

3d. That the Cretaceous from the beginning was a lignite-producing period,

4th. That the fauna, whenever of a character to be compared with known standards is Cretaceous, even to the top of the series,

5th. That the hypothesis that this group or any portion of it is Tertiary is unsupported by definite evidence,

I am compelled to regard the Great Lignitic Group as Cretaceous, simply a renewal of the conditions marking the period of the Dakota Group.

ON THE REMAINS OF POPULATION OBSERVED ON AND
NEAR THE EOCENE PLATEAU OF NORTH-
WESTERN NEW MEXICO.

BY E. D. COPE.

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While encamped on the Gallinas Creek, at the point where it issues from the Sierra Madre, with the party detailed by Lieut. Wheeler for purposes of geological exploration, I occupied intervals of time in the examination of the traces left by the former inhabitants of this portion of New Mexico.

Had time permitted, the exploration of these remains might have been much extended, but under the circumstances a mere beginning was made. The observations show that the country of the Gallinas, and the Eocene plateau to the west of it, were once occupied by a numerous population. Now, there are no human residents in the region, and it is only traversed by bands of the Apache, Navajoe, and Ute Tribes of Indians. The indications of this ancient population consist of ruined buildings, pottery, flint implements, and human bones. Broken vessels of baked clay are frequently found, and the fragments occur in all kinds of situations throughout the country. They are usually most easily discovered on the slopes of the hills and hog-backs of Cretaceous and Tertiary age, and where abundant, generally lead to a ruined building standing on the elevation alone.

The hog-back ridges which I have described in my geological report, extend in a general north and south direction on the western side of the Sierra Madre, south of Tierra Amarilla. They vary from two to four in number, and stand at distances of from half a mile to three miles from the mountain range. The Gallinas Creek flows between two of them near their southern extremities for perhaps fifteen miles. At one point the hog-backs of Cretaceous Nos. 3 and 4 approach near together, and the creek flows near to the foot of the eastern front or escarpment of No. 3. The rock of this ledge is a hard sandstone, and resists erosion hence its outcrop forms continuous sharp ridges, with distant interruptions, which are termed by the Mexicans the Cuchillas or Cristones. The hog-back of No. 4, being composed of softer material, is worn by erosion into a succession of sub-conical eminences.

My attention was first called to the archæology of the region by observing that the conic hills just mentioned, appeared to be in many instances crowned with stone structures, which on examination proved to be ruined buildings. These are round, or square, with rounded angles and from fifteen to twenty-five feet in diameter, and composed of stones of moderate size, which have been roughly dressed or built without dressing into solid but not very closely fitting masonry. The walls remaining measure from ten feet high downwards. The floor inside is basin-shaped, or like a shallow bird's-nest, and frequently supports a growth of sage-brush (*Artemisia*) of the same size and character as that growing on the plains below, and other shrubs. Sometimes they contain piñon trees (*Pinus cembroides*) of one and two feet in diameter, which is the average and full size to which they grow on the adjacent ridges and plateaus. Within and about them, fragments of pottery abound, while flint implements are less common. As these are similar in all the localities examined, they will be subsequently described. A building more or less exactly agreeing with this description, was found on the summit of every hill of a conical form in the vicinity. Their form is probably due to the shape of the hill, as they were differently built on the level hog-backs. None of the circular buildings were found to be divided, nor were any traces of such buildings observed on lower grounds.

The hog-back of Cretaceous No. 3 is, at the locality in question, only one or two hundred yards distant from the eastern crest of the hills just described, from which it is separated stratigraphically by a bed of lignite. At some points this stratum has been removed by atmospheric erosion, leaving a ravine between the hog-backs. Near the middle of a section of the hog-back of No. 3, a portion of this formation remains, forming a narrow causeway, connecting it with the ridge just behind it. The eastern face is a perpendicular wall of sandstone rock, of about three hundred feet in elevation; the western face is the true surface of the stratum, which here dips about 45° to 55° west by north. The top of the ridge varies in width from four to eleven feet.

In riding past the foot of the precipice, I observed what appeared to be stone walls crowning its summit. Examination of the ridge disclosed the fact that a village forming a single line of thirty-two houses extended along its narrow crest, twenty-two of them being south of the causeway and ten north of it. The most southern in situation is at some distance from the southern extremity of the hog-back. I selected it as a position from which to sketch the country to the south and west; see figures 16 and 17 of the geological report. It is built on the western slope of the rock; a wall of twelve feet in height supporting it on that side, while the narrow ledge forming the summit of the ridge is its back wall. It is square, 3.355 metres on a side, and has a floor leveled with earth and stones. Two stout cedar posts probably once supported the roof; their stumps remain well cracked and weathered. Bushes of sage, similar in size to that of the surrounding plain, are growing within the walls. The

second house is immediately adjoining, and is surrounded by an independent wall, that on the lower side of the ridge being still twelve feet in height. The length of the enclosure is 4.69 metres, and the width 2.68 metres ; full sized scrub-oak and sage-brush are growing in it. The stumps of two cedar posts remain, one five, the other eight inches in diameter. The third house adjoins No. 2, but is surrounded by a distinct wall, except at the back or side next the precipice, where a ledge of rock, completes the enclosure. The latter is 4.02 metres long ; it contains a scrub-oak of three inches diameter, which is an average size for the tree.

Beyond these ruins is an interval of sixty-nine metres, where the summit of the rock is narrow and smooth, and the dip on the west side 55° . The walls of an oval building follow (fig. 1), which enclose a space of 4.69 metres. They are two to two and a-half feet in thickness and stand eight feet high on the western side ; the eastern wall stands on the sheer edge of the precipice. A building adjoins, with the dividing wall common to the preceding house. Its east and west walls stand on parallel ledges of the sandstone strata, whose strike does not exactly coincide with the axis of the hog-back. Diameter of this enclosure 5.37 metres. A space of 15.4 metres follows with precipices on both sides when we reach house No. 6. The eastern wall stands five feet high on the summit of the precipice, from which a stone might be dropped to the ground perhaps three hundred and fifty feet below, only eight feet of the western wall remained at the time of my examination. The enclosure is 6.04 metres long, and not quite so wide, and is divided transversely by a wall which cuts off less than one-third the length of the apartment. In one of the opposite corners of the larger room is the stump of a cedar post five inches in diameter. This house can only be reached by climbing over narrow ledges and steep faces of rock. House No. 7, follows an interval of 42.30 metres. Its foundation wall encloses an irregular square space 4.70 metres long and 3.69 metres wide ; it is eleven feet high on the western side, and very regularly built, and well preserved ; on the east side it is eight feet high, and is interrupted by a doorway of regular form. From this a narrow fissure offers a precarious hold for descent for a considerable distance down the face of the precipice, but whether passable to the bottom I could not ascertain.

The crest of the ridge is without houses for 52.34 metres further ; then a building follows whose enclosed space is an irregular circle of 4.70 metres diameter. A transverse summit-ledge forms its southern wall, but the remaining portion is remarkably massive, measuring three feet in thickness. Its western wall is twelve feet high, and contains many huge stones, which four or five men could not lift unaided by machinery.

Several scrub-oaks, of three inches in diameter grow in this chamber, and stumps of the cedar posts that supported the roof remain. Here follows a row of ten similar ruined houses, measuring from 3.35 to 6.24 metres in length. Of these, No. 13 is remarkable for containing a scrub-oak of thirteen inches in diameter, the largest that I have

seen in the country, and the species is an abundant one. In No. 14, the remaining part of the western wall is fifteen feet in height. There was a good deal of pottery lying on the western slope of the rock, but of flint implements and chips, I found but few. All of these ruins contain full-grown sage-bushes. No. 18 is the largest ruin; the length of its enclosure is 8.62 metres, and the width 6.71 metres; its west wall is six feet high; the floor is overgrown with sage of the largest size. This building stood 51 metres from No. 17; 12.80 metres northward, the ridge descends slightly to the level of the causeway already mentioned. Here are five more ruined buildings of the same average size as the others, interrupted by but one short interval.

From this depression, that part of the hog-back which is north of the causeway rises abruptly in a perpendicular face. It is composed principally of two layers of the sandstone dipping at 45° W. which are separated by a deep cavity from a point fifteen feet from the base upwards. This niche has been appropriated for a habitation, for it is walled across to a height of six feet from its base. The foot of the wall is quite inaccessible, but by climbing round the eastern face of the precipice, a ledge is found at the base of the projecting stratum which forms the east wall of the enclosure. This was scaled by means of a staircase of stones, a number of which were in position at the time of my visit. The remaining portion of the hog-back is elevated and smooth, and the foundation stones only of several houses remain. One of these contains two stout posts of which four feet remain above ground; the last is near the end of the ridge, and is bounded by a wall of ten feet in height which forms its western side.

The walls of these houses are built with a mortar of mud, mixed in many cases at least with ashes, judging from the abundant specks of charcoal which it contains. It is not of good quality, and has weathered much from between the stones. I could not discover any indication of burning of the houses by fire, either on the stones or the cedar posts. The latter doubtless lost, by weathering, such indications had they existed, and the combustion of the entire contents of such small edifices could have affected their stone walls but little. I found no remains of bones of animals or men about them.

This town I called Cristone. The same hog-back recommences a little more than a mile to the north, rising to a greater elevation, say six or seven hundred feet above the valley. The east side is perpendicular, while the dip of the west side is 60° , and sometimes even a higher angle. On this almost inaccessible crest, I could see from the valley the walls of ruined stone buildings such as I have described, but unfortunately my limited time prevented me from making a detailed examination of them. In the opposite direction, I observed a similar ruin on an outlying hill adjacent to the southern portion of the southern hog-back. This one is of larger size than any of the others; but I was unable to visit it.

The position of these buildings is susceptible of the same explanation

as that of the still inhabited Moquis villages of Arizona, so interestingly described by Lieutenant Ives in his report on his survey of the Rio Colorado of the West, and of the route from its cañon to Sante Fé. They were doubtless perched on these high eminences for purposes of defense, and they were conveniently located near a perennial stream, which permitted them to carry on a system of agriculture, no doubt similar to that now practiced by the Moquis. The inhabitants of Cristone felt, however, one disadvantage not known to the Moquis; they were, so far as present indications go, without water on their elevated rocks, but were dependent for their supply on the Gallinas Creek. I found no indications of cisterns which should furnish such supply in time of siege, although they doubtless could depend for a considerable length of time on rain-water which they caught and preserved in the many vessels of pottery whose fragments are now so numerous about the ruins.

At this point the bluffs of the Eocene bad-lands are from nine to ten miles from the Gallinas Creek. Here also the slopes are in places covered with broken pottery, and on the summit of some of the less elevated buttes, circular walls indicate the former existence of buildings similar to those crowning the conical hills along the creek. The latter contains the nearest water to these ruins. In other localities ruined stone buildings occupy the flat summits of mesa hills of the bad-lands, often in very elevated and well-defended positions. It was a common case that the erosion of the faces of these bluffs had undermined the foundation of the houses, so that their wall stones, with the posts were mingled with the pottery on the talus below. At one point, foundation walls stand on an isthmus connecting a butte with the mesa, of which a width of twenty feet remains, but which is furrowed with water channels. Here Eocene fossils and crockery, including a narrow-necked jug, were confusedly mixed together. At another point the narrow summit of a butte of nearly two hundred feet elevation is covered with remnants of stone buildings which extend for a length of two hundred yards. The greater part of them had been undermined, and the stones were lying in quantities on talus at the time of my visit. At one end of the line, the bases of two rectangular walls, perhaps of towers, appeared to have been placed as supports to the terrace. Very dry cedar posts occur among the ruins, and three such, standing upright on the summit of the butte, mark a spot as yet unaffected by the disintegration of the cliff. In another portion of the ruins, a row of large earthenware pots was found buried in the earth; the slow moving change of level of the marl had already fractured them. At another locality I took from a confused mass of ruins, the temporal bone of an adult person, the ilium of a child, ribs and other bones. At a remote portion of the ruins on a remaining ledge, I found a square enclosure formed of stones set on edge, three stones forming each half of the enclosure. I excavated this for the depth of a foot, without finding any indication of its use. In some of these localities, I found chips, arrow-heads, and thin knives of chalcedony, with similar implements of obsi-

dian. The obsidian knives are similar to those which I have seen as commonly found in Mexico.

At the head of the Cañoncita das Heguas there are numerous low hills of the Eocene marl, covered with piñon forests of adult trees. On a low slope of one of these, I found the burial place of one of the inhabitants, as indicated by his bones, and trinkets doubtless buried with him. His tibia was a marked example of the platycnemic type. Close to them were some good quartz crystals, of course intruded in such a formation, a piece of *chalchuiltl*, an apparently transported scaphite, some implements of obsidian, flint, etc., and a single perfect lower molar of a large mammal of the genus *Bathmodon*, attached to a piece of the jaw, which looked as though the ancient proprietor had not been ignorant of the peculiar products of the neighboring bluffs.

In traversing the high and dry Eocene plateau west of the bad-land bluffs, I noticed the occurrence of crockery on the denuded hills for a distance of many miles. Some of these localities are fifteen and twenty miles from the edge of the plateau, and at least twenty-five miles from the Gallinas Creek, the nearest permanent water. In some of these localities the summits of the hills had been eroded to a narrow keel, destroying the foundations of the former buildings.

In no locality did I observe inscriptions on the rocks or other objects, which were probably the work of the builders of these stone towers; but I give a copy of figures which I found on the side of a ravine near to Abiquiu, on the river Chama. They are cut in Jurassic sandstone of medium hardness, and are quite worn, and overgrown with the small lichen which is abundant on the face of the rock. I know nothing respecting their origin.

It is evident that the region of the Gallinas was once as thickly inhabited as are now the more densely populated portions of the Eastern States. The number of buildings in a square mile of that region, is equal to, if not greater than the number now existing in the more densely populated rural districts of Pennsylvania and New Jersey. Whether this is the case to the south and west, I do not know, as I was unable to devote the necessary time to the examination. I found, however, that without investigation, it is very easy to pass the ruins by unnoticed, since their elevated position, ruinous condition, and concealment by vegetation, render them almost invisible to the passing traveler. In general, I may say that the number of ruins I found, was in direct proportion to the attention I gave the matter; where I looked for them I invariably found them in suitable situations.

Perhaps the most remarkable fact in connection with these ruins is the remoteness of a large proportion of them from water. They occur everywhere in the bad-lands to a distance of twenty-five miles from any terrestrial source of supply. The climatic character of the country then has either undergone material change, or the mode of securing and preserving a supply of water employed by these people, differed from any known to us at the present time. I found no traces of cisterns, and the

only water holders observed were the earthenware pots buried in the ground, which did not exceed eighteen inches in diameter. There is, however, no doubt that these people manufactured great numbers of these narrow-necked globular vessels, whose principal use must have been the holding of fluids, and chiefly of water. Nevertheless, it is scarcely conceivable that the inhabitants of the houses now so remote from water, could have subsisted under the present conditions. Professor Newberry (Ives' Report) is of the opinion that a diminution in the amount of rain-fall over this region has taken place at no very remote period in the past, and cites the death of forests of pine trees which still stand, as probably due to increasing drought. It is of course evident, that erosive agencies were once much more active in these regions than at present, as the numerous and vast cañons testify, but that any change sufficient to affect this process should have occurred in the human period, seems highly improbable. In other words, the process of cutting cañons of such depth in rocks of such hardness is so slow, that its early stages which were associated with a different distribution of surface water supply, must have far antedated the human period.

Nevertheless, if we yield to the supposition that during the period of residence of the ancient inhabitants the water supply from rains was greater than now, what evidence do we possess which bears on the age of that period? There is no difference between the vegetation found growing in these buildings, and that of the surrounding hills and valleys; the pines and sage-brush are of the same size, and to all appearances of the same age. I should suppose them to be contemporary in every respect. In the next place, the bad-lands have undergone a definite amount of atmospheric erosion since the occupancy of the houses which stand on their summits. The rate of this erosion under present atmospheric influences is undoubtedly very slow. The only means which suggested itself as available at the time, was the calculation of the age of pine trees which grow near the base of the bluffs. These have, of course, attained their present size since the removal of the front of the stratum from the position which the trees now occupy, so that the age of the latter represents at least the time required for the erosion to have removed the bluff to its present position. But how much time elapsed between the uncovering of the position now occupied by the tree and its germination, there is, of course, no means of ascertaining. My assistant, an educated and exact man, counted the rings in a cut he made into the side of a piñon (*Pinus cembroides*) which stood at a distance of forty feet from a bluff, not far from a locality of ruins. In a quarter of an inch of solid wood he found sixteen concentric layers, or sixty-four to an inch. The tree was probably twenty inches in diameter, which gives six hundred and forty annual growths. The piñon is a small species, hence the closeness of the rings in an old tree.

At present it is only possible to speculate on the history of the builders of these houses, and the date of their extinction. The tribes of Indians at present inhabiting the region at irregular intervals, can give no account

of them. But it is not necessary to suppose that the ruin of this population occurred at a very remote past. On the Rio Chaco, not more than thirty miles from the Alto dos Utahs, are the ruins of the seven cities of Cibolla, the largest of which is called Hungo Pavie. These have been described by General Simpson,* who shows that each of the towns consisted of a huge communal house, which could have accommodated from 1500 to 3000 persons. Their character appears to have been similar to that of the existing Moqui villages. The "cities of Cibolla" were visited by the marauding expedition of Coronado, in 1540, which captured them to add to the vice-royalty of Mexico. In his letter to Mendoza, the viceroy, Coronado, states that the inhabitants on the fourth day after the capture "set in order all their goods and substance, their women and children, and fled to the hills, leaving their town as it were abandoned, wherein remained very few of them." There can be no doubt that the Eocene plateau and hog-backs of the Gallinas offer hills of the greatest elevation in the entire region, and it is highly probable if the account quoted be correct, that some at least of the exiled Cibollians found a refuge in this region, and may have been the builders of Cristone. This would place the age of the ruins described, at three hundred and thirty-five years. Of course, it is possible that they represent villages contemporary with and tributary to the seven cities.

The inhabitants of the rock-houses of the Gallinas, necessarily abandoned the communal type of building generally employed by their race, and appear only to have considered the capacities of their dwellings for defense. Yet the perils of life in Cristone, due to the location alone, must have been considerable. Infant sports must have been restricted to within doors, and cool heads were requisite in adults to avoid the fatal consequences of a slip or fall. Intoxication must have been rare in Cristone. There is no trace of metal in any of the ruins of the Gallinas, and it is evident that the inhabitants were acquainted with the use of stone implements only, as was the case with the builders of Central America. I have already alluded to their pottery. It is usually of a bluish-ash color, but is occasionally black, brown, and more rarely red. It is never glazed, but the more common kind is nicely smoothed so as to reflect a little light. This pottery is ornamented with figures in black paint, which are in lines decussating or at right angles, or enclosing triangular or square spaces; sometimes colored and uncolored angular areas form a checker-board pattern. The coarser kinds exhibit sculpture of the clay instead of painting. The surface is thrown into lines of alternating projections and pits, by the use of an obtuse stick, or the finger nail; or it is thrown into imbricating layers by cutting obliquely with a sharp flint knife. Thus the patterns of the ornamentation were varied according to the taste of the manufacturer, although the facilities at their disposal were few.

With these observations, I close this sketch of a glimpse at one locality of the earliest civilization known on the American continent.

* Report of St. Jas. H. Simpson, of an expedition in the Navajoe Country in 1849. Ex. Doc. 1st Sess. 31st Congress.



Cope, E. D. 1875. "On the Remains of Population Observed on and near the Eocene Plateau of North-Western New Mexico." *Proceedings of the American Philosophical Society held at Philadelphia for promoting useful knowledge* 14(95), 475–482.

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