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THE MIOCENE GROUP OF ALABAMA.[1]

BY LAWRENCE C. JOHNSON.

FIVE or six years ago it was doubtful if the Gulf States had any well-defined Miocene. The brilliant discoveries of Mr. D. W. Langdon, at Chattahoochee and at Alum Bluff on the Apalachicola, set that question at rest for Florida; still there was general doubt of any extension of the same into Alabama.

Dr. Eug. W. Hilgard had defined and located the Grand-Gulf Group in Mississippi, and conjectured it might be Miocene. But he was not perfectly satisfied, and for want of fossils no paleontologist would undertake a decision. This also it would have been bold a few years ago to say had any continuation into Alabama.

Whilst at work for the U. S. Geol. Survey (1889), the Grand Gulf was explored, to a considerable extent, in Louisiana, Mississippi, and Alabama.

Dr. Hilgard, for Mississippi, divided it lithologically into two phases: the first well seen at Grand Gulf, in which quartzites prevail; the second, most abundant, has the peculiar, characteristic silicious clay-stones, found in such masses nowhere outside of this group.

It was the fortune of the writer to observe two other phases in Mississippi:

(1) The quartzitic phase — being only a phase of the next — roughly estimated, extends from the north-west corner of the formation on Big Black River, to a curved line drawn across from Rodney to Pelahatchie. It is most largely developed on Bayou Pierre and Cole's Creek. For convenience it may be called the "Bayou Pierre Phase."

(2) The second, having very irregular boundaries, may have its southern line drawn from Tunica, in Louisiana, by Columbia, Miss., by the mouth of Okatoma Creek, by the Falls on Leaf River near Estabuchie, passing to the southward of Ellisville and crossing Chickasawhay River between Winchester and Waynesboro. For convenience this division will be called the Fort Adams, or the Ellisville phase.

(3) More remote from the Great River, and southing farther, the less silicious the formation becomes, at Hattiesburg, and on that part of Leaf River from Okatoma to Rogers' Creek, and on Chickasawhay above Leakesville, a third phase is exhibited, abounding in phytogene remains — almost lignitic. This is the Hattiesburg phase or formation.

(4) A fourth manifests itself below Leakesville on the Chickasawhay, on the Lower Leaf River and Pascagoula — being clays of a more tenaceous quality — abounding in specks and nodules of calcareous material, and in a few places holding shells of mollusks. One locality of the last, where first discovered, is the Shell Landing below Roberts' Bluff, four miles south-west of Vernal postoffice. This is the Pascagoula phase or formation.

The last three extend into Alabama, though the fourth lies so deep under the great ridge of sands of Mobile County that no overland outcrop has yet been discovered. In the deep boring at Mobile it was reached at about 600 feet. The shells of the boring have been pronounced by Dr. Dall identical with those of Pascagoula, and a list of them furnished by him in this journal, Sept. 16, 1892.

The second and third phases have been traced across Alabama. The second is finely developed at Healing Springs, in the northern part of Washington County. Briar Creek is about the boundary between it and the Eocene, and southward of that it is frequently exposed by the washing away of the surface sands, as far as the head-waters of Bilbo Creek.

The southern part of Washington is underlaid by the Hattiesburg — the third phase. Many of the shallow ponds and cold clay flats are to be accounted for by this fact; and so are the ridges of better soil. Lignitic spots, coming to the surface where drainage is sufficient, have weathered into limited areas of better soil. Such a spot is on the southern branches of Basset Creek, on the St. Stephens and State Line road.

Baldwin and Escambia counties afford a continuation of these parallel lines of silicious clay-stones, of ponds, and of cold clay flats — not without places of better soil. This is the true origin of the well-known strip of red lands on the high ridges northward of Williams and Canoe stations — up West Escambia.

Finally, in the vicinity of Brewton, Burnt Corn, Murder Creek, and Conecuh River, expose sufficient of these three older phases of the Grand Gulf as to leave no doubt with regard to the horizon to which it properly belongs.

Chalk Hill, at N. B. Dixon's (Sec. 1, T. 2, N. of R., 13 E), is a repetition of Chalk Hill at Healing Springs, while the hills near Castleberry on Murder Creek (Sec. 1, T. 2, N. of R., 10 E.), and the exposures on Conecuh at Silas Bluff (Sec. 6 and 7, T. 1, N. R., 12 E.), at Coal Bluff (Sec. 7, T. 1, N. R., 11 E.), and at Roberts, Silas Creek (Sec. 5, T. 1, R. 12 E.) display the Hattiesburg phytogene phase as fairly as Augusta on Leaf River,— with the addition of molluscan fossils not found in Mississippi. These are only in casts, true: because the clay-sandy material, without lime, was too porous to retain calcareous shells.

Of the precise type and horizon of these fossils we are not left in doubt; but to marshal our testimony on the subject, it will be necessary to step across the line, and to bring forward by continuity the Miocene Marls of Florida, to wed these Grand-Gulf clays of Escambia.

II. Wakulla Springs, in the county of the same name, has a peculiar limestone, which is found from St. Mark's Bay into Georgia. Generally fossils are few. The great coral, *Astræa Floridana* or *belea*, and *Orbitolites Floridana*, ever present in these warm sea-formations, are among them. In the deep excavation at Weelaunee, Jefferson County, and the Bloxham well near Tallahassee, fossils are more numerous and of greater variety.

On the Chattahoochee River, at Rock Island, between Port Jackson and the mouth of Flint River, the Wakulla rocks again manifest themselves, and upon the Eocene Vicksburg limestones of Jackson County. Below the mouth of Flint, at the village Chattahoochee, and forming the left bank of the Apalachicola to Aspalaga landing — ten miles — is another phase of the older Miocene.

On Chipola River, at and above Chipola postoffice, is another phase of the older Miocene — the Chipola beds. These lie in and upon the Chattahoochee more silicious form, in which the fossils are very obscure. In the more calcareous ferruginous deposits of Chipola, Farley Creek, and Ten-mile Creek, they are the best preserved in the world. Even the Orbitolites are perfect, instead of a mere impression. Neither of these formations can be said to cross the Choctawhatchee River, westward. The obscurely fossiliferous sandy rocks of Econfina, and at Douglas Ferry on the Choctawhatchee, may be assigned to the Chattahoochee. But west of that great river the territory which should be occu-

[1] Recent investigations made by Lawrence C. Johnson, for the Geological Survey of Alabama, published in advance of the General Report, by permission of Dr. Eug. A. Smith, the Director.

pied by the older Miocene, is usurped by a long synclinal valley, which is overwhelmed by deep sands. Upon the maps this syncline is easily followed by Sandy Creek and the upper waters of Shoal River. From the bend of the latter the syncline crosses to the Yellow River and takes the whole valley of Black-water north of Otaheite.

The great roll, or anticline, forming the southern and western limits of this syncline, may be easily followed westward from Alum Bluff, by Abes Spring — crossing Choctawhatchee at Knox Hill — and forms the high ridge upon which Defuniak is located. It is cut through by Shoal River at the high hills or bluffs between the Wise Bridge and Christmas Bluff, and by Yellow River at Hickman Bluff, above the railroad, and subsiding below the same southward to Daw's Bluff and northward to Oak Grove, whence fifteen or twenty miles of the river is in the trough of the syncline, the very region where the older Miocene should be found, if continued west of Econfina River.

Walton County, West Florida, is traversed by some considerable streams, which have removed in places the superficial Orange Sands, and cut deep into fossiliferous beds, on Yellow River, Shoal River (lower part), Alaqua, and Blairs Creek or Euchee.

Christmas Bluff — an almost inaccessible locality in the vicinity of Taylor's Mill, to the north of Mossy Head, is perhaps the best for the amount of the exposure — there being sixty feet from the water to the Orange Sand of the ridge above — twenty feet of the top being calcareous and full of the finest shells. The lower forty feet of the bluff seem to be without fossils, at least none were discovered at the brief visit of 1889. The compact sands of this lower part of the bluff strongly resembled those at the base of Silas Bluff on Conecuh River, and still more the sands at the head of Ten-mile Creek, and on Econfina in Calhoun County, Fla. In the last, however, were impressions of fossils, which connected it with the Chattahoochee Formation.

At no one of the many localities exposing fossils could all the phases of these formations be seen. Alum Bluff comes the nearest to this requirement; yet it is best to study them where more widely parted and where each may have scope for a grander display.

Such typical localities may be found on the two neighboring creeks, Alaqua and Euchee, south of and very near to Defuniak Springs.

The phase seen near Euchee Ana consists of a sandy ferruginous clay, calcareous in spots, having innumerable shells and casts of the small *Mactra congesta*, mixed with or finished off at the top with a good deal of silicified wood and lignitic matter. This is the counterpart of the topmost layers at Alum Bluff and of the lowest bluff at Abes Spring on Chipola.

The Alaqua phase, on the other hand, has the larger shells — *Conchs Cardiums, Arcas, Pectunculus*, etc., in good variety, and a fine state of preservation. This is the formation of the upper bluffs at Abes Spring. In fact, Chipola River affords the finest opportunity for the study of all the phases of the Miocene with exception perhaps of the Wakulla rocks. There is at the Abe Spring lowest bluff more than 100 feet longitudinally of the Euchee phase, above that more than a mile of the Alaqua phase, culminating in a 60-foot bluff at the Darling Slide, and above that for eight miles are the Red Ortholax beds, and gray allied calcareous sands up to "Look and Trimble" shoals of the more indurated Chattahoochee form.

The Alaqua phase the writer learned from Mr. N. H. Darton, whom he met in Florida soon after the discovery, to regard as equivalent to his Chesapeake. The more complete studies of Dr. W. H. Dall, it appears, led him later to the same conclusion.

The younger Miocene, of the Alaqua type at least, is perfectly and largely developed on the bluffs of Yellow River, from the Alabama line to Milligen in Florida, the most northern of these beds being the low shell landing at Oak Grove, six miles south of the line.

Twenty miles north-west of Oak Grove, and across the deep sands of the synclinal valley of Black Water, the great anticlinal roll reaches Conecuh River. At Roberts, on the head of Silas Creek, the bluff washed out by the waste-way of the mill is filled with casts of the same Alaqua fossils. The clay and wood and lignitic matter of the upper part of this wash-out bluff seem identical with Coal Bluff, six miles to the south-west. No fossils are found at the Silas Bluff, though so near; and there is no reason to doubt that the lower strata of Silas are identical with the outcrop at Dixon's Chalk Hill, six miles further north, and 100 feet higher hypsometrically, — that is the same as the older underlying Grand Gulf quartzitic clays and rocks, — neither should it be doubted that these are equivalent to the calcareous clays of the Chattahoochee formation — in time. That these in precise mode and form did not pass this far west is in perfect harmony and accord with the geological history of the region.

III. In time of the older Miocene, all of Florida above water was an archipelago of small Eocene islands, located where now are the counties Suwanee, Fayette, Columbia, Alachua, Levy, Marion, Hernando, Citeus, Pasco, and Sumter, — or rather parts of them, — and there were probably a comparatively deep strait and strong current between them and the Eocene rocks of the same age in Georgia. Dr. Dall has shown by the fossils that this channel of the older Miocene period was a warm-water sea.

In this warm-water channel was laid the Wakulla rocks of the county of that name, of Jefferson, of Leon, and of Jackson, underlying the Chattahoochee beds.

Now observe upon a map how the Eocene of Jackson and Holmes extends southward to Orange Hill in Washington County, which rises boldly above the waters of the low country a height of some 200 feet. In Miocene time this must have been a notable promontory, jutting out into the shallow seas. It is not probable that the warm currents of the great bight of Georgia, either at ebb or flow, had much force to the westward of Orange Cape, and the cold waters of the Mississippi embayment, as reasoned by the same authority, reinforced by the rivers of Alabama, creeping along through estuaries, were very unfavorable to molluscan life. For which reasons, when by position and continuity, the rocks of Wakulla and of Chattahoochee shall have been traced westward of Orange Hill, it is not to be expected the fossils of *Weelaumee* and of the Red-beds will be found therein.

There remain now only two other formations, not collated and accounted for — the Pascagoula clays and the Euchee phase of the younger Miocene.

So far as known, the Euchee stops abruptly at Daw's Bluff below Milligen. This part of Santa Rosa County is depressed, whether by subsidence or by denudation does not as yet appear. By position it might be assumed that the Euchee is to the east the equivalent of the Pascagoula of the west. But the fossils are not the same; neither is it probable that the circumstances of genesis were the same in both. Proximity to the Great River rendered the laying down of every phase of the Grand Gulf unique on this continent.

Both the Pascagoula and the Euchee were estuary so far as they agree, and it is possible the small *Mactras* to the east were the representatives of the still less marine Guathodons of the west. It is said the living *Guathodon cyrenoides* of our coast is not at present found east of Mobile Bay, but the writer has found them in Kitchen-middens on Choctawhatchee Bay, in the waters of which they and the oysters are now both said to be wanting. If not exactly equivalent, both these stand in the several regions to which they belong as the youngest known formations of this Miocene group.

THE SCIENTIFIC ASPECT OF THE UNIVERSITY SETTLEMENT MOVEMENT.

BY FREDERIC A. C. PERRINE, D.SC., BOSTON, MASS.

OF the social work in our great cities by philanthropists and churchmen, there is undoubtedly a considerable proportion unfortunately carried on in such a casual manner as to afford only pain to one trained in habits of scientific investigation and scientific caution in action. Many charitably-aimed movements have been proven to be the greatest practical failures and, in spite of the high-minded intentions of their progenitors, stand con-