

CHAPTER XIV.

THE TERTIARY GROUP; SERIES XI.

1118. This, from an agricultural point of view, is a very important series of formations. It underlies, as may be seen by reference to the Map, a wide central belt in West Tennessee, which includes within its outcrop a very large portion of the most desirable lands of this section or the State. The geological age of its formations is, as yet, not fully settled. It is not even certain that all of them are Tertiary, though with the data before us, this is the best disposition we can, at present, make of them.

1119. The series includes the following formations, or sub-groups:

11,c. *Bluff Lignite*, (provisional.)

11,b. *Orange Sand*, or *LaGrange Group*.

11,a. *Porter's Creek Group*, (provisional.)

SECTION I.THE PORTER'S CREEK GROUP; FORMATION II,*a*. (*Provisional*.)

1120. I have heretofore included this division in the *Orange Sand*. It may be well, however, to keep it separate, until its age is more satisfactorily ascertained. There is no marked distinction between this and the adjacent groups, except that it contains proportionally much more *laminated or slaty clay*. The clay has the usual characters, contains mica scales, is dark when wet, and whitish gray, when dry. The thickness of the series is, perhaps, 200 or 300 feet. In this are usually several beds of slaty clay from five to fifty feet in thickness. In

Hardeman County, on Porter's Creek,* is a heavy bed, said to be 100 feet thick. I have seen as much as 50 or 60 feet of it exposed.

1121. Along the Memphis and Charleston Railroad, the belt of surface occupied by the group is about eight miles wide. It becomes narrower as we follow it northward. (11a, 11a, on the Map.) The belt appears to be the northern extension of Hilgard's "Flatwoods" region, the group, itself, forming the lower part of his "*Northern Lignitic*."

1122. An interesting section of the beds included in this division, may be seen on the road from Bolivar to Purdy, commencing about seven miles from the former place, and extending to, or beyond Wade's Creek. In this region are alternating beds of *slaty clays*, ("*soap-stones*,") hard, argillaceous *sandy rocks*, *orange sand*, and at some points, *white clays*. The wells of the region are mostly in "soapstone." The sandy rocks above contain casts of shells.

1123. At *Paris*, in Henry County, the following section occurs, the lower part of which, is referred to the Porter's Creek Group:

(6) <i>Soil and Sub-soil</i> at the top of the plateau on which Paris is located.	
(5) <i>Orange Sand</i> ,.....	30 feet.
(4) <i>Light Yellow Sand</i> , with numerous thin leaves of <i>Sand stone</i> and " <i>Soapstone</i> ,"	5 feet.
(3) <i>Light Yellow Sand</i> ,.....	12 feet.
(2) <i>Thin Sandstones and Slaty Clay</i> ,.....	1 foot.
(1) <i>Slaty Clay</i> , (<i>Soapstone</i> ,) the lowest stratum seen,.....	20 feet.

1124. At *Huntingdon*, and at many other points within the belt in which this group outcrops, beds of the laminated clays occur.

1125. I have not as yet, met with rocks in this formation containing determinable shells. In several of the cuts along the Memphis and Charleston Railroad, specimens of leaves are found in the clays, and sometimes in thin local sandstones. The leaves in my collection from this group, which are not many,

* The first creek on the Map, west of Middleton, on the Memphis and Charleston Railroad.

have not been examined. One is much like *Quercus Saffordi*, Lsqx., of the succeeding group, and may be that species; the others are unknown to me.

SECTION II.

ORANGE SAND, OR LA GRANGE GROUP; FORMATION IIb.

1126. The outcrop of the *Orange Sand** or *La Grange Group*, forms more than a third of the entire surface of West Tennessee. It occupies a belt about 40 miles wide, which runs in a northeasterly direction through nearly the central portion of this division of the State. (See Map and section IIb, IIb.) As seen in bluffs, railroad cuts, gullies, and in nearly all exposures, it is generally a great stratified mass of yellow, orange, red, or brown and white sands, presenting occasionally an interstratified bed of white, gray, or variegated clay. The sand-beds are usually more or less argillaceous; sometimes but little or not at all so. Like the Ripley Group, it contains occasionally, patches, plates, and thin layers of ferruginous, sometimes argillaceous, sandstone, and, as in that group, presents, locally, massive blocks of sandstone on high points. At La Grange, a fine section of the group, more than a hundred feet in thickness, is exposed.

If penetrated to some depth, the beds of the Orange Sand would lose their bright colors, and become gray or dark.

1127. In deep wells, dark beds of sand, with occasionally one of clay, are met with. These often contain vegetable matter. Now and then, the trunk of a tree is encountered, much to the annoyance of well diggers. I have seen but one bed of lignite in the group, and that a limited one, near its southeastern margin.

* The name, *Orange Sand*, was originally applied by me (Reconnaissance, 1856,) to a series of strata of which the formation now thus designated was the principal member. It then included the *Cretaceous* beds; these have been excluded, but the name has not been dropped. Since my first use of the name, Drs. Harper and Hilgard, in their respective Reports, have applied it to a superficial formation occurring in Mississippi, quite different from anything it was intended to include.

1128. It is difficult to estimate the thickness of this group. It doubtless dips, though at a small angle, to the west. Its thickness may be assumed to be about 600 feet.

1129. The Orange Sand includes within its outcrop, nearly all of the following counties: Fayette, Haywood, Madison, Gibson and Weakley; the larger parts of Hardeman, Carroll and Henry; and small parts of Shelby, Tipton, Henderson, Dyer and Obion.

1130. At the bottom of a railroad cut three miles south of Somerville, in Fayette County, I collected, a number of years ago, from a thin, local sandstone in place, a series of fossil leaves, beautifully presented. These were described by Prof. Leo Lesquereux, in 1859,* but the figures were not given. They may now be found figured on plate K, of this volume.

In addition to these, several leaves, or rather, the impressions of leaves, have been collected by Prof. Meigs, from the clays at La Grange, three of which, Prof. Lesquereux has described.

1131. Below is a list, including all the species described from both localities. Nos. 12, 13, and 14, are the LaGrange species; all the others are from near Somerville. At the end of this section is added the descriptions of the species from the latter locality.

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| 1. <i>Quercus crassinervis</i> , Ung. | 8. <i>Andromeda vacciniifoliae affinis</i> . |
| 2. <i>Quercus Saffordi</i> , Lsqx. | 9. <i>Andromeda dubia</i> , Lsqx. |
| 3. <i>Quercus myrtifolia</i> ? Willd. | 10. <i>Sapotacites Americanus</i> , Lsqx. |
| 4. <i>Quercus Lyelli</i> , Heer. | 11. <i>Salix? densinervis</i> , Lsqx. |
| 5. <i>Prudus Caroliniana</i> , Michx. | 12. <i>Salix Worthenii</i> , Lsqx. |
| 6. <i>Fagus ferruginea</i> , Michx. (Fruit.) | 13. <i>Ceanothus Meigsii</i> , Lsqx. |
| 7. <i>Eleagnus inæqualis</i> , Lsqx. | 14. <i>Juglans Saffordiana</i> , Lsqx. |

1132. Of the species above, No. 3, 5, and 6 are living; the others are only known as extinct forms.

In regard to the age of the Orange Sand and its equivalent, in Mississippi, it is the opinion of Prof. Lesquereux, that the leaves make it "most intimately related to the Miocene of Europe." He adds, however, the following:

"Still, I do not consider the question as solved. It can only be satisfactorily settled by recognized differences, or identity of species collected in

* American Jour. Sci. [2,] XXVII, p. 363.

these strata of American formations. For it may be, that, as we have in our Upper Cretaceous dicotyledonous plants of genera still represented in our living Flora, like some of the Miocene of Europe, we may have Eocene deposits with species still more nearly related to our present vegetation; thus bearing a character approaching that of the European Miocene. Under the uniform development of the formations of the Mississippi Valley, the typical forms may have escaped changes from disturbing influences similar to those which have evidently modified, by repeated cataclysms, the recent formations of Central Europe."

1133. I must confess that I cannot rid myself of the impression that this group is at least *Eocene*. I do not know that I can assign a good reason for this *impression*. I have seen, however, imperfect specimens of leaves in older beds, even in known *Cretaceous clays*, much like some of those of this group, although I could not say they were absolutely identical, on account of their unsatisfactory condition. I see too, that Dr. Hilgard is inclined to place his "*Northern Lignitic*," which includes my *Porter's Creek* and *Orange Sand* groups, at the very bottom of the *Eocene*. (See his Report, page 108, and on.)

I have not been able to find even the cast of a shell in this formation. The discovery of a few known species, if such exist, is a desideratum.

APPENDIX.

1134. "*Species of Fossil Plants collected near Somerville, Fayette County, Tennessee, by Dr. J. M. Safford, State Geologist of Tennessee. Described and Figured by L. Lesquereux.*" The following short description of these fossil leaves has already been published in Silliman's Journal, (May, 1859.) Though, since that time, I have had opportunity to examine other specimens of some of these species, I do not find any reason to change my opinion about their relation or their identity. It is, nevertheless, necessary to remark, that if many species of living plants or trees may be easily identified from their leaves only, the determination of fossil leaves is always more or less hypothetical, at least, so far as specific identification is concerned. This is not a reason to prevent the publication of fossil plants, and to deny the value of the indication which they give concerning the age of the strata in which they are found. Peculiar genera or groups of plants are peculiar to each formation, and these groups are, generally, well characterized enough to show, even without identification of species, to what geological epoch the leaves belong.

The species are figured on Plate K, of this volume:

1. *Laurus Caroliniensis*.* Michx. (Red-bay,) Fig. 10, grows now in the swamps from south Delaware and south Virginia, to the two Floridas, in

*Since this paper was written, Prof. Lesquereux has identified this species with *Quercus Lyellii*, Heer.

pine barrens. Good and entire specimens collected from the same Geological horizon, and belonging to the cabinet of the Mississippi University of Oxford, show an identity of form between the fossil leaves and the living species.

2. *Prunus Caroliniana*, (Michx.) (Wild Orange tree.) *Fig. 6.* The species is now confined to the islands, and near the coasts of Carolina, Georgia, etc., and in the Bahama islands, where it is at its true latitude.

Michaux remarks that this species is not found on the main land at a distance of two to ten miles from the shores, where the temperature is five to six degrees colder in the winter, and proportionally milder in the summer.

3. *Quercus myrtifolia*, (Willd.) *Fig. 3.* Inhabits now the islands south of Georgia and along the coasts of Florida. Comparison of living specimens with this fossil leaf shows a perfect identity of form and venation.

4. Fruit of *Fagus ferruginea*, (Michx.) (Red Beech.) *Fig. 11.* This fruit is somewhat more distinctly ribbed on the sides and margins than in our living species; but the characters are not marked enough to permit a separation. Though the range of the American beech is indicated as rather northern, the tree is found most abundant, and of the most remarkable growth, on the Tertiary, and even Cretaceous formations of the south, even in Louisiana.

The following species are either new, that is extinct or undescribed species, or unknown to me:

5. *Salix? densinervis*, (Lsqx.) *Fig. 9.* Leaves narrow, one and-a-half to two inches long, lanceolate or tapering at both ends, entire. Medial nerve scarcely inflated at the base. Secondary nerves very close, anastomosing as in the leaflets of a fern or of a *Trifolium*. This nervation is quite peculiar for a *Salix*, and probably when better specimens are found the plant will be referred to another genus.

6. *Quercus crassinervis*, (Ung.) *Fig. 1.* The specimen is broken, and shows only the middle part of a large, sharply dentate leaf, apparently oval-lanceolate in outline. The broad nerves, and the running of the secondary nerves to the point of the teeth, as the form of the acute teeth would refer this species to *Quercus crassinervis*, Ung., a species found in the Upper Miocene of Europe.

7. *Quercus Saffordi*, (Lsqx.) *Fig. 2, a, b, c.* Leaves nearly linear, rarely an inch broad, four to six inches long, gradually tapering to a point. Margins regularly and distinctly mucronate-serrate, entire near the base, and decurrent in a broad petiole or enlarged nerve. Medial nerve, broad and flat, secondary nerve, oblique, straight, running to the point of the teeth, and alternating with shorter and slender ones. There is not any published fossil species that might be compared with this. It is distantly related to living species of southern Texas and Mexico; but among the leaves kindly furnished to me for comparison by Dr. Asa Gray, there were none of these new species to which it could be referred.

8. *Andromeda dubia*, (Lsqx.) Fig. 5. A thick, smooth, round-elliptical, obtusely pointed, leaf, with entire, wavy, somewhat reflexed margins and obsolete nervation. It is related to *Andromeda ferruginea*, Michx. of the pine barrens of the south.

9. *Andromeda vacciniifoliae affinis*, (Lsqx.) Fig. 4, a, b. Thick, oval-lanceolate, pointed or obtuse leaves, with perfectly the same size, outline and nervation as the *Andromeda vacciniifolia*, (Heer.), a plant of the Upper Miocene of Europe. Its nearest relative in America, is, I think, *Andromeda acuminata*, Michx.

10. *Elæagnus inæqualis*, (Lsqx.) Fig. 7. Leaf long-elliptical, obtuse, with entire wavy margin, rounded near the base on one side, and about one inch longer, and decurrent on the other side of the short petiole. Secondary nerves well marked, thick near the base, emerging in acute angle, with a camptodrome much divided nervation I do not know of any living species to which this could be compared. Among the fossil plants published till now, its nearest relative is *Elæognus acuminatus*, (Web.), of the Miocene of Europe.

11. *Sapotacites Americanus*, (Lsqx.) Fig. 8. Though the specimen shows only the upper part of the leaf, the form and the nervation agree well with that of the species of this genus found in the Miocene of Europe. I have not seen any other specimen but the one figured here.

SECTION III.

THE BLUFF LIGNITE; FORMATION II,c. (*Provisional.*)

1135. This is a provisional group, and consists, especially in the middle and southern parts of the State, of a series of stratified sands with more or less sandy, slaty clay, characterized by the presence of well-marked beds of *lignite*.* I have sometimes included it in the Orange Sand. It will be best, however, to keep it separate until the questions of age are definitely settled. The upper part of the series is generally well exposed below the *Gravel* of the *Mississippi Bluffs*. (§§ 279-283.) At Memphis, however, it scarcely appears above low water. About one hundred feet of the series has been seen. In this

*In the northern part of the State, its upper portion is frequently more or less indurated, presenting layers of soft sandstone; and here, too, the lignite is not as well seen.

thickness it contains from one to three beds of *lignite*, which are from half a foot to four feet in thickness.

1136. The *Bluff Lignite* appears to have no marked eastern outcrop, and may thin out in an easterly direction beneath the Gravel; at least, the beds of lignite by which it is characterized do not appear to extend very far east from the range of the bluffs. (See section on the Map, Form. 11c.)

1137. Below is a section of the bluff at Randolph, (§§ 280, 282,) which will serve to illustrate not only the character of this division, but also that of the overlying formations to be described.

(3) BLUFF LOAM, 68 feet.

Fine siliceous earthy matter of a light ashen or a light buff color, containing land shells.

(2) BLUFF GRAVEL, 24 feet.

Chert Pebbles, and coarse yellow and orange sand, with a bed six feet thick of variegated plastic clay beneath.

(1) BLUFF LIGNITE, 90 feet.

A mass of dark grayish laminated micaceous sand, with lignitic woody fragments, leaves, &c. Laminæ of sand alternate with other laminæ, containing more or less clay. Interstratified with this are *two beds of lignite*; the upper one six feet from the top, and from six inches to two feet thick; the other twelve feet lower, and about eight inches thick. Some thin laminæ of *lignite* occur below this bed.

This portion in all,48 ft.

A portion not exposed in place where the section was taken, but seen in part at another point; consists of laminated sand, like that above.

Down to the water's edge,42 ft.

1138. The following section, taken at "*Old River*," (§ 280,) in the southern part of Tipton County, exhibits the different strata which at that point compose the Bluff.* The entire thickness is 168 feet.

*I am under especial obligations to Dr. C. W. Dickson, of Portersville, for kindly guiding me to this point—a distance of sixteen miles from his residence—and for his assistance otherwise.

I take this occasion, also, to express my thanks to Dr. Oldham, of Ripley, who, notwithstanding his engagements at home, traveled with me to and from the lignite localities near Fulton, a distance of fifty miles in all.

- (3) **BLUFF LOAM, 45 feet.** (Caps the Bluff.)
 Bed of light-yellow ashen earth or loam, more or less calcareous; contains land-shells, (*helix*, *cyclostoma*, etc.)
 The lower part becomes more yellow and sandy.
- (2) **BLUFF GRAVEL, 39 feet.**
 (d) Layers of orange and yellow sand, with thin seams of red sandstone, three and a half feet.
 (c) Bed of coarse *gravel* and sand, sixteen feet.
 (b) Reddish and white potter's clay, in seams with sand, one foot and a half.
 (a) Bright yellow sand, with occasional seams of clay, eighteen feet.
- (1) **BLUFF LIGNITE, 84 feet.**
 (h) Thin seams of gray or white sand and clay, interstratified with some vegetable matter—fifteen feet.
 (g) Bed of *lignite*, from three to four feet.
 (f) Dark clay and *lignite* interstratified—two feet.
 (e) Seams of gray and white sand, interstratified with layers of *lignite*—five and a half feet.
 (d) Bed of *lignite*, six inches—becoming, a few hundred yards to the left, along the Bluff, four feet thick.
 (c) Gray sand in thin layers, with numerous seams of dark clay and layers of *lignite*, some of which are from three to six inches thick—thirty-two feet.
 (b) Same as above mostly; one bed of *lignite*, (leaves, etc.,) two feet thick—fifteen feet.
 (a) Beds of dark laminated clay. The base of the Bluff is concealed mostly by a talus of materials from above—ten feet.
Level of alluvial plain.

1139. I add here the section of the bluff at Raleigh on Wolf River, in Shelby County:

- (3) **BLUFF LOAM, 34 feet.** (Top of the bluff.)
 Light-yellow ashen siliceous earth or loam.
- (2) **BLUFF GRAVEL, 47 feet.**
 Yellow and orange sands containing more or less gravel throughout, some layers mostly gravel; a few clay seams near the top; presents a few masses of ferruginous conglomerate; has a chalybeate spring at its base.
- (1) **BLUFF LIGNITE, 20 feet.**
 (b) *Bed of Lignite*, has been mined, and was used one winter,

(1855-6,) by Dr. D. Coleman; from ten inches to three feet in thickness; has an under-clay a few inches thick.

- (a) A laminated gray mass of thin clay and sand seams; contains leaves and sticks, layers of which occasionally make black lines in outcropping on the face of the exposure; runs down to the bed of the Wolf.

1139. Leaves from the Bluff Lignite, at least from the portion in Tennessee, have not, so far as I know, been examined. The series may be synchronous with that at the *Chalk Banks*, near Columbus, Ky., some of the leaves of which have been described by Mr. Lesquereux. (*Am. Jour. Sci.*, [2], XXVII, 364.)

1140. *Minerals, Useful Material, and Agricultural Features of the Tertiary Group*.—This Group, like the others peculiar to West Tennessee, contains but few minerals. *Lignite* is a note-worthy one in this. In small pieces, it may be said to be common in all the divisions of the Group. It is met with in the bottoms of wells, and in exposures where the strata have not been weathered. A bed of it in the Orange Sand has been mentioned in § 1118. It is in the *Bluff Lignite*, however, that the beds of this substance are the most conspicuous. The sections just given present some of these, and exhibit their relations to the other strata. The beds may be traced in some cases for long distances, in a horizontal direction.

1141. Beds of pipe and potter's clay occur at numerous points in this formation. At a few localities, potteries have been established, but the manufacture of stone-ware has not been carried to the extent that it might well be.

1142. The agricultural features of the territory underlaid by these formations, and especially by the Orange Sand, are often very good. Much of the best cotton land of West Tennessee rests upon the Orange Sand. The soil is a mellow siliceous loam, and, where the ground lies well, presents us with very desirable farming regions. But as the soil is easily tilled, so it is easily washed away. Special attention, proper draining, and good farming, are required to keep it up, and to improve it. (See §§ 274 and 286.)