Cretaceous rocks of the Albuquerque country

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CRETACEOUS ROCKS OF THE ALBUQUERQUE COUNTRY

Attempts were made by the Field Conference Committee to obtain for this Guidebook at least two papers dealing with the Cretaceous stratigraphy of the Albuquerque country and a third dealing with the igneous geology of the Mount Taylor volcanic field and particularly its volcanic necks. Because of previous commitments, those approached were unable to prepare the solicited papers. In view of the economic significance of the Cretaceous stratigraphy, authors' abstracts of several published papers are reprinted here.

CHARLES B. HUNT, 1936, GEOLOGY AND FUEL RESOURCES OF THE SOUTHERN PART OF THE SAN JUAN BASIN, NEW MEXICO; PART 2, THE MOUNT TAYLOR COAL FIELD: U. S. GEOL. SURVEY BULL. 860-B, P. 31-80, ILLUS.

ABSTRACT (p. 31-32)

"**The Mount Taylor coal field was studied primarily to determine its coal and other fuel resources. The exposed rocks range in age from Jurassic to Recent. The Jurassic, cropping out only locally, is represented by the Morrison formation, of variegated shale and some sandstone. Its top is marked by an erosional unconformity. The overlying Upper Cretaceous covers most of the area and is represented by three formations—in ascending order the Dakota (?) sandstone, the Mancos shale, and the Mesaverde formation. The Dakota (?) sandstone is a lenticular clastic deposit and is locally absent. The Mancos consists mostly of marine shale; three sandstones found in the lower 350 feet in the area east of Mount Taylor thin out to the northeast. The relations between the Mancos and the next younger formation, the Mesaverde, are complex. In the southern part of the field the Mancos is only 1,000 feet thick and represents only the earlier part of Colorado time (Benton and earliest Niobrara). It is overlain by the predominantly continental, coal-bearing Mesaverde formation, which, however, includes in its lower part two thick zones of marine shale. In passing northward there is a marked and rapid change in the lower part of the Mesaverde; the continental beds and the nearshore sandstones become thinner and less conspicuous, and the two marine shale zones become correspondingly thicker. This transition continues until, at the north edge of the field, the sandstones and continental beds practically disappear and the two shale units merge with the older shale to form an expanded Mancos about 2,000 feet thick. The shale units within the Mesaverde at the south are thus seen to be tongues of the Mancos. In the northern part of the area the Mancos represents all of Colorado time and perhaps earliest Montana time as well. The main body of the Mesaverde continues northeastward as a coal-bearing formation. Late Tertiary clastic deposits are present in the eastern part of the area, and there are recent deposits of alluvium and gravel throughout the area.

"Intense volcanic activity occurred in this area in middle and late Tertiary time, beginning with the eruptions on Mount Taylor. The huge depression covering nearly 4 square miles at the head of Water Canyon and just east of Mount Taylor Peak marks the old crater, now enlarged by erosion. The eruptions began with rhyolitic tuff, followed by a series of porphyritic latite and trachyte, and ended with porphyritic andesite. The eruptions continued until a cone at least 2,000 feet high had been built. However, with the gradual lessening of the activity of Mount Taylor lava was erupted from vents that broke out on the periphery of the old crater. These vents are marked by lava cones and volcanic necks. They surround Mount Taylor but are most numerous northeast of the mountain. None of these later vents seem to have been very long-lived, each supplying one or at most very few sheets of a relatively nonporphyritic andesite or basalt. This later activity was extended far to the north and northeast. The basaltic lava flows in the San Jose Valley, along the south border of this area, and the Albuquerque volcanoes, 10 miles east of this area, are very recent and not directly related to the volcanism on and around Mount Taylor.

"Most of the field lies in the southeastern part of the San Juan Basin where a gentle northward dip generally prevails. However, there are several domes which locally have steep dips and numerous faults. The shallower zones have been tested for petroleum in most of the domes, but no production has yet been obtained. The eastern part of the field lies in the Basin and Range province and has been severely faulted. All the faults, so far as known, are normal and have nearly parallel trends at the surface. The displacements reach a maximum of about 3,500 feet. In general the major faults within this part of the field produce a stepdown to the west. The faulted blocks generally dip east, although the amount of dip has considerable range. The deformation probably began in middle Tertiary time and continued until after the basal beds of the Santa Fe formation had been deposited in the eastern part of the field.

"There is generally a sharp boundary separating the severely faulted eastward-tilted beds in the Basin and Range province and the slightly faulted northward-tilted beds of the San Juan Basin. The boundary lies chiefly along faults that have dropped the areas in the Basin and Range province with respect to those in the San Juan Basin.

"The coal beds of the Mount Taylor field are confined to the Mesaverde formation. The coal is of subbituminous rank, and many beds are present. The usual thickness of the coal beds is about 15 inches, but there are numerous exceptions, and some are as much as 6 feet thick. The lack of good roads over most of the field precludes commercial mining on a large scale at this time. However, the south side of Mount Taylor is near the Atchison, Topeka & Santa Fe Railway and United States Highway 66, and the northeast corner of the field is near a State highway, and several small mines are active in these two localities."

CARLE H. DANE, 1936, GEOLOGY AND FUEL RESOURCES OF THE SOUTHERN PART OF THE SAN JUAN BASIN, NEW MEXICO; PART 3, THE LA VENTANA-CHACRA MESA COAL FIELD: U. S. GEOL. SURVEY BULL. 860-C, P. 81-161, ILLUS.

ABSTRACT (p. 81-82)

"*** The exposed rocks are of Upper Cretaceous and Tertiary age. The Dakota (?) sandstone, at the base of the Upper Cretaceous series, and the overlying Mancos shale, of marine origin, crop out only in the eastern part of the area. Above the Mancos shale lies a varied assemblage of partly marine and partly continental beds, which are included in the Mesaverde formation but differentiated into five members — the marine Hosta sandstone at the base, the Gibson coal member above

it, the Allison member still higher, the marine Chacra sandstone member at the top in the western part of the area, and the marine La Ventana sandstone at the top in the eastern part. The overlying formation, the Lewis shale, is thin where it lies above the Chacra sandstone but increases greatly in thickness eastward by the successive passing of all of the Chacra sandstone and the upper part of the La Ventana sandstone into gray marine shale. Above the Lewis lies the thin Pictured Cliffs sandstone, the highest marine formation of the Upper Cretaceous. The coal-bearing Fruitland formation, the Kirtland shale above it, and the conglomeratic Ojo Alamo sandstone are also included in the Upper Cretaceous series. Above the Ojo Alamo lie rocks of Eocene age—the banded drab clay and light-colored sandstone of the Puerco (?) and Torrejon formations, capped by the conglomeratic sandstone of the Wasatch formation.

"The area lies in the southeastern part of the San Juan Basin, in which the rocks are gently warped into the form of a great shallow bowl about 100 miles in diameter. The structure of the basin is mostly simple, showing low dips toward the center, with irregular low undulations but no pronounced folds. The rocks are broken by some normal faults of small throw. The western flank of the Nacimiento Mountain uplift forms the eastern margin of the basin along the eastern edge of this area, and here the rocks are steeply folded and even overturned toward the basin.

"The coal is of subbituminous rank and of fairly good grade, but the coal beds are very irregular and lenticular. Most of the coal beds are thin, but some beds are from 5 to 9 feet thick. Coal occurs in the Fruitland formation and in the Chacra, Allison, and Gibson members of the Mesaverde formation. Considerable prospecting and some commercial mining has been done on Allison and Gibson coals along the Rio Puerco in the eastern part of the area, where railroad transportation is available."

J. D. SEARS, C. B. HUNT, AND T. A. HENDRICKS, 1941, TRANSGRESSIVE AND REGRESSIVE CRETACEOUS DEPOSITS IN SOUTHERN SAN JUAN BASIN, NEW MEXICO: U. S. GEOL. SURVEY PROF. PAPER 193-F, P. 101-121, ILLUS.

ABSTRACT (p. 101)

"In explanation of the large-scale intertonguing of marine and continental deposits shown by the Mancos shale and the Mesaverde formation in the southern part of the San Juan Basin, New Mexico, and of the marked variations in the stratigraphic boundary between those formations, the paper offers views as to sedimentation processes that are believed not only to account for the features observed in this field but also to be applicable in the interpretation of similar deposits in many other fields. Three successive series of beds, each comprising a sequence of marine, near-shore, coastal, flood-plain, coastal, near-shore, and marine deposits, are evidence of three transgressions and regressions of the Upper Cretaceous sea. The writers have endeavored to visualize the conditions and processes of land and sea movement and of sedimentation that would bring about such repeated transgressions and regressions and the deposition and preservation of materials in such sequences.

"The paper is divided into three sections: First, a presentation of the depositional concept held by the writers, with reasons for its adoption; second, a description of the nature, relations, and variations of the Mancos and Mesaverde in the southern part of the San Juan Basin; and third, an outline of the inferred depositional history of these formations.

"According to the concept presented, deposition took place in a broad, shallow trough or geosyncline, the middle, deeper part of which was occupied by a shallow sea, which at times spread over the adjacent lowlands and at times withdrew to the middle zone. Those transgressions and regressions of the sea are recorded in the alternations of marine and continental deposits around the margins of the trough. The writers accept the usual view that the advances of the sea and the development of transgressive deposits were brought about by a sinking of the trough. They do not, however, accept as applicable in this and similar cases the frequently expressed view that retreats of the sea and the development of regressive deposits were brought about by a reversal of the movement—that is, by a rising of the trough. Instead, they believe that both the regressions and the regressive deposits were due to a process of trough filling that operated during periods when the rate of sinking of the trough was much reduced and when the supply of debris was sufficient to build the near-shore deposits upward to and above the water surface and also outward, thus forcing the sea to retreat. As the result of continued, though slower, subsidence there was room beneath the profile of equilibrium for the quiet, conformable deposition of thick near-shore sands upon the older off-shore muds without erosion of the older material through wave action. This is shown by the widespread occurrence of transition zones between shale and overlying regressive sandstone, and by the extent, thickness, and uniformity of such sandstones. With continued subsidence there would also be opportunity for the development of thick coal-bearing coastal-swamp deposits behind and encroaching upon the beach sands as the sands grew upward and seaward. On the contrary, a reversal of movement with rise of the trough would bring at least a part of the previous transgressive deposits up into the zone of subaerial and subaqueous erosion and would almost surely not permit thick and widespread regressive deposits to be laid down on them and preserved. Moreover, in a broad structural downfold or trough, the natural tendency of further epeirogenic movement would be in a continuous downward direction, and frequently repeated reversals or up-and-down movements of the trough would appear to be so unlikely that they should not be postulated unless unmistakably required by evidence in the rocks.

"In the southwestern part of the San Juan Basin, near Gallup, the Mancos shale is 725 feet thick and consists principally of more or less sandy shale with several subordinate sandstones. Overlying it is about 1,800 feet of the Mesaverde; the upper part of the formation has been removed by erosion. The Mesaverde comprises sandstones, clays, and coal beds, and is predominantly of continental origin. In this area it has been divided into five units, named in ascending order the Gallup sandstone member, the Dilco coal member, the Bartlett barren member, the Gibson coal member, and the Allison barren member. From the vicinity of Gallup eastward across the southern edge of the basin the lower thousand feet of the Mesaverde (representing the units from the Gallup sandstone member to the Gibson coal member, inclusive) show great progressive changes. At first, two new massive sandstones appear in the section; of these, the Dalton replaces the upper part of the Dilco coal member, and the Hosta splits the Gibson coal member into two parts. Moreover, the lower third of the Gallup is divided and in part replaced by wedges of

Mancos shale. Farther east, a tongue of shale, the Mulatto, comes in between the Dilco and the Dalton, and a higher tongue of shale, the Satan, splits the Hosta sandstone member. These two shale tongues thicken steadily eastward. Concurrently, the intervening units of the Mesaverde grow thinner, and some die out; in the southeastern part of the basin even their most persistent layers, two thin sandstones that represent, respectively, the Gallup and a union of the Dalton and lower Hosta, become nothing more than sandy zones in the midst of a great body of shale about 2,000 feet thick. That shale body, a union of the thin Mancos farther west with the greatly expanded Mulatto and Satan tongues, forms the Mancos of the southeastern and eastern parts of the basin. It is directly overlain by the upper part of the Hosta sandstone, which in that part of the field marks the base of the restricted Mesaverde. Thus the Mancos-Mesaverde boundary rises stratigraphically about 1,200 feet in a distance of 100 miles from west to east—a direction that is basinward but oblique to the trends of the ancient shore lines.

"The depositional history of the three transgressive and three regressive stages that are recorded in the rocks of the Mancos and Mesaverde is outlined in the concluding section of the paper, in accordance with the general concept of depositional processes herein presented."

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There have been a number of revisions in the nomenclature since the last paper was published. Field conferences held by the New Mexico Geological Society in 1950, 1951, 1953, and 1959 passed through parts of the Albuquerque country and the guidebooks prepared for these conferences contain papers dealing with Cretaceous stratigraphy. Most such papers include selected bibliographies, and thus are highly useful as a starting point for bibliographic research.

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NOTE ON CRETACEOUS FOSSILS BY EDITOR

Cretaceous rocks are exposed over extensive areas in the northern half of the State. At first, continental sedimentation predominated; this was followed by marine sedimentation and then alternating marine and continental sedimentation; finally, the seas withdrew from New Mexico and continental sedimentation prevailed.

Fossils of Cretaceous (predominantly Upper Cretaceous) age may be collected at a number of localities in the Albuquerque country, notably (1) in the Rio Puerco valley west of Albuquerque—all the way from Cuba and La Ventana southward to Correo, Suwanee, and the vicinity of Mount Taylor—and (2) in smaller areas east of the Rio Grande—such as the Tijeras coal basin, the Hagan-Tonque basin, and in the vicinity of Madrid and Cerrillos.

Marine strata yield abundant fossils, including oysters such as **Ostrea soleniscus**, as much as 24 inches in length; clams such as **Inoceramus**, nearly as large; snails; coiled ammonites 15 to 20 inches in diameter; and shark teeth of both flesh-cutting and shell-crushing types. Other groups of organisms, such as corals, brachiopods, scaphopods, worms, echinoids, and asteroids, are rare. Foraminifers are common but because of their small size not conspicuous.

The continental deposits of rivers, deltas, lakes, and swamps yield abundant leaves and silicified wood; land animals such as dinosaurs; and fresh-water clams, snails, fishes, turtles, and crocodiles. (Large septarian concretions are often mistaken by the uninitiated for fossil turtles!) Interesting specimens have been found in the Rio Puerco valley of logs riddled by the burrows of **Teredo**, the boring pelecypod, whose living descendants are known as "shipworms."

Relatively few reports have been published describing and illustrating these Cretaceous fossils, and, what is still more unfortunate, the reports are mostly from earlier years and now out-of-print.

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