p., 40 illus.

*2. South and west sides of the San Juan Basin, New Mexico and Arizona, 1951, Clay T. Smith and Caswell Silver, eds., 163 p., 71 illus.

*3. Rio Grande country, central New Mexico, 1952, Ross B. Johnson and Charles B. Read, eds., 126 p., 50 illus.

4. Southwestern New Mexico, 1953, Frank E. Kottlowski, ed., 153 p., 70 illus. $3.00

5. Southeastern New Mexico, 1954, T. F. Stipp, ed., 209 p., 76 illus. $3.00

*6. South-central New Mexico, 1955, J. Paul Fitzsimmons, 193 p., 66 illus. Prepared with the cooperation of the Roswell Geological Society.

7. Southeastern Sangre de Cristo Mountains, New Mexico, 1956, A. Rosenzweig, ed., 151 p., 61 illus. $4.00

8. Southwestern San Juan Mountains, Colorado, 1957, Frank E. Kottlowski and Brewster Baldwin, eds., 258 p., 110 illus. $4.00

9. Black Mesa Basin [northeastern Arizona], 1958, Roger Y. Anderson and John W. Harshbarger, eds., 205 p., 106 illus. Prepared in cooperation with the Arizona Geological Society. $5.00

10. West-central New Mexico, 1959, James E. Weir, Jr., and Elmer H. Baltz, eds., 162 p., 91 illus. $5.00

11. Rio Chama country [New Mexico and Colorado], 1960, Edward C. Beaumont and Charles B. Read, eds., 129 p., 35 illus. $5.00

12. Albuquerque country [New Mexico], 1961, Stuart A. Northrop, ed., 199 p., 83 illus. $6.00

13. Mogollon Rim region [east-central Arizona], 1962, Robert H. Weber and H. Wesley Peirce, eds., 175 p., 77 illus. Prepared in cooperation with the Arizona Geological Society. $7.00

14. Socorro region [New Mexico], 1963, Frederick J. Kuellmer, ed., 240 p., 90 illus. $7.00

15. Ruidoso country [New Mexico], 1964, Sidney R. Ash and Leon V. Davis, eds., 195 p., 64 illus. $7.00

16. Southwestern New Mexico II, 1965, J. Paul Fitzsimmons and Christina Lochman Balk, eds., 244 p., 73 illus. $9.50

17. Taos–Raton–Spanish Peaks country [New Mexico and Colorado], 1966, Stuart A. Northrop and Charles B. Read, eds., 128 p., 40 illus. $7.50

18. Defiance–Zuni–Mt. Taylor region [Arizona and New Mexico], 1967, Fred Trauger, ed. $9.00

SPECIAL PUBLICATIONS

1. Bibliography and index of the New Mexico Geological Society Guidebooks, 1950-63; compiled by Sidney R. Ash. $0.75

MAPS

a. Geologic highway map of New Mexico, in color, 23x29 in.; compiled by Frank E. Kottlowski and others. ..... $1.00 folded; $1.25 rolled.

b. Geologic map of the Sierra County Region, compiled by Vincent C. Kelley; in Guidebook 6. ..... $0.50

c. Geologic map of the Rio Chama country; compiled by Clay T. Smith and William R. Muehlberger; in Guidebook 11. ..... $0.50

d. Geologic map of the Albuquerque country; compiled by Stuart A. Northrop and Arlette Hill; in Guidebook 12. ..... $0.50

e. Tectonic map of the Ruidoso–Carrizozo region; compiled by V. C. Kelley and Tommy B. Thompson; in Guidebook 15. ..... $0.75

f. Tectonic map of the Defiance–Zuni–Mt. Taylor region; compiled by V. C. Kelley; in Guidebook 18. ... $1.50

ROAD LOGS

Set of nine entry and exit road logs to supplement Guidebook of the Ninth Field Conference. $1.00

(a) Albuquerque to Gallup (N.M.) and return.
(b) Mountainair to Correo (N.M.) and return.
(c) Gallup (N.M.) to Cortez (Colo.) and return.
(d) Socorro (N.M.) to Holbrook (Ariz.) and return.
(e) Globe to Showlow and to Sanders (Ariz.) and return.
(f) Monticello (Utah) to Tuba City (Ariz.) and return.
(g) Kingman via Grand Canyon Junction to Flagstaff (Ariz.) and return.
(h) Flagstaff to Prescott (Ariz.) and return.
(i) Gap Trading Post (Ariz.) to Kanab (Utah) and return.

All publications are available by mail (please add 25 cents for postage and handling each guidebook) from, or over the counter, at the New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico. Guidebooks, and the geologic highway maps are available over the counter at the Dept. of Geology, Univ. of N. Mex., Albuquerque; Holmans, Albuquerque; Roswell Map Service, Roswell; and the Museum of Northern Arizona, Flagstaff, Arizona.

Checks should be made payable to the New Mexico Geological Society.

SCHEDULE OF CONFERENCE

Wednesday, Oct. 18

5:00-11:00 P.M.	Registration at the Shalimar Motel, U.S. Highway 66, west side of Gallup, New Mexico.

Thursday, Oct. 19

6:00-7:00 A.M.	Late registration at Shalimar Motel.
7:00-7:30 A.M.	Caravan assembles on north side of U.S. Highway 66 directly opposite Shalimar Motel Office, headed east—Departure time: *promptly* at 7:30 A.M.
	Conferees missing the late registration may register and obtain guidebooks at any of the first-day stops.

Friday, Oct. 20

7:45-8:00 A.M.	Caravan assembles on north side of highway, opposite the Shalimar Motel, headed east—departure time: 8:00 A.M.
6:00-7:00 P.M.	Cocktail Hour, Shalimar Motel.
7:00 P.M.	Banquet, Shalimar Motel.

Saturday, Oct. 21

7:45-8:00 A.M.	Caravan assembles on north side of highway, opposite the Shalimar Motel, headed east—departure time: 8:00 A.M.

THERE WILL BE NO CATERED LUNCHES

PHYSIOGRAPHIC SETTING

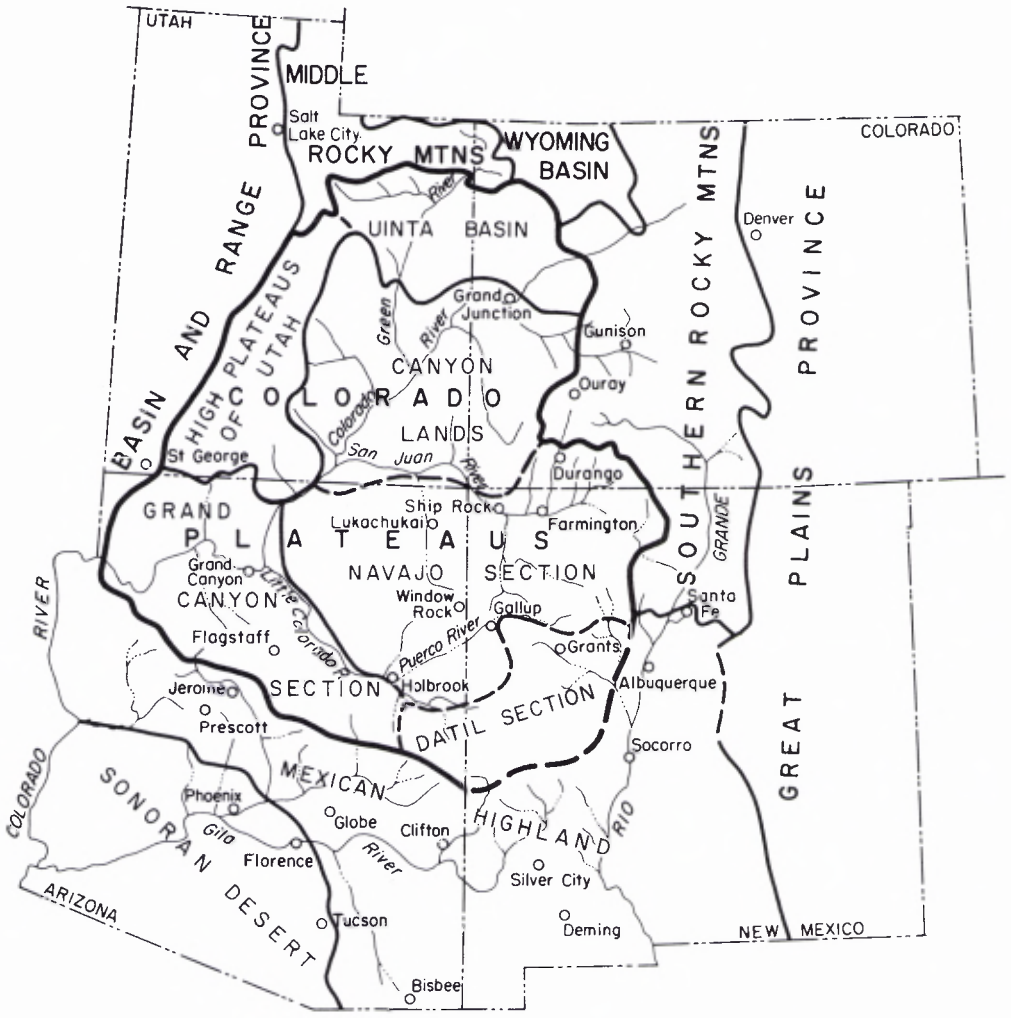
The entire tour route of the Eighteenth Field Conference is within Fenneman's (1931) Colorado Plateau province of the Intermontane Plateaus. The Conference will visit parts of two sections, the Navajo and Datil, and at one point in the northern Chuska Mountains the conferees will be able to look north and deep into the Canyonlands section in southwestern Utah. Far to the west of the first day's route lies the Grand Canyon section—beyond our vision from any vantage point on the trip. The Mexican Highlands section of the Basin and Range province lies far to the south and southeast, again beyond sight. Indeed, the caravan route crosses only the northeastern tip of the Datil section, thus most of the well-timbered, high, and rugged terrain of the Datil lies between the caravan route and the bleak desert areas of the Mexican Highlands.

The Southern Rocky Mountain province of the Rocky Mountain System lies to the northeast of the Navajo section. From vantage points high in the Zuni Mountains, or on Mount Taylor, one can see, on a clear day, the Nacimiento Mountains that define a part of the eastern margin of the Navajo section in New Mexico.

Fenneman recognized as the distinguishing features of the Colorado Plateau province the approximately horizontal attitude of the bedded rocks and the generally great elevation, pointing out that, except for the bottoms of canyons, no appreciable part of the province is below 5,000 feet. Altitudes in the province range up to 12,700 feet in some peaks but the highest plateaus are at about 11,000 feet.

Fenneman used generally altitude and extent of dissection as the principal basis for subdividing the province into sections. However, the criterion of vulcanism was used to separate one section, the Datil, from the other sections. In that section, volcanic rocks blanket the country and so dominate all aspects of the physiography and geology in general as to leave little else for consideration, and no doubt as to the propriety of delineating a separate section.

Because Fenneman used volcanic rocks alone as a cri-



Physiographic divisions of the region—from Fenneman, 1931.



The Nutria monocline and the northwest side of the Zuni uplift from a point approximately over Ramah. Note the plateau-character of the uplift surface. The Wingate Cliffs north of Fort Wingate are visible as a light band just below the horizon at the upper end of the monocline. Chuska Mountains on left horizon.

Photograph by Vincent C. *Kelley*

teria for delineating the Datil section, then placed the Zuni Uplift within that section, his placement of the boundary between the Datil and Navajo sections has been a subject for discussion and debate. A further brief examination of the question is in order for this field conference.

The proper "sectional" designation for the Zuni Uplift is the principal question to be settled. The distinguishing characteristics of the Datil section according to Fenncman's text and map arc features of volcanic origin—"lava flows entire or in remnants; volcanic necks." The Mount Taylor volcanic field well fits this criterion but the Zuni Uplift certainly does not.

The Navajo section, on the other hand, is, according to Fenneman, "mainly a country of sandstone with lesser amounts of shale. As the beds are generally not quite horizontal and have been subject to great erosion in an arid climate, the mesa, cucsta, rock terrace, retreating escarpment, canyon, and dry wash are the distinctive features of the landscape. In some parts volcanic necks and buttes are abundant."

It is clear that if these be the criteria for delineating the Navajo Section, then the Zuni Uplift is best placed in thatsection. It still, however, would remain something of an anomaly within the section.

Fenneman (1931, p. 317-318) describes the Zunis as belonging to the class of "domed mountains," similar to the Black IIills, formed by upward pressure from below. As such, they are really rather distinct, physiographically, from the characteristic parts of either the Navajo or Datil sections.

Left as another possible question by the two clearly-stated sets of criteria separating the sections is the proper sectional designation for the Mount Taylor volcanic field. There would seem to be in these criteria some slight justification for placing this area in the Navajo section as it sits on a plateau of horizontally bedded rock that would, without the volcanic cover, be a part of the Navajo section. One figure that Fenneman (1931, p. 313) adapted from Gregory indicates the volcanic field is a part of "Dutton Plateau" (north of the Santa Fe railroad) and thus in the Navajo section. However, Fenneman's text (1931, p 317319) clearly places it in the Datil section and it seems to fit most securely in that niche, all his criteria considered.

Having settled once and for all (at least to the satis-

faction of the writer) the proper sectional designation of the Zuni Uplift, let us consider briefly each day's route.

The first day of the conference takes us into the region of the Defiance Uplift. The Defiance Plateau, the Chuska Mountains, and Chuska Valley are the definitive land forms. The Chuska Mountains are the dissected remnants of a once broad sheet of Eocene sediments that were deposited along the axis of the peneplaned Defiance mono-cline. The Chuskas are characterized by steep bounding cliffs and more or less flat-topped summits that reach altitudes of about 9,000 feet above sea level.

The second day of the conference takes us into the northern end of the Zuni Mountains and across the gently dipping strata that flank the mountains on the north. The Zunis were formed by an elongated, gently domed and faulted uplift from which much of the sedimentary cover has been stripped, leaving exposed the crystalline basement rocks that form the core of the dome. The strata that flanked the dome dip gently away on all sides. Erosion of these alternately hard and soft upturned strata has resulted in the formation of a succession of cliffs and valleys ringing the uplift.

The third day of the conference takes us southeast along the northern flank of the Zuni Uplift, thence northeast away from the uplift and into the Datil section. The stagefor the early part of the day is dominated by the plateau forms of the Navajo section but Mount Taylor soon appears, front and center, and commands the attention for the duration of the trip. This great volcanic mass, the related flows and volcanic necks and plugs around it, and the much younger volcanic rocks to the south present a different appearance and a welcome contrast to the, by now, somewhat monotonous succession of sandstone cliffs that we have seen for most of the past two days.

Many eminent geologists described the terrain and geology of the region in which this field conference will travel long before Fenneman categorized the land forms of the nation. None did it so beautifully as Dutton and because his writings are not readily available and are even unknown to some geologists, the following descriptive passages are quoted from his "Mount Taylor and the Zuni Plateau," in: The Sixth Annual Report of the United States Geological Survey 1884-85, p. 113-198.

If some of the quotations seem to be not entirely pertinent to the conference, let them be enjoyed anyway for the word pictures they paint, and the opportunity they give to "see" this country through the eyes of a "working" geologist of some 80 years ago.

(Ouotcs from Dutton follow)

THE GENERAL FEATURES OF THE DISTRICT.

At the town of Albuquerque in New Mexico, and for a distance of many miles north and south of it, the Rio Grande may for the present be regarded as forming the boundary of the southeastern part of the Plateau country. A few miles east of the town rises the Zandia Range, a large and rather imposing mountain ridge, which reminds us in every feature of some of the characteristic ranges of the Great Basin, perhaps of the Southern Wasatch at Provo. The Zandia Range belongs to that branch of the Cordilleras which trends from the Mexican boundary a little east of north, and eventually expands into the great Rocky Ranges of Colorado. Looking westward across the Rio Grande a new topography begins, the topography of the Plateau country. From the house-tops of the town we recognize it at once; and if we take the car of the Atlantic and Pacific Railroad, which here leaves the Atchison Topeka and Santa Fe, we shall soon find ourselves within it. . . . For more than 120 miles the track steadily ascends with a strong gradient until it reaches the Continental divide, which separates the waters which flow into the Gulf of Mexico from those which run to the Gulf of California. The condition and aspect of the country along this route need little description, for many travelers have described it already. The lowlands near the river are barren and desert in the extreme. The highlands are moderately moist and well timbered.

In the immediate valley of the Rio Grande the climate is temperate in winter and insufferable in summer; higher up the summers are temperate and the winters barely sufferable. Below, vegetation is limited to scanty grass during a part of the year and such growths as irrigation can be made to produce. Natural trees on their native heaths are limited to the cottonwoods and willows in the river bottoms. Even the sagebrush, the ashy bloom of the desert elsewhere, resents the scorching summer and refuses to stay, and the cacti, vengeful and repellant everywhere, here assume a still more cruel and misanthropic mien. Higher up the junipers begin to appear, at first gnarled, stunted and timid, at length bold, exuberant, and well favored. Still higher the yellow pines become abundant and cover thousands of square miles of mesa and upland with magnificent forests.

MOUNT TAYLOR AND THE ZUNI PLATEAU

A few miles west of the river we observe around us the low ledges of eroded strata lying nearly horizontal, the beginnings of those cliff and terrace forms which grow higher and grander as we advance. . . . Traces of volcanic action, too, are abundant. Thin sheets of basalt are seen covering limited areas. Sometimes it mantles the soil of a valley bottom, sometimes it is the cap-sheet of sonic mesa. It is scattered about in an irregular way, as if the molten stuff had been dashed over the coun try

from some titanic bucket, and it lies like a great inky slop over the brightly colored soils and clays. There is often no trace of a vent or cinder cone marking the spot whence it issued from the earth, and until we reach Mount Taylor we find nothing to remind us of our old conventional ideas of a volcanic mountain....

Fifty miles west of the Rio Grande, the railroad leads among more pronounced cliffs and mesas. . . . Where we first encounter .these cliffs, they are of no great altitude, but in an inferior way they suggest more impressive ones beyond. Many of the tables have lava caps, but more have none. There are lavas, too, in the valleys and passageways between the mesas, and these valley lavas are seen at once to be much younger than those on the tops of the tables. And by the way, what is a mesa? What is the special significance of this term? And why is it used instead of good Anglo-Saxon? I will answer these questions by asking another. Did it ever occur to the reader how poverty stricken the (I will not say English exactly, but) Anglo-American language is in sharp, crisp, definite topographic terms? English writers seem to have gathered up a moderate number of them, but they got most of them from Scotland within the past thirty or forty years. They arc not a part of our legitimate inheritance from the mother country. In truth, we have in this country some three or four words which are available for duty in expressing several scores of topographic characteristics. Anything that is hollow we call a valley, and anything that stands up above the surrounding land we call a hill or mountain. But the Spanish—or Mexican, if you prefer—is rich in topographic terms which are delightfully expressive and definite. There is scarcely a feature of the land which repeats itself with similar characteristics that has not a pat name. And these terms are euphonious as well as precise: they designate things objective as happily and concisely as the Saxon designates things subjective. Therefore we use them. There are no others adapted to the purpose. A mesa means primarily a table. Topographically it is applied to a broad, flat surface of high land, bounded by a cliff, the crest of which looks steeply down upon the country below. And the Plateau country is mesa, mesa everywhere—nothing but mesa. It is not at all necessary that the high tabular surface should be completely encircled, or irregularly but completely environed, by a descending cliff. One side may be cliff-bound, while the other dies away by a gentle, barely perceptible declivity into distant lowlands. Still it is a mesa. Or a few miles back of its crest line a second cliff may spring up to a higher flat beyond. Even so it is to the Mexican a mesa, though we might in this case call it a terrace. The Mexican sees but one side at a time, and if that answers to the general conception it is enough for him.

. . . . Frequently the mesa is breached entirely through by a valley, and this valley may be either a narrow canon or an into-space ten, fifteen, even twenty miles wide, or any intermediate width.

Where the railroad enters the mesas it finds a breach of this kind cut completely through a long and wide chain of them. It is the valley of the San Jose. On the north rises the rather imposing pile of Mount Taylor, an old volcano, not of the first and barely of the second order of magnitude....

A farther distance of 25 miles carries us through the belt of high mcsas. . . . **To** the westward rises by moderate slopes a large and rather lofty mass, designated on the map "Zuni Mountains," though it seems to me more proper to call it a plateau. From every direction, so far as visible, the strata can be seen rising by well marked though never steep slopes to its summit ..... To the northwestward stretches away a broad noble valley. On the right-hand (northeast) side of it we see in the distance a range of highly colored cliffs, loftier than any hitherto encountered. On the left side of the valley are the rather gentle though sufficiently marked slopes of the Zuni Plateau, clothed all the way up with pines and junipers. In the immediate foreground, and indeed, under our feet and spreading over all the lowlands and plains in front, is a chaos of black, rough lava of peculiarly horrid aspect. Its freshness betokens great recency of eruption; and indeed a very few hundred years only can possibly have passed since it was o utpourcd..... Many have presumed that it came from Mount Taylor; but this is a mistake. . . .

Here we may consider ourselves as well within the Plateau country. The scenery is strong and somewhat impressive, for the component masses of the landscape are all large, and for the most part of the true plateau type. Mount Taylor, however, is exceptional, for this is a great mountain, with a roughly conical peak, with long sharp tumbling spurs, cleeptly-incised ravines, and intervening buttresses. Still we find a few such elsewhere within the province and it is therefore not altogether anomalous. The wide expanses of featureless plains, the far-off summits of giant cliffs, resplendent with rainbow colors, the flat crest lines dropping in vertical palisades, the naked strata lined off at their partings, the bright yellowish or ashy soil, the brilliant sun-light and torrid heat, the blue haze of the atmosphere, like an ethereal veil between us and surrounding objects—all these are the true characteristics of the Plateau country, with which we have already become familiar in other portions of it. Before us it stretches for 400 miles, repeating its characters in forms that are ever the

same yet not the same, which arc uniform yet infinitely varied. The broader or generic features are constant, the specific features protean and full of contrast.

But let us follow the course of the railroad a little farther to the northwestward.... At length, 130 miles by rail from Albuquerque, we reach the Continental divide, at an altitude of about 7,300 feet. Beyond it the waters are gathered into the Pucrco River, a tributary of the Little Colorado (Colorado Chiquito). The heart of the Zuni Plateau is still to the south, while to the north the red and variegated cliffs of the Jura-Trias have assumed grand proportions, not far below those of the magnificent fronts of the Vermillion Cliffs of Southern Utah. From the Continental divide the road steadily descends, and 25 miles westward the cliffs to the north suddenly end, their crest lines quickly descending to the general level and vanishing. . . . Here we cross a great monocline, dipping sharply to the westward, and enter once more upon the Cretaceous. .

Hard by this point is Fort Wingate, one of the largest and most important military stations in the Indian country, where troops are stationed in sonic force to keep watch over the populous Navajo Nation on the one hand and the more peaceful Zunis on the other. Just south of the post and immediately above it rises the highest part of the plateau. From its summit we gain an overlook of the country far to the northward and westward. To the north there is comparatively little to attract attention except the great cliffs which we have already noted and which are, so to speak, close at hand. But the eye now ranges beyond their crest lines into a region which presents but little diversity. The land is for the most part flat and monotonous, its smooth surface barely broken by low ledges of sandstone and shale, much too insignificant to be called cliffs and mesas, nor yet sufficiently scoured by erosion to form bad-lands. From the crest of the great Jura-Trias cliffs, as far northward as we can see, the country is made up of horizontal Cretaceous beds, some high, some low, in that stratigraphic system.

To the northwestward, and only 40 miles away, rises a conspicuous plateau mass of much smaller though still considerable dimensions. It is named on the map the Choiskai Plateau (more frequently pronounced Chusca and so written on older maps), which is one of the sacred places of the Navajos. It is in fact a lofty mesa, composed of strata which are horizontal in the eastern and middle portions of the mass, but turn upwards as they approach its western verge. The upper portion of this mesa must surely be Tertiary, but the most diligent search failed to disclose a single fossil. Still I feel confident that its strata are of Tertiary age, for the youngest Cretaceous (Laramie) is far beneath them.

Still more to the northwestward and westward we look over a country which is greatly diversified, and where the rocks have been subject to considerable dislocation by faults and monoclinal flexures of the normal plateau type. Erosion has worked upon them remorselessly, carving out many bold irregular forms, the exact meaning and relations of which are not distinguishable at a distant view. Six to eight miles distant is the Nutria monocline, rolling up towards us and showing the ends of the Jura-Trias in serrated edges. This side of the monocline is Permian or Lower Trias; beyond it all is Cretaceous. Yet, before taking up the description of the plateau itself, let us look hastily at the southwestern side of it and endeavor to gain a distant view of the region beyond its flanks. Only a few points need to be noted. The southern and southwestern side is simply a repetition of the northeastern in inverse order. There is the gently sloping flank, descending into a broad valley parallel to the axis of the plateau, and on the farther side of the valley rise up the Jura-Trias Cliffs facing us. Beyond their crest line the Cretaceous strata reappear, stretching far away into the unknown regions to the southward. Thus, then, the Zuni Plateau is simply a great swell in a vast regional expanse of Mesozoic rocks, breaking for a brief space the continuity of that system of strata. From its broad surface the Mesozoic has been denuded, leaving the edges of the strata more or less upturned to face it roundabout on all sides in rainbow cliffs. Away from the plateau the strata resume their horizontality and the Cretaceous becomes again everywhere the surface of the land. Vast and imposing is the expanse of this mighty Cretaceous system. If we could rise in a captive balloon 2,000 feet above this standpoint, the radius of vision would embrace more than 20,000 square miles covered with it. Yet it is but a trifle in comparison with its whole extent, which embraces half of the North American continent. Its thickness is equally matter of wonder. Whence came this stupendous mass of material?

NOMENCLATURE CHART*

ERA	PERIOD	EPOCH	EASTERN SIDE OF DEFIANCE UPLIFT ROUTE: GALLUP TO LUKACHUKAI		NORTH FLANK OF ZUNI UPLIFT ROUTE: GALLUP-ZUNI MTS-SMITH LAKE		MT TAYLOR AREA ROUTE: GALLUP-GRANTS-PAGUATE	
			FORMATION	MEMBER	FORMATION	MEMBER	FORMATION	MEMBER
U_ N, UN z W o	I- 4)	RECENT	Alluvium		Alluvium and basalt		Alluvium and basalt	
		PLEISTOCENE	Gravel and sand		Silt. sand, and gravel			
	L - . : , R . c c ILlj	PLIOCENE	Fo rmation / Chuska Sandstone		Mt. Taylor sheet basalts		Mt. Taylor sheet basalts	
		MIOCENE			Mt. Taylor cone volcanics		Mt. Taylor cone volcanics	
		OLIGOCENE	Volcanic Rocks		Rocks of this interval are not present in the area traversed the second day		Rocks of this interval are not present in the area traversed the third day	
		EOCENE	San Jose Formation					
		PALEOCENE	Nacimiento Fm / Animas Fm.					
C..3 U NI o Li) 2	in S 0 bt 0 15 tat CC 0	MONTANAN	Oto Alamo Formation					
			McDermott Formation					
			Kirtland Shale					
			Fruitland Formation					
			Pictured Cliffs Sandstone					
			Lewis Shale					
			Tohatehi Formation					
			Cliff House Sandstone		Cliff House Sandstone		Cliff House Sandstone	
			Menefee Formation	Allison Member / Cleary Member	Menefee Formation		Menefee Formation	
		COLORADAN	Point Lookout Sandstone		Point Lookout Sandston	H osta tongue / Satan tongue	Point Lookout Sandstone	
			Crevasse Canyon Formation	Gibson Coal Mem. / Mulatto tongue / Dalton Ss Mem. / Bartlett Bar ren me.	Crevasse Canyon Formation	Gibson Coal Mem. / Dalton Ss / Dileo Coal Mem / Muiat to tongue		upper Mancos
			Gallup Sandstone	Gallegos Mem. / D-Cross tongue / er G- Ilu i / Peseado tongue	Gal/up Sandstone	Gallegos Member / lower Gallup / D-Cross tongue	Gallup Sandston e	lower Mancos
			Manc os Shal a	Sonastee Member / Tower Mancos Shale / Greenhorn Member / Graneros Member	Mancos Shale		Shale	Tres liermanos Sandstone Member (of Hunt)
		DAKOTAN	Dakota Sandstone		Dakota Sandstone	TwowhglosthSeajidstont / see & T r ' 1 ni s Mem	Dakota Sandstone	
	‹ N- K	UPPER	Morr ison Formation	Brushy Basin Member / Westwater Canyon Mem. / Recapture Mem. / Sal Wash Member	Morrison Formation	Casirmero pro„it, Mem. / Brushy Basin Mem. / Westwater Canyon Mem. / Recapture Shale Mem. / Chavez Mem.	Morrison Formation / Cow .	Brushy packpile Ss. / Basin Mein. Poison Cy. T. / Westwater Canyon Mem. / Recapture Shale Mem. —
			Zuni I Bluff Sandstone / Bluff Sandstone		Cow '---------'- Springs / Sandstone Bluff Ss. / Thoreau Fm.	Upper Thoreau / Lower Thoreau	Sandstone Bluff Sandstone	
		MIDDL	Summerville Formation		Summerville Fin.			
			Todilto Limestone		Todilto Limestone		Todilto Limestone	beds Limestone beds
			Entrada Sandston e	Upper Member / Medial Silly Member	Entrada Sandstone	Upper Member / Medial Silty Member	Entrada Sandstone	Upper Member / Medial Silty Member
			Carmel Formation		Carmel Formation		Carmel Formation	
	Y't IT I—	UPPER	Wingate Sandsto ne	Mem. . / Rock Point Mem.	Wingate Sandstone		Wingate Sandstone	
			Chinle Formati on	Owl Rock Mem. / Petrified Forest Mem. / Lower Red Mem. / Shinarump Congl. em.	Chinle Formation	Upper Shale Member / Middle Sandstone Member / Lower Shale Member / Lower Sandstone Member	Chinle Formation	UpMpeer mber Shale ,...,,.....CoMemrreo . Ss. / Middle Sandstone Member / Lower Shale Member / Lower Sandstone Member
		LOWER	Moenkopi Formation					
o N o RI J .< Ci-	4 m c IA IA	LEONARD	De Chelly Sandstone	De Chelly Upper Ss / De Chelly Lower Ss / Ft. Defiance Mem. / Black House Mem. / Oak Springs Mem. (ton gue Su al) / Hunters Po int Mein.	San Andres Limestone / Glorieta Sandstone / Yeso Formation	San Ysidro Mein. / Meseta Blanca Mem.	San Andres Limestone / Glorieta Sandstone / Yeso Formation	
		WOLFCAMP	Supai Formation		Alio Formation		Abo Formation	
	2 Z	UPPER	nt Honaker Trait Fm.	In subsurface only in northwestern New Mexico and northeastern Arizona	Unnamed Limestone / Older Units not shown	In subsurface only	Older Units not shown	In subsurface only
		MIDDLE	Paradox Fm / Pinkerton Trail Fm.					
		LOWER	x Molas Fin.					
	to	MERAMEC OSAGE	Leadville Limestone					
	>R.1 to	UPPER	Ouray Limestone / Elbert Formation / Aneth Formation					
PRECAMBRIAN			Quartzite		Granite. gneiss and schist		? Granite, gneiss, and schist?	

COMPILED FROM PREVIOUSLY PUBLISHED CHARTS, AND SUGGESTIONS FURNISHED BY D. F. KITTEL, R. G. MARVIN. H. W. PEIRCE. C. B. READ. C. T. SMITH. AND L. L. WERTS THE EDITOR ASSUMES FULL RESPONSIBILITY FOR THE ABOVE TREATMENT OF INFORMATION VOLUNTEERED AND WISHES TO POINT OUT THAT NONE OF THE RECOMIVE NDED RELATIONSHIPS SUBMITTED WERE ADOPTED WITHOUT CHANGES. AND THE CHANGES WERE ARBR/TRARILY MADE BY THE EDITOR.