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THE MOUNT TAYLOR VOLCANIC FIELD: A DIGEST OF THE LITERATURE

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Editor's note: Mount Taylor and the kindred volcanic features associated with it will be often in view during the Field Conference, a fact reflected in the title of the Guidebook. Unfortunately, none of the papers submitted for the Guidebook dealt with the Mount Taylor volcanic field. This digest of the Mount Taylor literature was prepared and included so that the book's contents will more nearly justify its title, and so that the conferees will have available the important facts concerning this large and interesting feature of New Mexico geology. A number of direct quotations from the literature are included for the descriptive beauty of their prose, and several illustrations are reproduced.

The earliest mention of Mount Taylor (as such) in a report dealing with geology or geography is in J. H. Simpson's (1850) journal of a military reconnaissance from Santa Fe, N. Mex., to the Navajo country. Simpson's party named Mount Taylor and described briefly the rocks encountered along the route. Jules Marcou (Marcou, 1856, 1858) drew the first geologic map of the Mount Taylor country and recognized the volcanic origin of the mountain. E. E. Howell (1875) interpreted the age relationships of the Mount Taylor lavas, the sheet basalts, and the deformation of underlying Cretaceous strata. Other observers, notably J. S. Newberry (Newberry, 1861, 1876) and G. K. Gilbert (*in* Emmons, S. F., and others, 1893), described Mount Taylor as a scenic feature.

The geologic literature of the Mount Taylor field really began with Captain Dutton's classic report of 1885. His commentary is geologically sound, and is couched in the noble English of the naturalists of his day. Charles B. Hunt, in his U.S. Geological Survey Bulletin (Hunt, 1936) and Professional Paper (Hunt, 1938) added detailed structural and petrographic information to the literature. These three treatises, and V. C. Kelley's San Juan Basin structural papers (Kelley, 1950; Kelley and Clinton, 1960), provided most of the material for the summary that follows. Other papers which deal specifically with parts of the Mount Taylor field are those of Johnson (1907), Moench and Schlee (1967) and Gabelman (1956).

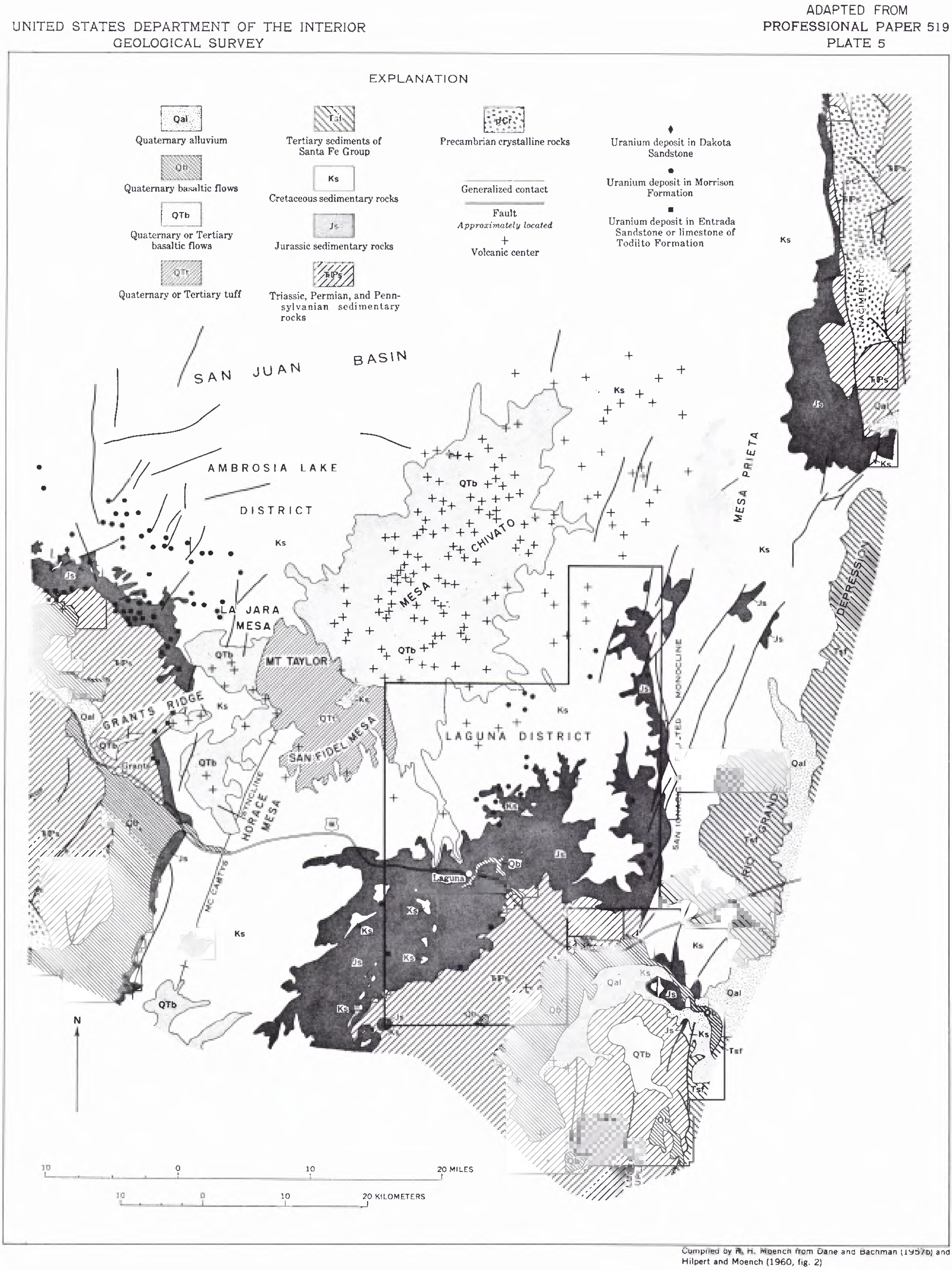
The Mount Taylor volcanic field lies between two of the Nation's principal uranium-producing districts: the Ambrosia Lake–Poison Canyon area on the west and the North Laguna area on the east. The map compiled by Moench (Moench and Schlee, 1967) has been modified and reproduced in part to use in this digest both as an index and to show the relationship of the uranium districts to the volcanic field.

The Mount Taylor field extends northeastward from the Rio San Jose, to and across the Rio Puerco. Flows associated with the Mount Taylor centers are seen along the route of U.S. Highway 66 between Laguna and Grants, and the swarm of volcanic necks east of Mount Taylor presents an impressive panorama from any direction.

The Mount Taylor field occupies the northeastern corner of the Datil Section of Fenneman's (1962) Colorado Plateau physiographic province. Flows from centers in the field probably covered the Puerco Fault Belt and the Ignacio Monocline and the fault belt associated with it. These features, which lie parallel with the long axis of the main volcanic mass and some 25 miles east of it, are generally thought to mark the western boundary of the Rio Grande Trough and of the Basin and Range physiographic province. On Kelley's (1950) structural map of

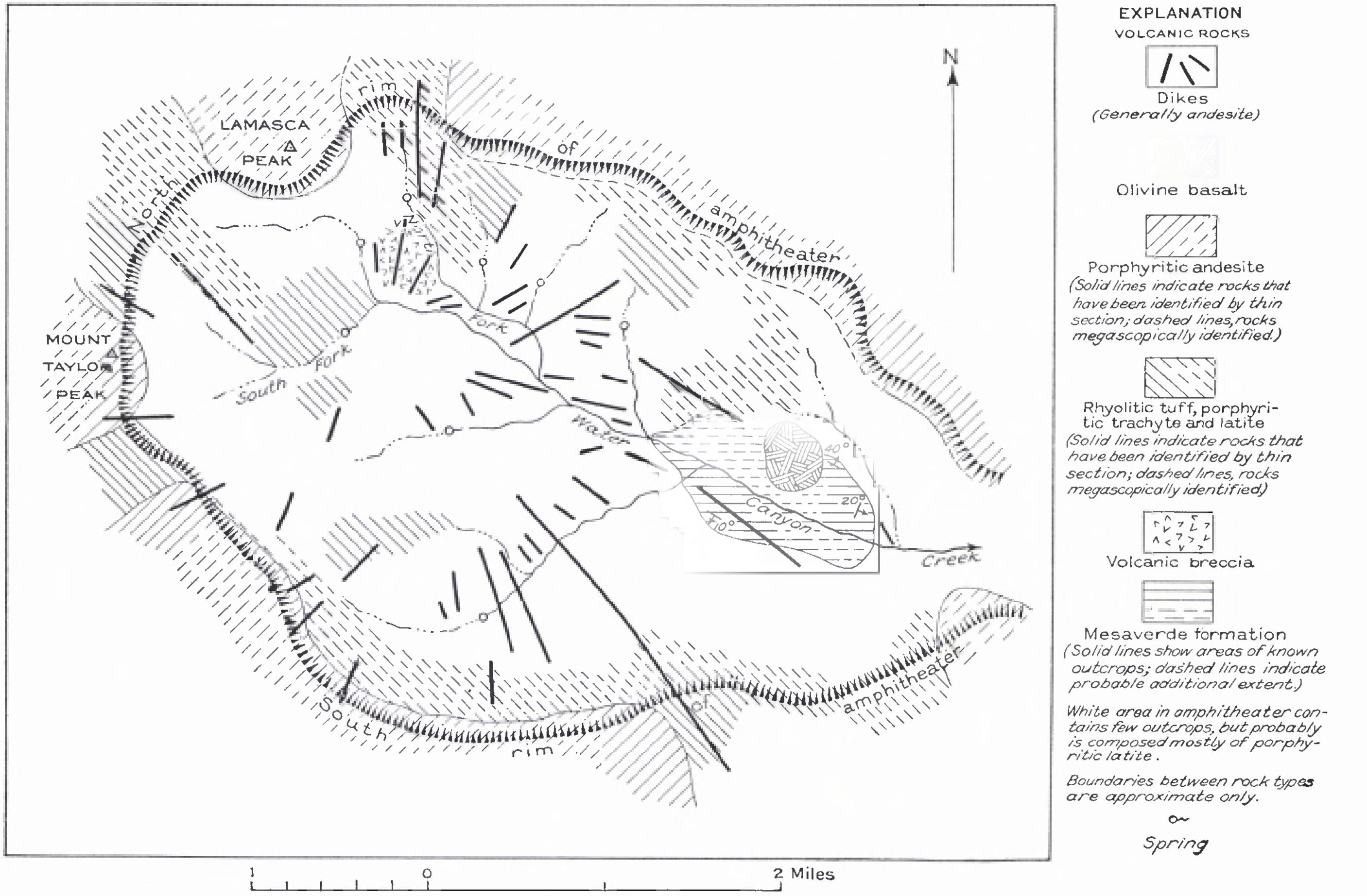
Mount Taylor, looking north from Cubero on old highway—about mile 54.10 on Access Log. Valley in foreground is cut in soft beds of the Mancos Shale. The cliffs and steep slopes of the hills in the middleground are developed in the alternating hard and soft beds of the upper and lower Gallup Sandstone which here dip northwest and pass under the Mount Taylor volcanic sequence. Mount Taylor lies approximately on the axis of the McCartys syncline.

Photograph by F. D. Trauger



Generalized geologic map of the southern part of the San Juan Basin and adjacent areas, New Mexico showing uranium deposits and their relationships to the Mount Taylor volcanic field.
(After Beaumont, Dane, and Sears, 1956)

GEOLOGICAL SURVEY FROM HUNT, C. B., PROFESSIONAL PAPER 189 PLATE 11



From Hunt (1938, p. 59); Figure 10.—Geologic sketch map of the amphitheater and surrounding rim of the Mount Taylor volcano.

the San Juan Basin, the Mount Taylor syncline (upon which Mount Taylor lies) is found on the south flank of the San Juan Basin, near the lower end of the Chaco Slope.

South of the volcanic field, the Mount Taylor syncline (otherwise known as the McCarty syncline) is symmetrical and shallow. At the southern limit of the field, the syncline abruptly assumes a northward plunge and its structural relief increases from some 600 feet to about 1,500 feet (over a total width of about 20 miles). The syncline passes under the volcanic field and dies out near the northern end. Sandstones and shales of the Cretaceous Dakota Sandstone, Mancos Shale, and Mesaverde Group are exposed in both limbs of the fold and presumably underlie the Mount Taylor volcanic rocks.

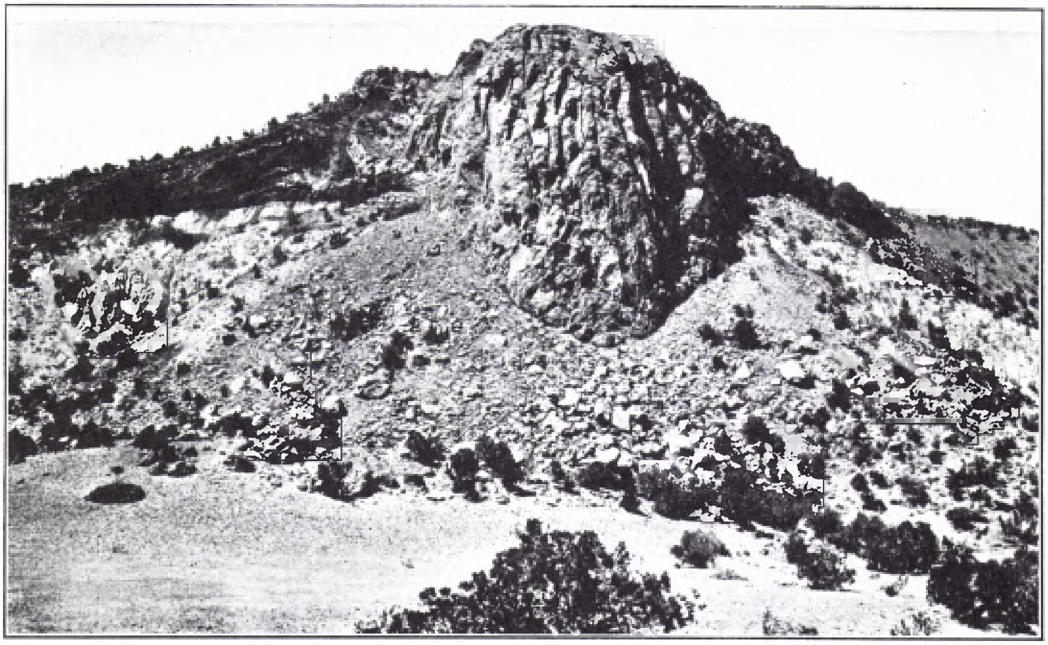
The prominent mass of the volcanic field is made up of Mount Taylor itself and the lava-covered mesas upon which it appears to stand. Mount Taylor is a lava-and-tuff cone, and represents the earliest (Miocene), and most active volcanic center in the field. Dutton opened his discussion of the cone with these comments:

"If the cone of Mount Taylor were all that this locality has to present for study it would hardly have repaid the trouble of a visit. But the volcanic district of which it is the culminating point presents matter of great interest and instruction when viewed as a whole, for it discloses clearly the origin of the great lava caps which form such a conspicuous feature in many parts of the West, and offers a wide range of information concerning the modes of accumulation of lavas in the basic group." (Dutton, 1885, p. 166).

Erosion has breached and enlarged the original crater, which probably was located about a mile east of Mount Taylor Peak (the highest point on the present-day eroded rim) and probably was less than one square mile in area. The present five-square-mile amphitheater created by erosion of the crater opens to the east, and the creek that drains it is now about 2,500 feet below the rim. Porphyritic andesite, with some latite and tuff, covers the cone and overlies a sequence of tuffaceous rhyolites and porphyritic trachytes and latites. The lower sequence is now exposed within the amphitheater and beneath younger lavas in the mesas south and west of the cone.

The cone is heavily timbered and has been deeply incised by erosion. Talus, soil, and vegetation conceal the rocks in many places, but chaotic masses of lava and agglomerate and swarms of dikes can be seen. The dikes

GEOLOGICAL SURVEY PROFESSIONAL PAPER 189 PLATE 11



A. CROSS SECTION OF BASALTIC NECK EXPOSED BY EROSION IN GRANT RIDGES, 6 MILES NORTHEAST OF GRANT.

View looking southwest in sec. 3, T. 11 N., R. 9 W. Basalt in core is jointed in vertical columns and surrounded by a thin zone of platy jointing developed along the contact with white tuff. Bedded breccia overlies the tuff, and basaltic lava overlies the breccia on the far side of the cone. The tuff, chiefly rhyolitic, was erupted from Mount Taylor.

within the amphitheater are of porphyritic andesite (of the composition of the flows covering the cone), and occur in a radial pattern centered near the head of the amphitheater, presumably at the site of the crater.

"The eruptions of the Mount Taylor volcano began probably in late Miocene time, subsequent to the major movements of folding and faulting in the central and western part of the volcanic field. . . . The volcano broke out in the deepest part of the McCarty syncline, which was the center of maximum intensity of the early folding. Inasmuch as both the volcano and the fold are unusual features of the southern San Juan Basin, their association seems to indicate more than fortuitous coincidence. The volcanic activity followed the major structural movements, but the time interval is not known. It is interesting, though purely speculative, to consider the possibility that the structural movements and fusion of the deep-seated magma were contemporaneous and related, and that the time interval between the structural movements and surface eruptions was that required for the lava to find its way to the surface." (Hunt, 1938, p. 63).

Mesa Chivato, La Jara Mesa, San Fidel Mesa, and Horace Mesa, which together make up the "pedestal" under Mount Taylor, all rise to an elevation of about 8,000 feet above sea level. The plains surrounding the mesas lie at elevations ranging between 6,000 feet and 6,700 feet; Mount Taylor Peak is 11,389 feet above sea level.

Mesa Chivato (the plateau-like expanse to the northeast of Mount Taylor), and the table-lands bordering the base of the Mount Taylor cone on the west and south, namely La Jara Mesa, Horace Mesa, and San Fidel Mesa, are the remnants of the earliest pediment developed around the cone. The pediment surfaces were covered soon after formation by flows of basalt and andesite that are for the most part younger (Pliocene?) than any of the flows from the cone itself.

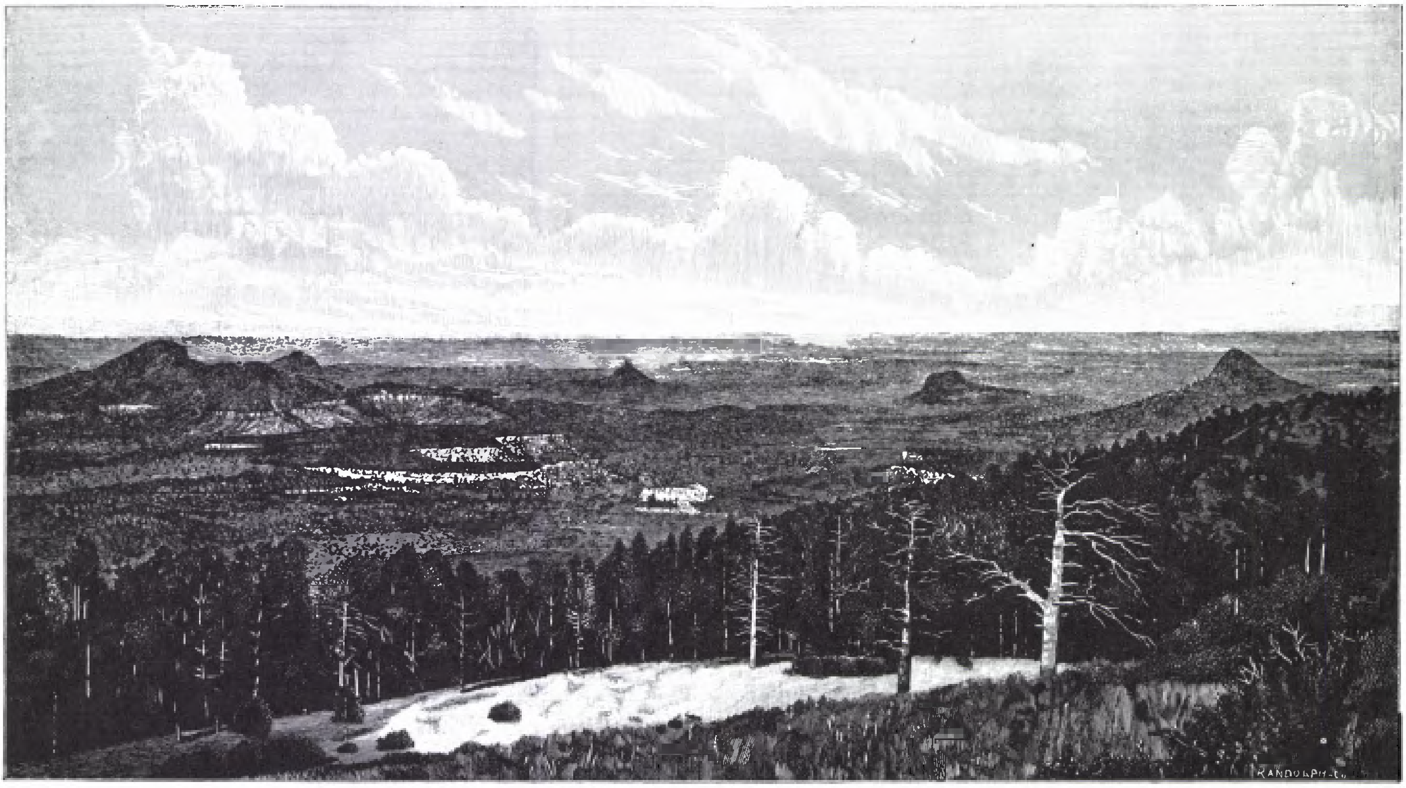
The mesa-tops are studded with the eroded remains of the small cones from which these later lavas poured. Some are still in good condition: Cerro Chivato and the Cerros de Guadalupe atop Mesa Chivato rise several hundred feet above their surroundings. Others are so ravaged by erosion that their sites can be identified only through careful inspection of the rocks. Captain Dutton (1885) surmised that the number of cones upon Mesa Chivato exceeded one hundred, or possibly two hundred. The Mesa Chivato cones are clustered in groups along three rough arcs concave to the west, and are composed of basalt and scoria, as are the cones on the other mesa surfaces.

In several places along the rims of the mesas, erosion has produced natural cross sections of the cones, exposing the edges of the flows on the surface and the congealed lava in the conduit.

One of the most striking features of the Mount Taylor field is the array of volcanic necks exposed in the valley of the Rio Puerco between the Mount Taylor mesas and their neighbor to the east, Mesa Prieta.

"If we stand upon the eastern brink of the Mount Taylor mesa we shall overlook the broad valley of the Puerco (East). The spectacle is a fine one and in some respects extraordinary. The edge of the mesa suddenly descends by a succession of ledges and slopes nearly 2,000

U. S. GEOLOGICAL SURVEY SIXTH ANNUAL REPORT PL. XX



Panorama from the edge of the Mount Taylor mesa. *From Dutton (1885).*

feet into the rugged and highly diversified valley-plain below. The country beneath is a medley of low cliffs or bluffs, showing the light browns and pale yellows of the lower and middle Cretaceous sandstones and shales. Out of this confused patchwork of bright colors rise several objects of remarkable aspect. They are apparently inaccessible eyries of black rock, and at a rough guess, by comparison with the known altitudes of surrounding objects, their heights above the mean level of the adjoining plain may range from 800 to 1,500 feet. The blackness of their shade may be exaggerated by contrast with the brilliant colors of the rocks and soil out of which they rise, but their forms are even more striking. It is rare to find such shapes in the Plateau country, much more so elsewhere. It is obvious at once that these rocks are of volcanic origin; and the experienced geologist who has traveled much in these regions will recognize their significance at a glance, though their full meaning might not be at first apprehended by the layman. They are by no means unique, for Dr. Newberry has described some fine examples of the same type occurring in the valley of San Juan, far to the northwestward.

These black rocks are technically called 'necks'." (Dutton, 1885, p. 166-167.)

Hunt's description of Cabezon Peak (Hunt, 1938, p. 68), the best known and most impressive of the necks, is repeated here.

"Cabezon Peak . . . . . is the highest and most impressive of the necks, rising nearly 2,000 feet above the Rio Puerco, and the protruding basaltic core is about 1,500 feet in diameter. The diameter of the pipe is probably at least 2,000 feet, as indicated by poor exposures of basaltic breccia around the base of the basalt core. The country rocks intruded by the neck are Cretaceous sandstone and shale that dip gently northward, and although the contact is not exposed there is no indication of deformation by the intrusion. The exposed neck is nearly cylindrical and is about 800 feet high. It consists of dense columnar-jointed basalt below and highly scoriaceous basalt on top . . . . The joints in the dense basalt immediately below the scoriaceous top are nearly vertical, but downward they flare slightly toward the peripheral contact. It is not certain whether this flaring is due to greater depth, as Johnson [1907] has suggested, or whether the base of the neck is closer than the top to the side contacts. The jointed columns range from a few feet to 8 feet in diameter. Throughout the neck the jointing is much more regular than is common in the other necks, probably because of the absence of basaltic breccia except along the contacts.

Cabezon Peak is slightly higher than the basalt sheets on Mesa Prieta, but these sheets rise gently northward and if projected would approximately coincide with the top of the peak. The thick cap of scoria on top of the peak is probably a remnant of a cone built on the surface of eruption.

The basalt at Cabezon Peak consists of about 60 percent of calcic plagioclase (labradorite?), 15 percent of olivine,

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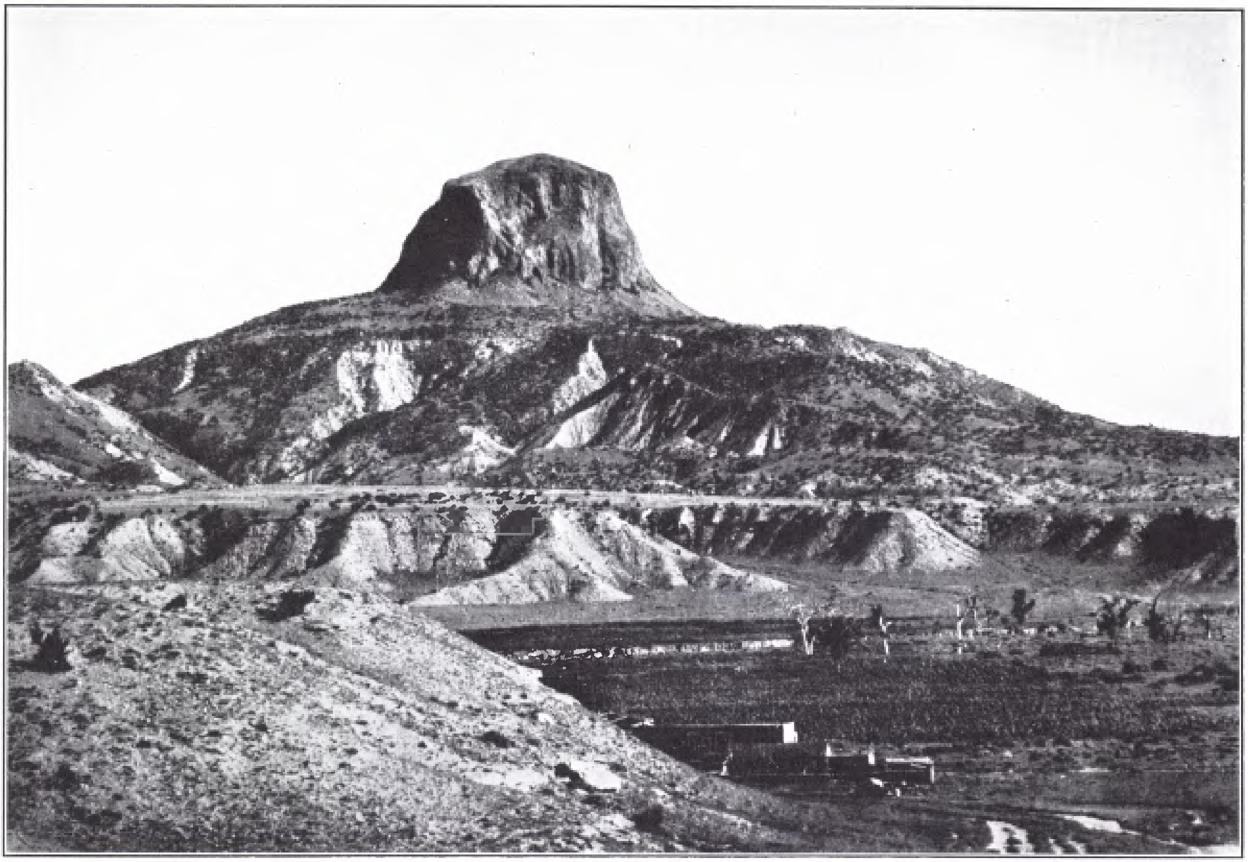

A. CABEZON PEAK VIEWED FROM THE BLUFFS ABOVE THE VILLAGE OF CABEZON.
The peak is a volcanic neck of basalt jointed in nearly vertical columns but capped with highly scoriaceous basalt. Photograph by W. T. Lee.

20 percent of augite, and 5 percent of magnetite. The feldspar is anhedral, with indistinct borders. The olivine is commonly in considerably resorbed or altered phenocrysts. The augite is commonly in small euhedral crystals, but the magnetite is disseminated in slightly larger crystals."

Hunt counted about 50 of the necks. Most are composed of basalt (or andesite) and basaltic breccia, which in turn is composed of fragments of sedimentary rock and basalt in a friable, glassy matrix. The basalt generally is dense and invariably well jointed into columns. The breccia commonly is banded; it occurs in the bases of the larger necks (that is, it is the outer shell, or casing, around the central column of basalt) and may form the entire mass of smaller ones. At nearly every place where breccia is associated with basalt or andesite, the breccia is the older rock.

The Upper Cretaceous sediments through which the volcanic rocks intruded are neither tilted nor metamorphosed; only a minimum of baking took place along the side contacts of the intrusives. It is Hunt's opinion that the igneous material was introduced through a process of progressive stoping. As Hunt (1938) envisaged the process, the first effects upon the sediments as an intrusion worked upward from below them were baking, induration, and fracturing. The fractures were the result of a combination of induration and expansion, steam explosions, and forces brought to bear by the rising column of molten rock. As the column rose, the volatile constituents concentrated at its apex entered the fractures and loosened the breccia to create a churning, plastic, mass. Basalt was then free to rise into the fluid breccia, first as irregular stringers, then as a central column that forced the breccia against the walls of the conduit as it passed. The banding of the breccia is flow structure produced by the dragging action of the basalt column.

Mesa Prieta, about 15 miles east of Mesa Chivato and across the Rio Puerco, is capped by sheets of lava like that upon Mesa Chivato. Dutton was the first to suggest that the Mesa Prieta flows were once continuous with those on the mesas to the west, and that the flows originally covering the intervening expanse were derived from vents now represented by the exposed and eroded necks.

In Dutton's words, ". . . . . . the most significant fact is the occurrence of plain evidences that the wide intervals which separate Mount Taylor from the Prieta on the one hand and the southern mesas on the other were once covered with a vast mass of Cretaceous strata, now eroded, and that these strata in turn were overflowed with lavas. Whether the volcanic sheets were of unbroken continuity across these intervals, or whether the denuded areas were only partially overflowed is now uncertain, but the fact is patent that a large expanse of volcanic rocks once covered areas from which they have been denuded, leaving, however, certain remarkable monuments of their former presence." (Dutton, 1885, p. 166).

Basalt dikes, doubtless related to the basaltic sheet eruptives, are prevalent in the volcanic field, and particularly so east of Mount Taylor and Mesa Chivato. All trend north, paralleling the strike of most of the faults in the region; however, only one instance is reported in which a basalt dike intruded along a fault plane. The dikes typically are about 2 feet thick, rarely as thick as 30 feet. They contain both dense, jointed basalt and breccia which bears sedimentary xenoliths. Chilled basalt borders bound many dikes; little or no alteration or deformation of the country rock (again, Cretaceous shale and sandstone) accompanied the intrusions.

Very recent basalt flows (possibly even post-Columbian) that look as though they might in some places still be hot cover the floor of the valley of the Rio San Jose along the south border of the Mount Taylor field. These flows are much younger than any of the Mount Taylor lavas, as can be demonstrated by the fact that they fill topographic lows cut hundreds of feet below the levels of the youngest Mount Taylor flows. Vents near Laguna, near Bluewater, and along the east flank of the Zuni Mountains were the sources of these recent flows.

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