

CHAPTER XII.

THE COAL MEASURES; FORMATION IX.

TYPICAL TOPOGRAPHY AND STRATA.—(A) THE SEWANEE DIVISION.—(B) THE RACCOON AND WALDEN'S RIDGE DIVISION.—(C) THE NORTHERN DIVISION.—(D) THE NORTHEASTERN DIVISION; ROCKS OF SPECIAL USE, MINERALS, AND AGRICULTURAL FEATURES.

937. We come, now, to the great depository of our *Stone-coal*, the *Coal Measures*, the most important contributor of all the formations, to the mineral formations of the State. This is a series of alternating strata of sandstone, conglomerate, shale, (rarely limestone,) and coal. (§ 319.) It is the last, or uppermost, of the *older* formations occurring in Tennessee.

938. The Coal Measures occupy, topographically, a high position for the most part. They form the top of the Cumberland Table-land, and rest upon the Mountain Limestone described in the last chapter. The hard, weather-resisting conglomerates and sandstones of the formation, appear in great cliffs, around the margin of the Table-land, giving to it sharpness of outline, and protecting the limestones and shales below from denudation. (§ 175.) The *area* occupied by the Coal Measures is co-extensive with that of the Table land. (§§ 172-184.) The two go together. The latter owes *its* existence, in part, and its preservation as a plateau, to the former.

939. The hard rocks of the formation, when elevated and approximately horizontal, are plateau-making. Had they been otherwise than hard, or had they been common limestones or shales, rocks that air, water and frost, can, with comparative ease, disintegrate and dissolve, the Table-land region would have been long since reduced to the general level of the valleys and plains around it.

The principles are the same as those involved in the formation of the Highlands out of the "crust" of the Siliceous Group spoken of in §§ 899 and 900, although the latter is a much less marked example of their application.

940. *Typical Topography and Strata.*—The surface of the Table-land may, in general, be described as a *great plain*, or

floor, upon which rests, at a greater or less distance from the bluff-margin overhanging the slopes, (§ 175,) an upper plateau, or on narrow sections of the Table-land, plateau-ridges, from 200 to 300 feet in height, and usually forming a prominent *back bench*.*

941. The plain or floor is underlaid by a heavy stratum, often full of small quartz pebbles, which geologists call, technically, *The Conglomerate*. This rock usually appears in the cliffs around the crested edges of the table-land. Occasionally it thins out before quite reaching the edge, the cliff being formed of some of the lower sandstones. It is, however, sufficiently near the truth, to say, that, the area of the Conglomerate is co-extensive with that of the Table-land.

It must be remarked here, that, on some parts of the Table-land there are two strata, each of which is spoken of as *The Conglomerate*. These may, however, be regarded as one; in fact, at some points, they actually become one, the intermediate layers separating them, running out. (§ 995.)

942. With this premised, the following may be taken as typical, for the most part, of the Coal Measures in Tennessee; as we shall see, however, there are important exceptions:

- (c) *Upper Coal Measures*, embraces generally one or two principal sandstones, (one of which may be a conglomerate,) and as many *coal-horizons*, in which one or more beds of coal may be looked for.

These strata make up the upper plateau, or back bench, spoken of above, and have, consequently, a thickness of from 200 to 300 feet.

To the *Northeastern Division* of the Coal Measures, this typical character, as we shall see, will not apply.

- (b) *Conglomerate*, making the floor upon which rests the division above, generally abounding in small white quartz pebbles, but occasionally without them.† This sometimes is a double stratum, including an unimportant coal horizon. See last paragraph.

* Sometimes a terrace, or an intermediate bench is met with in passing from the first floor of the Table-land to the top of the upper plateau.

† The Conglomerate at Altamont, in Grundy County, contains a local bed of hard, gray, crinoidal limestone, a rare circumstance in Tennessee. This bed is from three to four feet in thickness. I obtained from it a fine specimen of a species of *Hemipronites* which Mr. Worthen pronounces to be *H. radialis* of Phillips.

- (a) *Lower Coal Measures*, often called, without good reason, *False Coal Measures*, by geologists; a series of sandstones and shales with from one to three or four coal horizons. This is an important division of the Coal Measures in Tennessee, and the only one in some regions available as a source of coal. The thickness ranges (not including the *Cliff Rock* of the sections below) from a few feet to 300.

943. The typical character given, applies to the southern, western, and northwestern portions of the Table-land.

The principal exceptions to it are to be found on the eastern side, and especially in the northeastern portion, lying in the counties of Claiborne, Scott, Campbell, Anderson and Morgan. (§§ 185-187.) In some ridges within this area, as in Cross Mountain, the *Upper Measures* are more than 2000 feet thick.

944. It will be seen from the general statements made, that, in Tennessee the portion of the Coal Measures above the Conglomerate have, over large areas, been much denuded. This is more especially the case on the western side of the Table-land, and in sections where the formation is most elevated. Where the base of the latter is low, the denudation has been much less. In the section presenting the greatest thickness of Coal Measures, the Conglomerate is depressed to or below the base of the Table-land, or of the mountains.

The waste caused by denudation is, to some extent, compensated for by the greater development, at many points, of the Lower Coal Measures.

945. It has been stated that the Coal Measures are co-extensive with the Table-land, (§ 938;) this makes their outcrop in Tennessee occupy an area of 5100 square miles. Thus nearly *one-eighth* of the surface of the State is underlaid by the coalbearing rocks. (§ 178.)

946. With this preliminary notice of the general features of the Coal Formation, we pass to the more detailed description. The Coal Formation, or, what amounts to the same thing, the Table-land, is made up of several portions, or subdivisions, more or less natural. My plan will be to consider these separately, commencing with the more southern, and proceeding northward. The relations that these subdivisions sustain to each other, and to the whole, will also, as we progress, be pointed out, so far, at least, as the data at hand will admit.

947. (A) *The Sewanee Division*.—This includes that part of the Table-land lying west of Sequatchee Valley, and reaching from the Alabama line to the southern boundaries of White

and Cumberland counties. It embraces parts of Franklin, Marion, Sequatchee, Grundy, Warren, Bledsoe, and Van Buren. (See Map.) In this the strata are, approximately, horizontal.

948. The *Sewanee Coal Banks*, at Tracy City, in Grundy County, very near the Marion line, are a well-known point in this division. These banks have a railroad connection with the Nashville and Chattanooga road, and coal from them is taken directly to Nashville. (See page 74, (7).) The section of the Coal Measures to be seen in this vicinity, may be taken as an illustration of the general character of the Formation throughout the division, or, rather, of its character in those parts of the division holding the beds, both above and below the Conglomerate.

949. This section is given below. Its lowest beds outcrop about two miles south of Tracy City, in the "gulf" of the Little Fiery Gizzard, a small creek rising on the plateau in the region of the mines, and tributary to Battle Creek. The overlying beds are met with in succession in ascending this stream, some of them forming cascades, until the plateau or top of the Conglomerate is reached. Proceeding then some distance, and passing Tracy City and the railroad depot, the foot of the *back bench*, or upper plateau, is met with, and the section completed by ascending its slope to the top.

UPPER MEASURES; 290 feet.	(13)	CONGLOMERATE; cap rock of the upper plateau, and the uppermost stratum in this region,.....	50 feet.
	(12)	Coal , a few inches,.....	
	(11)	<i>Shale</i> ,	23 feet.
	(10)	Coal , outcrop,.....	$\frac{1}{2}$ foot.
	(9)	<i>Dark Clayey Shale</i> ,.....	1 foot.
	(8)	<i>Sandy Shale</i> ,.....	25 feet.
	(7)	SANDSTONE,.....	86 feet.
	(6)	<i>Shale</i> , more or less sandy,.....	45 feet.
	(5)	Coal , <i>Main Sewanee</i> , from	3 to 7 ft.
	(4)	<i>Shale</i> , some of it sandy,.....	33 feet.
	(3)	Coal , outcrop,.....	1 foot.
	(2)	<i>Shale</i> ,	3 feet.
	(1)	<i>Sandstone</i> ,.....	17 feet.

Sig. 24. Vol. 1.

CONGLOMERATE ,.....		70 feet.
LOWER MEASURES: (Gizzard Portion); 228 feet.	(10) Coal , outcrop, from.....	$\frac{1}{2}$ to 1 ft.
	(9) <i>Shale</i> , with clay at top,.....	10 feet.
	(8) SANDSTONE , <i>Cliff Rock</i> , (<i>Lower Cong. of Aetna Mines</i>),	65 feet.
	(7) Coal , outcrop, from.....	$\frac{1}{2}$ to $1\frac{1}{2}$ ft.
	(6) <i>Shale</i> , with a few inches of indurated clay at top,...	8 feet.
	(5) <i>Sandy Shale</i> ,.....	22 feet.
	(4) SANDSTONE , hard,.....	78 feet.
	(3) Coal , has occasionally shale above and below it; the Coal, from.....	1 to 3 ft.
	(2) <i>Hard Sandstone</i> , local,.....	20 feet.
	(1) <i>Shale</i> , including a thin sandstone,.....	20 feet.
MOUNTAIN LIMESTONE ; the uppermost bed a limestone containing <i>Archimedes</i> , &c., followed below by calcareous shale; the limestone,.....		20 feet.

950. The upper and lower parts of the section above, may be taken respectively as types of the upper and lower Coal Measures in the division under consideration. They will serve as starting points in the descriptions below.

951. *The Lower Coal Measures in the Sewanee Division.*—The lower part of the section above presents a phase, and approximately not an uncommon one, of the strata embracing the lower coals. This series, taking it in general, is, to some extent, variable; yet it has, nearly throughout, certain common features. The coal beds are almost always present, if not in workable volume, at least in seams or traces of some kind. In the eastern or southeastern part of the division, there are generally four coal seams below the Conglomerate. Going to the west side of the Table-land in Franklin, and in the southern part of Grundy, one of these is lost, and the number is reduced to three. Going northwest, into the northern part of Grundy, and in Warren, and but two of the seams are left. And the volume of the Measures is reduced, correspondingly, from 360 feet (not including Conglomerate) to 50.

The coal beds are very irregular in thickness. They are most frequently too thin to work with profit, but often swell out locally to thicknesses of three, four, five, and even nine feet. The amount of available coal they contain, notwithstanding the features mentioned, is very great.

The quality of the coal is generally good, but varies with the localities. It is not, as a general thing, highly bituminous; much of it is a solid, cubic, free-burning coal.

952. The lateral extent of this portion of the Coal Formation is very great, its area being the same as that of the entire Sewanee Division of the Table-land. The Conglomerate which overlies it, ought, perhaps, to be included in it, as the upper stratum. The Conglomerate is the principal plateau-making rock of the Table-land, as well as the protecting cover of the lower coal series, and has determined the area of both.*

953. Below are banks which have been opened in the coals below the Conglomerate. Sections and notices of the strata at different points are also given. These examples will serve to show the character of the series at different localities, the changes it undergoes, and approximately the amount of coal it holds.

954. None of the coals of the Lower Measures have been opened in the vicinity of Tracy City. It is their natural outcrops in the gulf of the Little Fiery Gizzard which are given in the section. The lower one (3) is well presented beneath a bluff of sandstone. It is seen to be variable in thickness, ranging from a foot, or even less, to three. If followed or drifted into, it would doubtless be found to swell out, now and then, to a greater thickness, and then, on the other hand, sink to practically nothing

955. Between Tracy City and the Alabama line, on the slopes of the Table-land, and beneath the conglomerate and sandstone cliffs overhanging the valleys of the streams emptying into the Tennessee and Sequatchee rivers, of which Crow, Battle, and Little Sequatchee creeks are the most important, are many outcrops of the lower coals. These often present local, and not unfrequently extensive, developments of the beds. There are many points where no coal of practical importance exists; and there are many others where the coal-horizons are so covered with debris as to make it impossible, without much work, to know what they do contain. More or less of these would show the coal beds thick enough to be made available, and contribute to the known aggregate.

* The part of the Conglomerate in the Sewanee Division of the Table-land is referred to here. This stratum corresponds, let it be noted, with the Upper Conglomerate of the *Ætna* Section, given on a following page; and the *Cliff Rock* is the Lower. See § 941.

956. In the *Valley of Crow Creek*, near Anderson Depot, on the Nashville and Chattanooga road, the Coal Measures present, at the margin of the Table-land, the following section:

- | | | |
|------|---|-------------|
| (12) | CONGLOMERATE , coming in back of the top of the cliff formed by the sandstone below. | |
| (11) | Coal and Shale ; coal, so far as seen, only eight or ten inches, | 40 feet. |
| (10) | SANDSTONE , heavy, makes the <i>cliff</i> ; thickness (estimated,) - | 120 feet. |
| (9) | Coal , from 2 to 5 feet of lustrous, black, good coal, more or less laminated by thin leaves of mineral charcoal, contains some pyrite occasionally in seams. Several thousand bushels have been taken from the bank at this point. The coal will, perhaps, average, | 3 feet. |
| (8) | Fire Clay , | 3 feet. |
| (7) | Shale , | 8 feet. |
| (6) | Sandstone , | 10 feet. |
| (5) | Coal? and Shale , | 10 feet. |
| (4) | SANDSTONE and Sandy Shale , | 55 feet. |
| (3) | Shale , | 1 to 6 ft. |
| (2) | Coal , has been opened, a laminated, cubic coal, without pyrite, will average, so far as seen, from, | 2½ to 3 ft. |
| (1) | Shale , with clay iron-stones, followed below by rocks not seen. | |

957. In its general features, this section resembles the Gizzard part of the Tracy City section.

The second *Coal* below the Conglomerate (bed. 9) has been, and perhaps is now, worked at several points below Anderson. Its average thickness is considerably less than three feet. Occasionally it is above this, and at one point in Alabama, not far below the Tennessee line, it measured *seven* feet, soon, however, running down to two.

958. I do not know that the lowest coal of the section above, (bed 2,) has been opened at any other point in this part of the Crow Creek Valley. At the head of Little Crow, where it is nearly two feet thick, some coal has been taken out of it.

959. In § 925, a section of the Lower Coal Measures at the top of the steep slope of the Sewanee Railroad, is given. The uppermost sandstone (4) of the section, is that lying next below the Conglomerate. Following the track of the road

back from the brow, a bed of shale is met with, containing a trace of coal; then comes the *Conglomerate*.

In this region the lower coals are absent, or exist only in traces.

960. On the western brow of the Table-land, in Franklin County, near the Grundy line, and about four miles northwest from the track of the Sewanee road, is the old *Logan Bank*. The section at this point is as follows:

CONGLOMERATE , forming slope back from the crest.	
LOWER COAL MEASURES; 202 feet.	(8) <i>Shale</i> , perhaps including a thin <i>coal</i> , estimated,..... 40 feet.
	(7) SANDSTONE, forming cliff,..... 74 feet.
	(6) Coal ,..... 1 foot.
	(5) <i>Fire Clay</i> ,..... 1 foot.
	(4) <i>Shale</i> ,..... 3 feet.
	(3) SANDSTONES and Sandy Shales; at lower part, clay shales holding clay iron-stones,..... 50 feet.
	(2) Coal , of Logan Bank; coal good, variable in thickness, from..... 1 to 3 ft.
	(1) <i>Shale</i> ,..... 38 feet.
	<i>Limestone</i> , bluish-gray, <i>crinoidal</i> ,..... 68 feet.

The coal above (3) has also been worked at another point not far off. Other sections of the strata on this part of the Tableland might be given, but they would not vary much from this. At some points the coal is thicker, at others not workable, and might not appear at all.

961. We pass now, in further illustration of the Lower Coals of the Sewanee Division, (§ 947,) to the *Valley of Battle Creek and vicinity*, in Marion County.

The following is a section of the Lower Measures at what was once known as *Rice's Bank*. The point is near the lower end of Battle Creek Valley, and on the mountain slope on its northern side:

- (15) **CONGLOMERATE**, seen back of the brow of the mountain.
- (14) *Shale*, with trace of *coal* (?) a few feet.
- (13) *Sandstone*, 50 feet.
- (12) *Shale*, (*coal*?)..... 10 feet.
- (11) SANDSTONE, *Cliff Rock*, hard, 90 feet.

- (10) **Coal**, outcrop,..... 2 feet.
- (9) *Shale*, 10 feet.
- (8) **SANDSTONE**, even-bedded,..... 40 feet.
- (7) **Coal**, Rice's Bank; considerable coal has been taken from this bank; is laminated, more or less, by seams of mineral charcoal; thickness ranges from 2 to 6 feet, so far as penetrated, (1858,) averages about..... 4 feet.
- (6) *Fire Clay*,..... 2 feet.
- (5) *Shale*,..... 15 feet.
- (4) *Sandy Shale*,..... 38 feet.
- (3) *Shale*,..... 12 feet.
- (2) **Coal**, a trace of coal, with *Stigmara* below.
- (1) *Sandstone*, rough, concretionary, weathering into shaly matter, 12 feet

962. The section below was taken at a point about a mile in an easterly direction from the last, and on the slope of the Table-land facing Sequatchee Valley. It embraces a bank, formerly worked by Rice and others, which may be designated as the *More Bank*. Both this and the Rice bank are at the southern point of the arm of the Table-land separating the Battle Creek and Sequatchee Valleys. The top of the mountain above the *More Bank* is in sight of Jasper.

- (18) **CONGLOMERATE**, heavy, at the top of the mountain, not measured.
- (17) **Coal**, outcrops, from..... $\frac{1}{2}$ to 1 foot.
- (16) *Shale*,..... 10 feet.
- (15) *Sandstone*, 15 feet.
- (14) *Sandy Shale* (?) with bluish shale below,..... 28 feet.
- (13) *Shale*,..... 15 feet.
- (12) **SANDSTONE**, *Cliff Rock* (*Lower Cong. of Aetna Mines*,) ... 105 feet.
- (11) **Coal**, outcrop, a few inches.
- (10) *Shale*,..... 8 feet.
- (9) **SANDSTONE**, 45 feet.
- (8) *Shale*, upper part sandy, 6 feet.
- (7) **Coal** same as bed 7, last section; the *More Bank* is in this; bed irregular, ranging from.....1 to 4 feet.
- (6) *Fire Clay*,.....3 to 5 feet.
- (5) *Shale*,..... 5 feet.
- (4) *Sandy Shale* and thin sandstones,..... 20 feet.

(3) <i>Slope</i> ; (including a Coal?) rocks concealed,.....	25 feet.
(2) <i>Sandstone</i> , thin-bedded,.....	33 feet.
(1) <i>Rocks</i> below covered, but at another point to <i>Mountain</i> <i>Limestone</i> strata.....	30 feet.
Thickness in all below the conglomerate,.....	355 feet.

963. Sections taken at other localities on the mountain slopes, bounding, and in the vicinity of, the Battle Creek Valley, might be given, but they would present no essential differences. Banks might be opened at many points where the coal beds, especially 7, of the sections, *swell out locally* to three or four feet. Most work has been done at available localities near the Tennessee River. The railroad will add new vigor to coal mining in this section, and, doubtless, lead to new developments.

964. It is to be noted that, the gulf of the Little Fiery Gizzard, affording the lower part of the section in § 949, is at the head, or, rather, at one of the heads, of the Battle Creek Valley. Comparing the sections just given, with the corresponding part of the one in the paragraph referred to, it will be seen that the series has increased in thickness, in a southeasterly direction, about 125 feet. Comparing them with the section in § 960, and with the top of Sewanee Railroad section, (§§ 925 and 959,) the increase is still greater. Moreover, a sandstone (apparently 13, of the Rice Bank section) and a coal seam (perhaps bed 7, of the same section) appear to have been interpolated.

965. The margin of the Table-land west of Jasper is generally high and bold. The sections its strata present are, in general features, much the same as those given.

The Conglomerate sometimes appears at the brow of the mountain, making, with the sandstones below, stupendous cliffs, but usually comes in a little back of the crest.

966. Passing to the deep, narrow, cliff-bound *Valley of Little Sequatchee Creek*, in the northern part of Marion County, we find the lower coals and sandstones presenting themselves much as in the Battle Creek region. There are many dark, wild gulfs leading into this valley, around which the *Cliff Sandstone*, (12 of the last section,) and often the Conglomerate above, appear in bold faces. In one of the gulfs, at the head of the valley, that of *Cave Creek*, there is a heavy local development of the coal under the Cliff Sandstone. At one point it is nine feet thick, and is exposed for 40 feet in a horizontal direc-

tion. In another gulf, called the *Pocket*, southeast of the latter, the coal beneath certain cliffs, known as the "*Chimneys*," shows itself in an exposure five feet thick.

967. At the head of Indian Creek, a tributary of Little Sequatchee, at a point only about five miles southeast of Tracy City, is the *Parmley Bank*, from which, blacksmiths, years ago, before the opening of the Sewanee Banks, obtained much of their coal, and by whom it was much esteemed. This coal is below the Cliff Sandstone (or 8 of the Gizzard portion of the section in § 949.) The bed here, is from 7 to 9 feet in thickness. It is, however, in a sort of pocket, and is soon reduced, on one side at least, to one foot.

968. Going northward, from Tracy City towards Collins' River, the *Lower Measures* become much reduced in volume, and present generally but two thin seams of coal. The sections below, taken in the vicinity of the Beersheba Springs, a few miles from Altamont, in Grundy County, will serve as illustrations of the character of the Coal Formation in this region. The coals are generally too thin to be of much value, but occasionally swell out in workable thickness.

969. With the Beersheba sections, one is also given, taken on the ridge near Ben Lomond, the well known mountain within a few miles of McMinnville. (page 75, (8).) This mountain is the terminus of the arm of the Table-land dividing the waters of Collins' River and Hickory Creek. In it, the *Lower Measures* are poorly developed; but at a few points the coal may be mined.

970. The following is a section at the mill, three miles south of Beersheba Springs:

		CONGLOMERATE,.....	180 feet.
LOWER MEASURES, 78 ft.	{	(4) Coal , a few inches in a bed of shale; all.....	25 feet.
		(3) <i>Sandy Shale</i>	50 feet.
		(2) <i>Black Band Iron Ore</i>	$\frac{1}{2}$ to 1 foot.
		(1) Coal , six inches in shale; all.....	2 feet.
		<i>Shales and Limestones of the Mountain Limestone Formation..</i>	35 feet.

The upper coal of this section swells to a thickness of three or four feet at points not far off.

971. Below is a section at the Falls of the Laurel, a little over a mile from the Springs:

CONGLOMERATE, very heavy.

LOWER MEASURES, 56 ft.	{	(8) <i>Shale</i> , abounding in clay iron-stones,.....	8 feet.
		(7) Coal , a few inches.	
		6 <i>Shale</i> ,	20 feet.
		(5) <i>Sandy Shale</i> ,.....	10 feet.
		4 <i>Shale</i> ,.....	6 feet.
		(3) Coal , good but thin,.....	1 to 2 feet.
		(2) <i>Sandstone</i> , or indurated shale,	4 feet.
		(1) <i>Shale</i> , exposed,.....	6 feet.

972. The following section occurs on a spur running out from the narrow neck which connects Ben Lomond with the main arm of the Table-land. The locality is about a mile south of Ben Lomond. At many points in this region no coal occurs.

CONGLOMERATE, the same that caps Ben Lomond, shows but few pebbles.

Coal,.....10 inchs.

Slaty Clay,..... 6 to 8 "

Coal,.....10 "

Shale, and other rocks below, but the Mountain Limestone soon appearing.

Such a pair of coals might be worked as a single bed, by removing the intermediate layer.

973. The Lower Measures of the western part of Van Buren County, are much like those in Warren and Grundy. Going eastward, into Bledsoe, they become thicker. The character of the Coal Measures in Van Buren will be further illustrated by sections, taken on the Caney Fork, to be given on following pages.

McMinnville was formerly supplied with coal from banks eighteen or twenty miles distant, but the locality of these, and as to whether they are in beds above or below the Conglomerate, I know not.

974. *The Upper Coal Measures in the Sewanee Division.*—The limits of the Sewanee Division have been given in § 947. Having considered the lower coals of this area, that is to say, those below the Conglomerate, we now pass to the upper ones, or those above this rock.

And now, the *upper* part of the section in § 949, will be our starting point, (§ 950.) This, as already stated, may be taken as the type of the Upper Coal Measures in the Sewanee Division,

and wherever an upper plateau, or bench, occurs above the Conglomerate, (§§ 940-942,) their strata may be looked for.

975. The area occupied by the plateau-ridges of the upper bench of this division is, in the aggregate, much less than that underlaid by the Conglomerate, or by the Lower Measures. The Conglomerate is almost wholly the surface rock of the Table-land from Tracy City, in a southerly and southwesterly direction, as far as the Alabama line. There is, in fact, nothing more than a few knolls to be met with in that direction, containing strata of the Upper Measures.

976. Some of the most important of these knolls are the following:

1st. One about two miles west of Tracy City, in which is the *Thompson Bank*.

2d. Another at the "Lower Mines," about half way between Tracy City and the Nashville and Chattanooga Tunnel. The best coal has been taken out of this by the Sewanee Company. It was first opened by Porter and Logan.

3d. The knoll in which is the old *Jackson Bank*, about a mile and a half south of the "Lower Mines."

977. From Tracy City, in southeasterly, easterly, and north-easterly directions, the bench-ridges, on the other hand, are often met with. In many cases they are long, serpentine, flat-topped ranges, lying as dividing belts between the extreme head-waters of creeks. They occur extensively on the Table-land around the waters of the Little Sequatchee, and from this region extend northward, between Sequatchee Valley and the waters of Caney Fork, to Cumberland County.

In passing from Tracy City to Altamont, the bench and bench-hills are met with for about eight miles, when the Conglomerate becomes, in the main, the surface rock, and continues so to Altamont, and also from this point on to Beersheba Springs.

978. There having been no regular topographical surveys, the comparative area underlaid by the bench ridges can only be estimated. Perhaps it will be near the truth to say, that they occupy, in the aggregate, about one-fourth of the area of this division of the Table-land.

979. Recurring to the section in § 949, the *Main Sewanee Coal*, (originally called the *Wooten Vein*,) is the only one of the coals in the vicinity of Tracy City that has been mined, (unless done

recently,) to any note-worthy extent. The coal here is of good quality, semi-bituminous, and contains but little pyrite. Perhaps no purer coal is brought to the Nashville market. It is objected to on account of its being more or less fragile, and its tendency to become *fine*; but, if properly handled and screened, it is a very desirable coal. Its fragile character is due to its peculiar *spumous* structure, which has been attributed by some to a sort of crystalization, but which, I think, is attributable to a lateral crushing movement of the strata in the vicinity. It is but a few miles to points where the rocks have been greatly disturbed. This structure is mainly confined to the Sewanee Mines. The thickness of the bed at the mines varies from two and a half to seven feet; it may be regarded here as a four or five foot bed.*

980. The Main Sewanee is a valuable bed of coal, and the most reliable one west of the Sequatchee Valley. It appears to be the southern extension of the Pennsylvania bed (B.)† A list of fossil plants occurring at the Sewanee Mines, in the shales associated with this bed, and its "satellite" below, will be given at the end of the Chapter.

981. This bed is to be looked for at all points on the Table-land where its proper geological horizon is presented, which is generally within 50 or 75 feet of the Conglomerate. It has been seen at quite a number of localities within the division of the Table-land under consideration, outside of the vicinity of Tracy City. Some of these are enumerated below, and the special features of the bed at each, given.

982. (a) The knoll two miles west of Tracy City, may be mentioned. In this a bank was opened many years ago, the coal showing, at the time of my visit, a clear face of 12 feet, and the bottom not seen at that. This thickness, however, was quite local.

983. (b) The "*Lower Mines*" (§ 976) are another point. Here the bed averaged three feet. The coal was cubic in structure. The section at this place is as follows:

* The facts upon which these statements are made, were observed before the war. What the new drifts and rooms would average, I am not informed.

† See page 95, of J. P. Lesley's Manual of Coal and its Topography; 1856, Philadelphia, Lippincott & Co. Also, Dana's Manual of Geology, page 331.

(8)	SANDSTONE, more or less shaly, and capping the knoll,...	16 feet.
(7)	Shale,.....	12 feet.
(6)	Coal, (<i>Main Sewanee</i>), removed,.....	3 feet.
(5)	Fire Clay,.....	1½ feet.
(4)	Sandstone and Sandy Shale,.....	16 feet.
(3)	Shale,.....	15 feet.
(2)	Coal,.....	1½ to 3 ft.
(1)	Shale, sandy,.....	10 feet.

CONGLOMERATE, a few feet at top sandstone.

984. (c) A third point is about five miles southeast of Tracy City, a mile and a half from the Parmley Bank, mentioned in § 967, and is near one of the gulfs of the Little Sequatchee. At this place is *Stone's Bank*. The *Main Sewanee* coal shows well here. It is a good solid coal, from four to five feet in thickness. The plateau-ridge, in which this bank occurs, extends, with but a few breaks, to the *Sewanee Mines*. The section at *Stone's Bank* is as follows, thickness estimated:

(9)	SANDSTONE, seen,.....	20 feet.
(8)	Space, doubtful, most likely sandstone above and shale below,.....	60 feet?
(7)	Shale,.....	2 to 3 ft.
(6)	Sandy Shale, or Sandstone,.....	3 feet.
(5)	Coal, (<i>Main Sewanee</i>),.....	4 to 5 ft.
(4)	Fire Clay,.....	1 foot.
(3)	Shale,.....	15 to 20 ft.
(2)	Sandstone, exposed,.....	2 or 3 ft.
(1)	Space, rocks not seen,.....	25 feet?

CONGLOMERATE.

985. (d) Outcrops of coal in the *Main Sewanee* horizon have been observed on the slopes of the plateau, or bench, ridges, around the upper part of the *Little Sequatchee Valley*, (§ 977,) but as no excavations have been seen, the character of the bed in this region cannot be given.

986. It is to be noted that the two last sections are capped with the sandstone next above the *Main Sewanee* Coal. This, indeed, often forms terraces and tables subordinate to the plateau-ridges.

987. Between the *Main Sewanee* and the *Conglomerate*, there is very generally a coal bed, or seam, which, for reasons that

will appear, may be called the *Jackson Coal*. (A of Lesley's Manual, page 45.) This is (3) of the section in § 949. At Tracy City, up to the time of my last visit, no developments of interest to a miner had been made in this bed. It is generally too thin to work. There is but one point where it has, to my knowledge, been mined, and that is at the knoll referred to in § 976, containing the old Jackson Bank. The latter bank is in this bed, and hence the name I have given to it. The coal at this point is tolerably good, would be quite so, but for the presence of pyrite. It ranges in thickness from two to three feet, and is separated from the Conglomerate by 12 feet of sandy shale. A considerable amount of coal has been taken out of this bed up to the time the Sewanee Mining Company commenced their operations.*

988. The Jackson Coal can also be seen at the "Lower Mines;" it is 2 of the section in § 983. A drift was run into the bed at this point by the Sewanee Company, but the coal was found to contain so much pyrite and shaly matter as not to be worth the mining.

989. (B) *The Raccoon and Walden's Ridge Division*.—Having considered the Sewanee Division of the Table-land with reference to the Coal Formation, we pass, now, to a second division. (See §§ 946, 947.) This embraces the portion of the Table-land east of Sequatchee Valley and the Crab Orchard Range of Mountains, (§ 188,) and extends longitudinally from the Alabama line to the Emery River, in Morgan County. It includes parts of Marion, Sequatchee, Hamilton, Bledsoe, Rhea, Cumberland, Roane, and Morgan.

990. The topography of this belt has been given in sections 141, 142, and 182. In the diagram on page 139, the part C E is a section of the southern end of the division. It shows how the Coal Measures (X) rest upon the Mountain Limestone (IX.) The elevation of the former is also to be noted. The formations are seen to dip in such a manner as to form a very shallow trough, the strata, however, in the central part being approximately horizontal.

991. In the part of the division east of the head of Sequatchee Valley

* This bank, with others on this section of the Table-land, and among them the Porter and Logan Banks, was first opened by Abram Van Vleck, a working man, but an intelligent one, having no occasion to cloak his ignorance by calling himself a "practical miner."

and Crab Orchard Mountain, this trough-like feature of the strata is more marked. Here, also, and indeed at points further south, the eastern edge of the division is thrown up in a crested ridge, the Conglomerate and sandstones of the Coal Formation entering largely into its structure, and being often tilted at high angles. In the southern part of the division this feature is not prominent, although the strata, as shown at E in the diagram run up, to some extent, as they come to the surface in Lookout Valley.

992. It is to be noted, as stated in § 141, that Walden's Ridge and the Raccoon Mountains appertain to the same belt. The range runs southwesterly, a long distance into Georgia and Alabama.

993. The completion of the Nashville and Chattanooga Railroad through the Raccoon Mountains, has been followed by the building up of a great mining interest in a region once wild, desolate and unproductive. We can learn here a lesson, as to what railroads will do for us when made to traverse mineral ground.* We trust that others will soon be built across our great coal field.

994. We take the region of the *Ætna Mines*, as our starting point in the consideration of the Coal Measures of the division before us. At no other point have the coals been so thoroughly explored as here. The following general section, of the strata in the *Ætna* region, will illustrate the character of the Coal Formation over a large area. The survey was made in 1858, and in years antecedent. As to whether any essentially new developments have been made since the war, I am not informed. The mountain, at the *Ætna Mines*, has the typical character described in §§ 940-942, that is to say, it is a table with a plateau-ridge, or back bench, upon it. The latter, on the mountain between the railroad and the Tennessee River, covers a considerable area, but it is often narrow, more or less broken, and much less in extent than the floor upon which it rests.

995. The *Upper Conglomerate* of the section forms a terrace around the plateau-ridges. The *Lower Conglomerate*, which, in the sections west of Sequatchee Valley I have called the *Cliff Rock*, makes, in many portions of the Raccoon Mountains, outside of the *Ætna* region, the cap-rock of the Tablelands. In fact, at some points, the two rocks appear to come together and form a single stratum.

* Much credit is due to the enterprise of Col. J. A. Whiteside (now deceased) and Robert Cravens, Esq., of Chattanooga, for the developments made in the Raccoon Mountains.

UPPER MEASURES, 220 feet.	(8) SANDSTONE, cap-rock of plateau-ridge above the Ætna Mines,.....	75 feet.
	(7) <i>Shale</i> ,	48 feet.
	(6) Coal , " <i>Walker Coal</i> ;" uniform, good, cubic.....	4 feet.
	(5) <i>Shale</i> , including sometimes a thin <i>coal</i> , (<i>Cravens</i>), from.....	30 to 40 feet.
	(4) Coal , " <i>Slate Vein</i> ;" including a layer eighteen inches thick, of shale and coal mixed,.....	5 to 6 feet.
	(3) <i>Shale</i> ,	44 feet.
	(2) Coal , " <i>Kelly Coal</i> ;" good, cubical coal, from.....	2 to 3 feet.
	(1) <i>Fire Clay</i> , from	1 to 2 feet.

UPPER CONGLOMERATE, simply a sandstone here,..... 75 feet.

- (4) **Coal**, seam, a few inches.
- (3) *Shale*,30 to 40 feet.
- (2) **Coal**, seam, ten inches.
- (1) *Sandy Shale*, from.....100 to 130 feet.

LOWER CONGLOMERATE, *Cliff Rock* of the sections east of Sequatchee Valley, in which it is included in the *Lower Measures*; becomes a well-characterized *Conglomerate* over the upper coal (Main Ætna or Cliff Vein) at Gordan's Mines, in Georgia, doubtless coalesce at some points with the Upper Conglomerate, the intervening layers thinning out, from.....70 to 100 feet.

LOWER MEASURES, (not including <i>Lower Cong.</i>), average, 288 feet.	(14) <i>Shale</i> , sometimes wanting, the rock above making the roof of the coal from.....	0 to 12 feet.
	(13) Coal , <i>Main Ætna</i> , or <i>Cliff Vein</i> ; the most important bed in the Raccoon Mountains, and has been mined at numerous points by different parties; has a wide spread under the <i>Lower Conglomerate</i> , or <i>Cliff Rock</i> , of the mountains; is irregular in thickness, ranging generally from eighteen inches to four feet, but occasionally sinking to a few inches, or rising in a swell six, seven, or more feet in thickness; structure of coal often peculiar, is in laminae from the fraction of an inch to two inches in thickness, the laminae separated by the seams of mineral charcoal, and each one made up of small, irregular, vertical prisms; the coal is of good quality, and in demand, not highly bituminous, contains but little pyrite, and makes good coke; will average, perhaps,.....	3 feet.
	(12) <i>Fire Clay</i> , indurated, contains <i>Stigmaria</i> , often with rootlets attached; has been made into good fire-brick, ...	1 to 3 feet.

LOWER MEASURES, (not including Lower Cong.,) average, 288 feet.	(11) <i>Shale?</i>	5 to 20 feet.
	(10) Coal , thin,.....	$\frac{1}{2}$ to 1 foot.
	(9) SANDSTONE and <i>Sandy Shale</i> ,.....	80 to 120 feet.
	(8) <i>Shale</i> ,.....	0 to 5 feet.
	(7) Coal , of good quality, usually too thin to be mined, from.....	$\frac{1}{2}$ to 3 feet.
	(6) <i>Fire Clay</i> ,.....	0 to 2 feet.
	(5) <i>Sandy Shale</i> , or <i>Sandstone</i> ,.....	20 to 25 feet.
	(4) <i>Shale</i> ,.....	15 to 20 feet.
	(3) Coal , lowest bed like the last, and banks have been opened in both; Mr. E. Alley opened a bank in this bed, at one point in the Raccoon region, where it was at first six feet, then nine, but soon fell to three,.....	$\frac{1}{2}$ to 3 feet.
	(2) <i>Fire Clay</i> ,.....	0 to 3 feet.
	(1) <i>Shales and Shaly Sandstones</i> ,.....	80 to 150 feet.

MOUNTAIN LIMESTONE FORMATION.

Variegated Shales and Limestones in the Valley of
Running Water.

996. The above section presents a fair analysis of the Coal Measures of the Raccoon Mountain Region. There are seen to be four coal beds below the Lower Conglomerate, one more than generally occurs below the corresponding rock in the slopes on the west side of Sequatchee Valley. Extending the comparisons made in § 964, to this section, and we see a still further increase, going eastward, in the volume and in the number of coal beds of the Lower Measures.

997. The plateau-ridges, or the Upper Measures, of the Raccoon Region, is, considering the thickness of the strata, very rich in coal. I know not the aggregate area they occupy; it is much less than that of the main floor they rest upon. They are most conspicuous on the part of the mountain between the railroad and the Tennessee River.* The elevation of one point of these above tide, is given on page 74, (6.)

998. The trio of coals, the *Kelly*, *Slate* and *Walker*, appertain doubtless to the horizon of the *Jackson* (3) and *Main Sewanee*, of the section in § 949. (See §§ 980, 964.) Their paleontological features have not been much studied. It is likely that

* In the Etwa Region "they are contained in two ridges, together equal to 1500 acres." (E. Alley.)

the *Kelly* and the *Jackson* are the same, and that the *Slate* and the *Walker* represent the *Sewanee*.

999. I add, here, before passing northward, the section presented at the point of *Lookout Mountain*. (§ 189, and 194, (5).) This is the last of a series of sections taken at intervals in a belt extending from the extreme western to the extreme eastern slopes of the Table-land, including in the latter, the great outlier above. They constitute, in fact, a complete section, running quite across the southern end of our Coal Measures.

The coals at the northern end of *Lookout* are poorly presented; in fact, the outcrops of most of them do not appear at all. Following the mountain into Georgia, however, several of them become workable beds. A special feature of this section is the great development of the Conglomerate at the top of *Lookout*.

UPPER CONGLOMERATE, very heavy, makes the great cliffs around the brow of *Lookout*; most of it contains pebbles; thickness estimated by Col. Whiteside and myself,.....250 feet.

(3) **Coal**, a trace at the *Point* of mountain.

(2) *Fire Clay*, was used by Mr. Cravens at the old "Bluff Furnace," and obtained from an outcrop below the *Hotel*, answered a good purpose.....1 to 9 feet.

(1) *Sandy Shale*,10 to 30 feet.

(This space between the two conglomerates, is, at some points, as near the *Hotel*, reduced to 9 or 10 feet, the *Sandy Shale* thinning out.)

CONGLOMERATE, middle part containing pebbles, on the road down the mountain, from the *Hotel*, is 25 feet thick, not well developed, contains 5 or 6 feet of shale in its middle part; at the *Point*,.....37 feet.

LOWER MEASURES, from 350 to 375 feet.	() <i>Shale</i> running up into <i>Sandy Shale</i> ,.....	15 feet.
	() <i>Shale</i> , dark,.....	8 feet.
	() Coal?	
	() <i>Fire Clay</i> , sandy,.....	5 feet.
	() <i>Shale</i> ,	6 to 8 feet.
	() <i>Sandy Shale</i> ,.....	15 feet.
	() SANDSTONE ,.....	15 to 23 feet.
	() <i>Sandy Shale</i> , running up into thin sandstone,....	60 to 70 feet.
	() <i>Shale</i> , heavy, (at the point,) becoming sandy in ascending,	220 feet.
	() <i>Sandstone</i> ,	10 feet.

Sig. 25. Vol. 1.

MOUNTAIN LIMESTONE. The sandstone above is immediately, or very soon, followed by the variegated shales of this formation; from the sandstone to the first limestone seen, is 50 feet

1000. Passing northward, from the *Ætna Mines*, we soon get into the narrow valley, or gorge, in which the Tennessee River finds a passage through the *Walden's Ridge Range*. (§ 149.) The strata of the Lower Coal Measures are here boldly presented in the slopes on both sides of the river. The coals have about the same general features as in the *Ætna Region*. They have not, however, been so fully explored, and hence, are not as well known. I have seen, however, the four coals below the Lower Conglomerate (or *Cliff Rock*) on the north side of the river. The *Main Ætna* is here in place, and has been mined to some extent. One of the lower beds has also been worked. Before the completion of the Nashville and Chattanooga Railroad, coal was taken out of these beds and sent down the river to towns in Alabama. I am not informed as to what has been done with them in late years.

1001. From the Tennessee, northward, through the division, to the *Emery River*, the Coal Measures have not been, as yet, sufficiently studied. Enough has been done, however, to inform us as to their general character.

The two principal sections given, the *Sewanee* (§ 949) and the *Raccoon*, (§ 994, 995,) may be taken in general as types of this portion of the series. Both the Upper and Lower Measures are often present. In the trough of the *Walden's Ridge Range* (§ 990) there may be, at some points, a few strata higher in the series than the topmost of the *Sewanee Section*. The *Main Sewanee* is, most likely, the principal coal. The upper bench feature is not as marked as it is south of the Tennessee River, or west of the *Sequatchie Valley*. Below will be presented a section of the strata in the vicinity of *Crab Orchard Mountain*, which will serve to illustrate the general features of the *Coal Series* in the northern part of the Division under consideration.

1002. At many points along the eastern slope of the *Tableland*, from the vicinity of *Chattanooga* to the *Emery River*, the coal beds outcrop, and numerous banks have been opened in them. The beds outcropping, are, doubtless, both those below

and above the Conglomerate, or conglomerates, as the case may be. Northward, the principal bed in which the banks occur, is, with little doubt, the *Main Sewanee*, or *Coal B*, of Lesley. (§ 980.) But further investigations are required before this can be asserted positively.

1003. The strata along the eastern slope are often much disturbed. (§ 991.) At a few points the Coal Measures are brought down to the valley; at others, detached blocks of the Measures containing coal, lie against the slopes as if they had been pitched over from above.

1004. The following are some of the banks that have been opened on the eastern slope. I quote, in part, from Col. W. B. Gaw's able Report to the officers of the proposed Chattanooga and Kentucky Railroad:

(a) First, may be mentioned here, a bank about six miles from Chattanooga, near the *Suck* in Tennessee River, and a little to the left of Col. Gaw's line; "worked by the Government during the war, and much coal taken out; the opening of the bed about 300 feet above the valley, and 400 feet above the river."

I have not seen this bank, but suppose it to be in the *Main Ætna*. Thickness variable, from one to eight feet. (§ 1000.)

(b) "At *North Chicamauga Creek*, on the left slope, about three-fourths of a mile to the left of the line of road, and about twelve and a half miles from Chattanooga, mines were worked before the war;" beds "are found upon the top and edge of the ridge," and of good thickness.

(c) *Clift and McRhea's Mines*, on *Soddy Creek*, about 22 miles from Chattanooga, and near the foot of the mountain. At this point the Coal Measures are brought down into the valley, the mines being, in the latter. This depression commences a few miles south of the mines, and is continued to about the *Rhea County* line. The beds are from two to five feet, rarely swelling out to seven or eight. "The coal from these mines has been consumed in Chattanooga for years."

(d) The next mines are in the vicinity of *Pearson's*, on *Rocky*, or *Sale Creek*, and about 28 miles from Chattanooga; "have been worked for a long time; coal known in Chattanooga and Atlanta as the *Sale Creek Coal*; mines now worked by a company of energetic Welsh."

(e) "*Jack's Bank*" is in the same vicinity. The coal bed at this point is in the knee of a synclinal fold. When I visited this bank, (1855,) there were rooms in the knee 10 to 15 feet high; thickness of bed from 4 to 6 feet; coal crushed, of spumous structure, but comparatively pure and excellent.

(f) "*Maj. Day's Mines*, some forty miles from Chattanooga, in *Rhea*

County, and about three-fourths of a mile from the proposed railroad. These have not been, much worked, but I regard the coal as of superior quality; the beds are of considerable thickness."

(g) "*Miller's Farm*, about 55 miles from Chattanooga. These mines have an especial value, from the fact that the opening of the bed is scarcely fifteen feet above the level of our road, and not more than a quarter of a mile from it." The coal is hard, cubic, and will bear transportation well.

(h) Then follows *Roddy's Mines*, about 62 miles from Chattanooga, and still further north, the banks on *White's Creek*.

(i) *Kimbrough's Mines*, in Roane County. "They are the most reliable and richest along the whole route. They are not worked at present, but before the death of the proprietor, were among the most prominent mines in the country." The bed of coal at Kimbrough's, is, most likely, the same as the *Haley*, (*Main Sewanee*,) in the section below. The bank is in a tilted block of measures, resting against the slope of the mountain. It affords a hard, lustrous, cubic coal. At the top of the mountain, just beyond the crest, there is an outcrop of coal appertaining, most likely, to the same bed.

(j) On *Big Emery* are several banks of coal, most of which, doubtless, like the Kimbrough Bank, are in the Main Sewanee. Four feet, or, perhaps, in a few localities, five feet, is a maximum average for them.

(k) The De Armond Banks, on the Little Emery, although belonging to another division, may be noted here. These are worked to a considerable extent. I have not seen them, but suppose them to be in the same bed as that to which the last mentioned banks have been referred.

1005. I close the description of this Division of the Coal Measures with the following section, which will serve to illustrate the character of the Coal Series, not only in the area to which our attention has been confined, but also in that which will succeed.

The section presents the strata as seen in intersecting, in Cumberland County, the *Crab Orchard Range*, (§ 188,) along the Sparta, or Crossville and Kingston road. It has already been stated that this range is the back of an anticlinal fold. (See § 346 and on.) The strata of the Coal Measures were raised in a great arch by this fold. The topmost of them, however, have since been, in good part, removed by denudation. The Conglomerate now forms the cap rock of Crab Orchard Mountain. The strata dip away from the range on both sides.

The thickness of the strata given, were, in most cases, estimated, and are but approximately true.

UPPER MEASURES, <i>Approximately 500 feet.</i>	(9) SANDSTONE, heavy; forms a wide, synclinal trough, in which is the bed of Daddy's Creek; (upon this rests, on the west side of the creek mentioned, a knoll of shale, 40 feet high;) thickness doubtful, say,	100 feet.
	(8) <i>Shale</i> , (Coal?) perhaps,	25 to 50 ft.
	(7) SANDSTONE, heavy; forms, on the east side of the range, the cascade at McNare's, from.....	100 to 150 ft.
	(6) <i>Shale</i> , (Coal?) perhaps,	60 feet.
	(5) Sandstone, including some shale in its middle part, say,	60 feet.
	(4) <i>Shale</i> , (includes a thin sandstone, one or two feet thick, with indications of coal below it,) about.....	50 feet.
	(3) Coal , <i>Haley's</i> , (<i>Main Sewanee</i> ,) seen west of the mountain, near the road, of good quality.....	4 feet.
	(2) <i>Fire Clay</i> ,	1 foot.
	(1) <i>Shale</i> ,	30 to 40 ft.

CONGLOMERATE, heavy, much of it coarse, caps the mountain; seen also at a low level on both sides of the range,.....100 to 150 ft.

LOWER MEASURES, 228 feet.	(5) <i>Slope</i> , (<i>shale with coal?</i>)	15 feet.
	(4) Sandstone	33 feet.
	(3) <i>Slope</i> , (perhaps mostly <i>shale</i> , with one or two <i>coal seams</i> ,)	110 feet.
	(2) Sandstone, thin bedded,	50 feet.
	(1) <i>Shale</i> , <i>coal shale</i> ,	20 feet.

MOUNTAIN LIMESTONE, runs up several hundred feet above the base of the mountain.

1006. (C) *The Northern Division*.—This embraces the part of the Table-land lying north of Van Buren and Bledsoe counties, and west of the Crab Orchard Range, (§ 188,) and a line running through Montgomery and Huntsville. Within its limits are parts of White, Cumberland, Morgan, Putnam, Overton, Fentress and Scott counties.

1007. The top of the Table-land is, in this portion, wide and without high mountains, presenting a flat surface, varied by valleys of moderate depth. In passing back from the margin of the slopes an upper plateau, or bench, is often met with, as in the Sewanee Division. (§ 940.)

1008. The maximum thickness of the Coal Measures presented in this area, is about equal to that of the series in the Crab Orchard Section, (§ 1005,) which may be taken as typical of the eastern portion of the area, or, at least, of that part of it adjacent to the Crab Orchard Range. In much of the area, however, especially westward and northward, the thickness is less.

1009. I present, first, a section taken in the vicinity of the old "*Eastland Stand*," on Clifty Creek, in White County, and near the Caney Fork Gulf:

UPPER MEASURES, 308 feet.	(13) SANDSTONE AND CONGLOMERATE, contains small pebbles at some points,	65 feet.
	(12) <i>Shale</i> ,.....	0 to 12 ft.
	(11) Coal , irregular,.....	$\frac{1}{2}$ to 2 ft.
	(10) <i>Fire Clay</i> ,.....	0 to 2 ft.
	(9) <i>Shale</i> , mostly, with two or three beds of sandy shale,	60 feet.
	(8) <i>Fire Clay</i> , (Coal)?.....	1 foot.
	(7) SANDSTONE, forms cliffs around the head of the gulf,	40 feet.
	(6) <i>Shale</i> ,.....	20 feet.
	(5) <i>Fire Clay</i> , (Coal)?.....	1 foot.
	(4) <i>Sandy Shale</i> , or <i>Sandstone</i> ,.....	25 feet.
	(3) <i>Shale</i> ,	52 feet.
	(2) Coal , at bottom of <i>Eastland's Well</i> ,.....	3 feet.
	(1) <i>Shale</i> ,	25 feet.

CONGLOMERATE, bottom, with several lenticular masses of coal in it; pebbles numerous at some points, at others rare,..... 60 feet.

L. M. 15 ft. { *Shale*, with one (occasionally two) seams of **Coal**, varying from 0 to 18 inches, in all,..... 15 feet.

MOUNTAIN LIMESTONE; *limestone*, 40 feet thick, forming a cliff with *Calcareous Shale* below it.

1010. The following is a section of the strata in the region of *Scarbrough's Mill and Coal Bank*, the two being about half a mile apart. The mill is on Caney Fork, just above the head of the Gulf, and at the crossing of the old Ross Road, and about four miles from the Eastland Stand:

UPPER MEASURES, 324 feet.	(9) SANDSTONE,.....	50 feet.
	(8) <i>Space</i> , rocks not seen,.....	30 feet.
	(7) <i>Shale</i> , outcrop not good,.....	62 feet.
	(6) <i>Shale</i> ,.....	38 feet.
	(5) Coal , <i>Scarborough's</i> , (may be <i>Main Sewanee</i> ;) a fine bed; place appears to be above No. 7 (Sandstone) of the Eastern Section. The pits were half filled with water at the time of my visit; could see but the upper part; thickness, according to Scarborough, from 4 to 6 feet, averaging,.....	5 feet.
	(4) <i>Fire Clay</i> ,.....	2 to 3 ft.
	(3) <i>Shale</i> ,.....	18 feet.
	(2) SANDSTONE,.....	40 feet.
	(1) <i>Shale</i> , (Coal?) with a thin sandstone in its middle part,.....	78 feet.

CONGLOMERATE, forming the rapids.

1011. In the hills south of Scarborough's Mill, there is another stratum of shale, with a sandstone above, resting upon the upper bed of the last section.

1012. It will be observed that the *Lower Measures* in the Eastland Section are very poorly developed. At many points, however, west of this, in White County, they are of considerable importance. This part of the series occurs beneath the brow of the Table-land at all points, facing the valleys of Caney Fork and Calf Killer, and is sometimes 100, or more, feet in thickness, though usually under this. It generally contains two or three (occasionally four) seams of coal, which frequently are too thin to work. Here and there, however, some one of them will swell out to three, four, or five, (or even, though very rarely, to seven or eight,) feet, affording a valuable local body of coal.

1013. The Measures below the Conglomerate on this part of the Table-land, are much like what they are on the western slope in the Sewanee Division. And it may be stated here in general, although no reference has yet been made to the series in Fentress and Overton, that the *Lower Measures* present similar features throughout, on the western slopes, from Kentucky to Alabama. They consist of shales and sandstones, the latter sometimes absent, and range in thickness from a few

feet to about 200. They contain two, sometimes three, rarely more, seams of Coal. These are often too thin for mining, but locally swell out, and form valuable deposits from two and a half to four or five (rarely more) feet in thickness. The Poplar Mountain and Upper Cumberland Coal Banks in Kentucky, are in the northern extension of this same series.

1014. Returning to White County, and the valley of the Calf Killer, the head of which is in Putnam County, we find several banks in the coals below the Conglomerate. Most of those are enumerated below. A few sections are also given, illustrating the character of the Measures.

1015. (a) *Little's Bank*, near the brow of the Table-land overlooking the valley of Calf Killer, about two miles and a half, direct, from Bon Air, and five or six from Sparta; has been opened for many years, the coal being used in Sparta. The following is the section at this point:

CONGLOMERATE , heavy, cap-rock of mountain.	
<i>Shale</i> , may have thin seams of <i>coal</i> , contains <i>clay iron-stones</i> ,...	80 feet.
<i>Sandstone</i> ,.....	13 feet.
Coal , thin seam, with fire clay,.....	1 to 2 feet.
<i>Shale</i> , lower part blackish,.....	12 feet.
Coal . <i>Little's Bank</i> ; coal cubical, of good quality, from 2 to 4 feet in thickness, and averaging,.....	3½ feet.
<i>Under-clay</i> ,.....	1 to 2 feet.
<i>Space</i> , down to the first limestone seen,.....	30 feet.

1016. (b) *Lance's Bank*, about half a mile from Littles, on the Bon Air side; bed same as that of Little's; coal three feet; section similar to that just given.

1017. (c) From *Lance's Bank*, around the mountain to Bon Air, thin outcrops of the seams occur at numerous points. On the old road, leading to the top of the mountain, in the vicinity of the latter place, the Measures below the Conglomerate, which is here 90 feet thick, consist of shales 100 feet in thickness, in which are four thin seams of coal, several of which have under-clays. (§ 923.)

1018. (d) *Rodgers' Bank*; in Dog, or Lost Cove, between two and three miles from Bon Air, in an easterly or southeasterly direction; opened by Gen. Rodgers; bed two and a half feet at outcrop, may be three or four feet within. In this region are, at some points, four seams, the bank above being in the third below Conglomerate. An outcrop of four feet in one of the seams of this cove is reported to exist at a point not visited.

1019. (e) Passing back to the cliffs overlooking the valley of Calf Killer, we find, at the head of Blue Spring Cove, northeast of Little's Bank, and

about four miles north of Bon Air, *Trowbridge's Bank*. The section here is as follows:

CONGLOMERATE , heavy, making the cliff.	
<i>Shale</i> , (may have a <i>coal</i> seam,).....	15 feet.
<i>Sandstone</i> , from.....	3 to 6 feet.
<i>Shale</i> ,	2 feet.
Coal ,	2½ to 3 feet.
<i>Sandstone</i> , rough, eight or ten feet seen.	

1020. (f) North of the last, and on the point of the Table-land about opposite the mouth of Cherry Creek, is *Officers' Bank*, which has afforded considerable coal. Not having visited it, I cannot give its character.

1021. (g) Several fine outcrops are reported in the head of England's Cove, beneath the Conglomerate; one, I was told, is "15 feet thick;" I cannot vouch for the truth of the statement.

1022. (h) At the extreme head of the Calf Killer gorge, in Putnam County, and about a mile south of Whitaker's, on the Walton road, the following section was seen:

CONGLOMERATE , capping the Table-land here.....	100 feet
<i>Shale</i> ,	4 to 6 feet.
Coal , at least.....	2 feet.
<i>Space</i> , doubtful,	5 feet.
<i>Sandstone</i> ,	35 to 40 feet.
<i>Shale</i> , at top, with lower part doubtful,	15 feet.
LIMESTONE .	

1023. (i) Other similar sections occur in this region. At Brady's Mill, in the same vicinity, the following is the section, no coal appearing:

CONGLOMERATE ,	100 feet.
<i>Shelly Sandstone</i> ,	25 feet.
<i>Sandstone</i> ,	15 feet.
<i>Shale</i> , with iron-stones,	15 feet.
<i>Space</i> , rocks not seen, in which there might be <i>coal</i> . The limestone soon follows.	

1024. (j) *Horn's Bank*, at the top of the mountain, on the west side of the Calf Killer Valley, in Putnam, near the White County line; a bed six feet thick in the bank; lies immediately below the Conglomerate, or with but a little shale intervening; has a heavy sandstone below it, the Mountain Limestone soon following.

1025. In none of the banks enumerated, has there been anything like extensive mining done. They are little else than openings made in the beds for the purpose of obtaining a little coal for local use. The stimulus of a railroad is needed, to bring out the mineral resources of this region.

1026. Returning to the sections in §§ 1009 and 1010, we see that the *Upper Measures* in these embrace several coals. The two principal ones appear to be the *Eastland* and the *Scarbrough*. The later may be the *Main Sewanee*, or *Coal B.* (§ 980.) Of this I cannot, at present, be certain, though I think it probable. In the sections I have referred the portions above the main Conglomerate to the *Upper Measures*, thus making them equivalent, in general, to the upper portion of the *Sewanee Section.* (§ 949.) This reference, as in the case of the *Scarbrough Coal*, is provisional. The plants have not been studied. The underlying Conglomerate is a well defined stratum, and, doubtless, equivalent to that of the *Crab Orchard Section.* (§ 1005.)

1027. The belt of the Table-land in White and Cumberland counties, west of the *Crab Orchard Range*, embraces in the most of its area, the upper plateau-ridges, which are usually capped with the topmost stratum of the *Eastland Section.* They, therefore, may contain the coals of this, and of the section at *Scarbrough's.* Very few natural outcrops are met with, and it remains for future enterprise to see how far the beds are developed.

1028. The sections taken on the slopes overlooking the *Calf Killer*, the two just referred to, and that of § 1005, taken together, will enable the reader to appreciate the general character of the *Coal Formation* across the middle parts of the Table-land.

1029. Before leaving this belt, *Davis' Bank*, in Cumberland County, must be mentioned. This is located about five miles in a southeasterly direction, from *Crossville*, and about a mile from the old *Lowry Stand.* The bank is on a branch of *Meadow Creek.* The coal is near the surface, has no covering but the soil, and is obtained from open pits. The bed is at least six feet thick. The coal is of excellent quality, lustrous, has the structure of the first-mined *Sewanee coal*, and is used by blacksmiths in *Crossville*, and at other points.

This coal, with the *Scarbrough* and the *Haley*, may belong to the *Main Sewanee.* Future investigations must settle this point. The strata in the vicinity of the *Davis' Bank* are much disturbed West of it, for half a mile or more, is a belt of tilted strata, sandstones and conglomerates out cropping in parallel ledges, which run in a northeasterly and southwesterly course. Following this belt of disturbance on the northwest, is a fault beyond which the rocks are horizontal. This is the first line of marked

disturbance met with in traveling southeastward, across this part of the Table-land.

1030. We now pass to the part of the division under consideration, lying in Putnam, Overton, Fentress, Morgan and Scott counties.

1031. The Coal Measures in this area present the same general features that they do in the portion just considered, and it will not be necessary for us to dwell at length upon them.

The *Lower Measures* of the area have been characterized in common with those of the whole western escarpment, in § 1013. The lower coals have been most worked, are best known, and, at many points, are the most available on this portion of the Table-land.

1032. The remarks made in §§ 1026 and 1027, apply as well to what I name here *provisionally*, the *Upper Measures*. The uppermost rock of the Eastland Section (§ 1009) appears to extend northeastward, through Cumberland, into the eastern end of Putnam, the southern parts of Overton and Fentress, the western part of Morgan, and further northward. It becomes at some points, a well defined and heavy conglomerate. It is the cap-rock of the greater part of the region indicated, appearing as the top-rock of the plateau- belts between the valleys of the mountain streams. The high, level roads of the Table-land, often run for miles upon it.

1033. The *Main Conglomerate*, separating the Lower and "Upper" Measures, in the Eastland Section, is also well characterized, is often 100 feet, and is the cap-rock of much of the Table-land in Putnam, Overton, Fentress, and the western part of Scott. Jamestown, and much of the surrounding country are based upon it. On the parts of the Table-land capped by the upper Eastland rock, the valleys cut down into the shales underlying the latter, and often through them, to the Main Conglomerate. The Measures between these rocks are thinner in Putnam, and in the northwestern part of Cumberland, than further south, and do not appear to contain as much coal.

1034. It may be found, hereafter, that the two conglomerates above mentioned, go together, like the pair in the *Ætna* Section, (§§ 994, 995,) although the features of the Eastland and Scarbrough sections point to Sewanee for their parallel. In the Crab Orchard Section, the upper one does not appear as a conglomerate.

1035. I present on next page a few typical sections, and an enumeration of a number of the coal outcrops and banks in this part of the Northern Division.

First is a section taken at the mouth of *Big Hurricane*, in the southwestern part of Fentress County.

UPPER MEASURES, 214 ft.	(6) CONGLOMERATE , forms cliffs overlooking the deep, wild gulfs of this region. The upper plateaus crowd in closely here,.....	40 feet.
	(5) <i>Shale (Coal?)</i>	51 feet.
	(4) <i>Sandstone</i> ,.....	6 feet.
	(3) <i>Shale (Coal?)</i>	21 feet.
	(2) <i>Sandstone</i> ,.....	46 feet.
	(1) <i>Shale (Coal?) and Sandy Shale</i> ,.....	50 feet.

CONGLOMERATE, mostly without pebbles here, forms a lower terrace of bold cliffs,..... 90 feet.

LOWER MEASURES, 35 feet.	(3) Coal , with a sandstone roof, very irregular, varies from 0 to 3 feet, is seen at several different points under the cliffs in the Hurricane gulf, coal cubic, apparently of good quality, from.....	0 to 3 feet.
	(2) <i>Fire Clay, Shale, and thin Sandstone</i> ,.....	4 feet.
	(1) <i>Shale</i> , with six or eight layers of thin <i>clay iron-stones</i> ,.....	25 to 30 feet.

MOUNTAIN LIMESTONE; limestone 15 feet; followed below by 100 feet of variegated, marly shales.

1036. The following was taken, in the southeastern part of Overton County, on the east side of the East Fork of Obey River, and near the road leading from Bledsoe's old stand to the "Three Forks" of the West Fork. It exhibits one of the coals in the *Upper Measures*:

UPPER MEASURES, 208 feet.	CONGLOMERATE ,.....	40 feet.
	<i>Shales (Coals?) and some thin sandstones</i>	80 feet.
	<i>Sandstone</i> , shelly,	25 feet.
	<i>Shale</i> ,.....	5 feet.
	Coal , has been mined, but the opening mostly closed at the time of my visit; coal cubical, of excellent quality; bed, I was assured, at least,.....	4 feet.
	<i>Shales?</i>	54 feet.

CONGLOMERATE, heavy, but not measured; below it are Shales and Sandstones, and below these again, the *Mountain Limestone Formation*.

1037. The sections above present sufficiently well, the general structure of the Coal Formation in this region. The Main Conglomerate has always a coal horizon, made up of shales and sandstones, below it, and, when the cap-rock of the higher

plateaus is present, one above it. Both horizons are variable in thickness, and, also, as to number and quality of their coals.

1038. The following are examples of banks opened in the *Lower Measures*, and of some of the natural coal outcrops occurring. Two additional sections are also given, which will further illustrate the character of the series.

1039. (a) *Whitaker's Coal*, in Putnam County. In §§ 1022 and 1023, are sections at the head of the Calf Killer Gulf. From a mile and a half to two miles north of these, on the breaks of Sinking Cane, are Whitaker's Banks. There are two of these, half a mile apart, both under the Conglomerate, a bed of shale intervening. One was six feet thick when first opened, soon, however becoming less; the other is from three to three and a half feet, affording a good, cubic coal, highly esteemed by blacksmiths.

At the latter bank there are nearly 100 feet of measures below the Conglomerate.

1040. (b) *Taylor's Bank*, at the head of Buffalo Cove, in Fentress County, and about four miles from Jamestown. The following is an approximate section at this point:

CONGLOMERATE , very heavy, caps the Table-land in this region.	
LOWER MEASURES, 180 ft.	<i>Shelly Sandstone</i> ,.....15 to 20 feet.
	<i>Shale and Sandy Shales</i> 60 feet.
	<i>Sandstone</i> 12 feet.
	<i>Shale</i> , 10 feet.
	Coal , lustrous, cubic, excellent coal. About half a mile from this point is another <i>bank (Little's)</i> in the same bed,.....3 to 4 feet.
	<i>Space</i> , rocks not seen,..... 4 feet.
	<i>Sandstone</i> , 20 feet.
	<i>Space</i> , rocks not seen,..... 30 feet.
MOUNTAIN LIMESTONE.	

1041. (c) *Poplar Cove Banks*, about three miles west of Jamestown, approximately the same position as the last. These are old banks, worked many years. Two boat loads were taken down the Obey to the Cumberland, and then to Nashville. Bed three to four feet.

1042. (d) On the White Oak, east of Jamestown, are several promising outcrops of coal. One of these is about six miles from Jamestown, at which point the following section is seen, the thickness of the heavier strata being estimated:

CONGLOMERATE , about.....		100 feet.
LOWER MEASURES, 76 feet.	<i>Space, rocks covered</i>	25 feet.
	<i>Shelly Sandstone</i> ,	15 feet.
	Coal , outcrop; a little shale above.....	1 foot.
	<i>Shales</i> ,	20 feet.
	Coal , main outcrop, fine natural show of good coal; from two to three feet seen, may be.....	4 to 5 feet.
	<i>Shale and Sandstone</i> ,.....	10 feet.

Bed of White Oak.

1043. (e) *Stepp' s Bank*, on White Oak, at the mouth of Yellow Creek, three miles, air line, from Jamestown. The bed has about the same position below the Conglomerate as the lower coal above; shows at the surface three feet of bright, good-looking coal, and is, doubtless, at least, a four-foot bed.

1044. (f) *Gen. Rodgers' Banks*, in Double-top Mountain, in the western part of Fentress. Double-top is an outlier, situated between the East Fork of Obey and Wolf River. I have not seen these banks, but am informed that the coal is excellent, the bed averaging nearly four feet. The banks are very near Obey's River, and boats, in high water, can be carried out to the Cumberland.

1045. (g) Returning to the head-waters of the East Fork of Obey, we find a fine natural outcrop of coal in Cumberland County, about a mile south of the old Emery road, and on *Dripping Spring Creek*, a tributary of Meadow Creek. This coal is immediately below the Conglomerate, and shows a clear face above the water of four feet, the bottom not being seen. The same coal also appears below, on Meadow Creek.

1046. (h) In the gulf of the *Big South Fork*, there are several outcrops of the lower coals of good thickness, but I cannot, at present, specify them. At Beaty's old salt-works, on the *Big South Fork*, in Kentucky, is a fine show of good coal. It measured, near the surface, from three to four feet; the bed is, doubtless, four or five feet thick.

1047. Outcrops of the *upper coals* are not so numerous as of those below the Main Conglomerate. There, are, at some points, three coal seams in this horizon, at others, two, and occasionally but one. A promising opening in one of these has been given in § 1036. Below are others:

1048. (a) On *Little Laurel*, in Overton County, and very near the Fentress line, is a fine natural exposure of solid, regular, cubical coal. The point is about southeast from Livingston, and a little north of east from the Oil Wells on Spring Creek. The bed is full four and a half feet thick. Coal has been taken from this place for special purposes. My guide (Mr. L. W. Hoover) stated at the time of my visit, that "this coal had made half

the game guns in Overton County, besides many that have gone West." The following is the section at this point:

UPPER MEASURE, 240 feet.	UPPER CONGLOMERATE,.....	55 feet.
	Shale? (Coal ?).....	60 feet.
	Shelly Sandstone	15 feet.
	Shale?.....	88 feet.
	Sandstone, seen,.....	2 feet.
	Shale,.....	15 feet.
	Coal ,	4½ feet.

Water of a branch emptying into Little Laurel.

1049. (b) At Hoover's, on Little Hurricane, (a point just within Overton, and about four miles west of the old Bledsoe Stand,) a bank was opened several years ago, apparently in the same stratum as that above. The coal is of good quality, three feet, thick, and has half a foot of slaty cannel above it. The same bed is seen in the valley of the Big Hurricane, about a mile east of Hoover's. The following is the section on Little Hurricane. An upper seam also appears.

UPPER MEASURES, 213 feet.	CAP ROCK, or UPPER CONGLOMERATE.....	30 feet.
	Shales and thin Sandstones,.....	90 feet.
	Shale,.....	5 feet.
	Coal , promising outcrop,.....	1 to 2 ft.
	Shale and some thin Sandstones,.....	68 feet.
	Black Slaty Cannel, six inches.	
	Coal , Hoover's Bank; may be a four-foot bed; has a good bed of shale above it; near the surface,.....	3 feet.

Space, down to Little Hurricane,..... 15 feet.

This is followed, not far below, by the *Main Conglomerate*.

1050. (c) One of the upper coals occurs at a point near the Putnam County line, about three miles north of the Emery road, and in a direction a little east of north from *Officer's*. It has much shale above it, and appears to have the relative position of the Hoover Coal.

1051. (d) Above the *Whitaker Bank*, containing the bed of coal three and a half feet thick, (§ 1039,) is an upper bed, two feet in thickness. This appears to be above the Main Conglomerate, which is here greatly reduced in thickness, and has, both above and below it, an unusual development of shale.

1052. (e) *Johnson's Bank*, in Cumberland County, on Clear Creek, at a point about two miles northeast of the old Johnson Stand. But little coal has been taken from this. Said to be a four foot bed. At the time of my visit, the pit was partly filled with water; above the water it showed two feet of excellent coal. Resting upon the bed are fifteen inches of cannel slate above which are indications of still more coal. This opening pro-

mises well. The coal lies but little below the Upper Conglomerate, which is quite heavy here.

This bed shows, at another point about three-fourths of a mile below, on the opposite side of the creek.

1053. An outcrop of one of the upper coals, four feet in thickness, is reported a few miles west of Johnson's, towards the head of England's Cove, and not far above the sub-conglomerate *fifteen-foot* bed spoken of on a previous page.

1054. On the old stock road leading south from the Bledsoe Stand, the two Conglomerates, with the shales between, are well seen. Below the upper one is a thin outcrop of coal, which appears to have the place of the Johnson Bed.

1055. (D) *The Northeastern Division*.—This, the remaining division of the Tennessee Coal Field, embraces parts of the counties of Morgan, Anderson, Scott, Campbell and Claiborne. Within it are numerous high ridges, or mountains, that rise above the general level of the Table-land, and in which is found a *great* development of the Coal Measures. In these ridges the shales, coals, and sandstones, generally horizontal, or nearly so, are piled up in alternating series to a great height above the Conglomerate. Altogether, the Coal Formation in this part of the State has a thickness not far from 2500 feet. Nowhere else in Tennessee does the formation present anything like this volume; nowhere else are there so many coal beds, or such an aggregate mass of coal.

1056. The topography of this area has been noticed in the First Part of this Report. The high ridges referred to are mostly included in the New River Group, (§§ 185-187.) They lie, for the most part, east of a line running through Montgomery and Huntsville, and occur, in general, as great water-sheds around the mountain-hemmed valleys of the upper tributaries of New River. They thus divide the waters of this river from those of the Emery on the south, those of the Clinch on the east, and those of Clear Fork and Tellico creeks of the Cumberland, on the north. From the main water-sheds great fingers run in, and interlock with the ramifying tributaries of New River.

The "*detached block*" of the Table-land, or nearly detached, as well as the remarkable skirting ridge, called here *Walden's Ridge*, are to be noticed. (See §§ 179-184.)

1057. The character presented in §§ 940-942 as typical of the Coal Field in general, is nearly lost in this division. The *Lower Measures* occur below the Conglomerate, but the *Upper*

Measures, as seen in that type, have piled upon them many superior strata. By *Upper Measures*, however, I mean here, as elsewhere, all above the *Main Conglomerate*.

1058. It is not in my power to present, at this time, a complete analysis of this rich portion of the Coal Field. There has not been time enough granted for that. I will be able, however, to give my readers its general features, which will enable them to appreciate its great mineral resources.

1059. I present, first, a section of the *Upper Measures* as seen in *Cross Mountain*. (§ 186.) This was taken in 1859, across the great ridge, at a point opposite Col. R. D. Wheeler's residence, in Campbell County, and about four miles in a southwesterly direction from Jacksboro.' My instrument was a pocket-level. The thicknesses are approximations. The section begins near the base of the mountain, at *Wheeler's Coal Bank*, and ascends to one of the highest points, the elevation of which is about 3,370 feet above the sea, and 2,329 feet above *Cove Creek*. (See page 73, (2).) The strata are nearly horizontal, excepting at the base, where they dip at a small angle into the mountain.

(45) SANDSTONE, caps the highest points of the mountain,.....	100 feet.
(44) Shales and Shaly Sandstones,.....	55 feet.
(43) Sandstone,.....	15 feet.
(42) Shales and thin Sandstones,.....	165 feet.
(41) Shale,	14 feet.
(40) Coal , a fine exposure, contains a six-inch seam of black shale, but otherwise pure cubic coal,.....	6 feet.
(39) Shale,.....	40 feet.
(38) Thin Sandstones and Shales; these rocks are in the gap through which the path leads from Wheeler's across to Beech Creek,.....	155 feet.
(37) Shale,	45 feet.
(36) SANDSTONE,.....	37 feet.
(35) Shale and Sandy Shale,.....	74 feet.
(34) Coal , fine outcrop, (may be 6 feet,).....	4 feet.
(33) Shale and thin Sandstones,.....	40 to 60 ft.
(32) Sandstone.....	60 to 80 ft.
(31) Shale,	50 feet.
(30) Coal , outcrop,.....	1 foot.
(29) Fire Clay,.....	1 or 2 ft.

Sig. 26. Vol. 1.

	(28) <i>Shale</i> ,.....	50 to 80 ft.
	(27) SANDSTONE ,.....	60 to 90 ft.
	(26) <i>Shales</i> ,.....	130 feet.
	(25) <i>Shales</i> , with <i>clay ironstones</i> ,.....	20 feet.
	(24) Coal , <i>outcrop</i> ,.....	1 foot.
	(23) <i>Shale</i> ,.....	6 feet.
	(22) Coal , <i>outcrop</i> at a large "lick" on Beech Creek side, may be a five or six-foot coal,.....	3 feet.
	(21) <i>Shale</i> ,.....	50 to 80 ft.
	(20) <i>Sandstone</i> ,.....	50 feet.
	(19) <i>Shales</i> , mostly,.....	100 to 120 ft.
	(18) SANDSTONE ,.....	75 to 100 ft.
	(17) <i>Shale</i> ,.....	45 feet.
	(16) Coal , <i>outcrop</i> , with shaly parting of three inches,.....	3 feet.
	(15) <i>Shale and Sandstones</i> , shales predominating,.....	190 feet.
	(14) SANDSTONE ,.....	50 to 80 ft.
	(13) <i>Shale</i> ,.....	20 feet.
	(12) Coal ,.....	3 feet.
	(11) <i>Shale</i> , with <i>clay ironstones</i> ,.....	25 feet.
	(10) <i>Sandstone</i> ,.....	25 feet.
	(9) <i>Shale</i> , heavy, thickness uncertain, say,.....	110 feet.
WHEELER'S BANK.	(8) <i>Shale and "black slate"</i> ,.....	10 feet.
	(7) Coal , <i>outcrop</i> ,.....	1 foot.
	(6) <i>Shale and Fire Clay</i> ,.....	4 feet.
	(5) <i>Shale</i> ,.....	5 feet.
	(4) Coal , with a three-inch parting in upper portion,...	5 feet.
	(3) " <i>Black Slate</i> ," contains <i>Stigmara</i> , with rootlets,.....	3 feet.
	(2) <i>Shale and Fire Clay</i> , with <i>Stigmara</i> ,.....	6 feet.
	(1) <i>Sandy Shale</i> , (foot of mountain,).....	30 feet.

1060. The entire thickness of the strata in the section above, is about 2,100 feet. At no point, except in Wheeler's Bank, has any work been done to lay open the *coal seams*, yet we have, known only by their natural outcrop, no less than *nine* of them, six of which show not less than three feet of coal each. The aggregate amount of outcropping coal is 27 feet. This promises well for the Measures when they shall have been thoroughly examined. Many seams, doubtless, do not appear

at the surface, and the aggregate of the coal, when fully made out, will be found to be more than double that given.

1061. Below is a section of *Tellico Mountain*, lying on the northwestern side of the Elk Fork Valley, (§ 354.) This valley is divided longitudinally by a great fault running through it. To the northwest of this fault lie the Coal Measures, the Conglomerate being the lowest stratum seen in the valley; immediately to the southeast, as shown in the section, are much lower formations, while the Conglomerate is raised to the very top of Pine Mountain.

This section was taken by F. G. Chavannes, Civil Engineer, in a survey of the Elk Fork Valley. It indicates, like the last, great richness in *coal*. The thicknesses are approximate.

MEASURES OF TELlico MOUNTAIN, 1620 feet, (approximately.)

- (11) *Shales, Slate, etc.*, a portion not defined; contains a bed of **Coal** not located; a heavy series at the top of *Tellico Mountain*, with a maximum thickness, according to Chavannes' sections, of not less than.....600 feet.
- (10) SANDSTONE, compact, forms cliffs, about..... 90 feet.
- (9) *Shales and Flaggy Sandstones*; "contains, I think, a three and a half feet **Coal Seam**,"..... 50 feet.
- (8) *Micaceous Flaggy Sandstones, Shales, Flaggy Sandstone*, 80 feet.
- (7) *Shales and Slate*, and very probably a valuable **Coal Bed**,.....100 feet.
- (6) *Flaggy Sandstone, Shales, Flaggy Sandstone*; contains **Coal Seams**,.....250 feet.
- (5) *Slate, Coal* one and a half feet thick, *Slate, Sandstone, Coal* two feet, *Slate, Grit, Shales, Slate, Grit*, 120 feet.
- (4) *Coarse Micaceous Sandstone*,.....200 feet.
- (3) *Slaty Grit* on top, *Shales, Slate, Yellow Shales*,..... 80 feet.
- (2) *Slaty Grit* on top, *Shales* eight feet, *Slate*, probably a four feet **Coal Bed**, *Shales*,..... 50 feet.
- (1) **CONGLOMERATE**, quartzose, thickness unknown. This outcrops in the Elk Fork Valley on the northwest side of the Fault. Mr. Chavannes, without giving any especial reason, says: "This rock is evidently higher in the series than the Conglomerate on the top of Pine Mountain." I know of no reason why it may not, provisionally, at least, be regarded as the same.

1062. Below is a section of the *Lower Measures*, as presented in the upper part of *Pine Mountain*. The *Conglomerate* of this is most likely a detached part of that at the base of the last section, and will serve to unite the two sections.

No outcrops of the lower coals have been observed on the face of Pine Mountain that I know of, but the seams are doubtless present. This section, with the exception of the parts within parentheses, is Mr. Chavannes'. As before, the thicknesses are approximate:

MEASURES OF UPPER PART OF PINE MOUNTAIN.	(4) CONGLOMERATE , at the summit of <i>Pine Mountain</i> , thickness unknown; has <i>Slate</i> and <i>Shales</i> below.	
	(3) <i>Flaggy Micaceous Sandstone</i> on top; <i>Slate</i> and <i>Shales</i> below, (contains, doubtless, a Coal or two, S.).....	220 feet.
	(2) <i>Compact Grit</i> on top, <i>Slate</i> , <i>Shales</i> , (Coal? S.).....	120 feet.
	(1) <i>Coarse Sandstone</i> on top, <i>Clay</i> , <i>Slate</i> , <i>Shales</i> , (Coal , S.).....	100 feet.

Then follows below the Mountain Limestone, forming the lower part of Pine Mountain.

1063. The sections above may be taken as typical of the character of the Coal Measures in the mountain ridges of the Northeastern Division. The high mountains in Anderson County, the *American Ridge* back of the Saltworks, (Winter's Gap,) present sections similar to that of the Cross Mountain, opposite Col. Wheeler's. The aggregate thickness of the natural coal *outcrops* on the side of the American Ridge, was estimated at 35 feet.

The mountains northeast of Montgomery and Wartburg belong to the same group as those mentioned, and have the same features as to Coal, and the Coal Formation.

1064. The parts of the division not presenting high mountains, have the character of the Coal Field in general, and a geological structure corresponding more or less nearly to that of the type given in § 942; at some points, one or more coal horizons are added above.

1065. In the Cross Mountain Section, (§ 1059,) I have included *Wheeler's Coal Bank*. This is in a very valuable bed of coal that appears to lie at the base of Cross Mountain, from the vicinity of Elk Gap to Coal Creek, and, indeed, at the base of

the main mountain, as far down as the Saltworks. It doubtless extends southwest from this point, and may be the bed worked in some of the banks on the waters of the Emery. This bed has been the main source of the coal used in Anderson and Campbell counties. It is of excellent quality, and highly esteemed. The features of Col. Wheeler's Bank are given in the section. Below are other banks in this bed.

1066. *Morrow's Bank*, near Elk Gap. I saw this in 1859. It was an opening made for the purpose of showing the coal, and the thickness of the bed. The presentation was about as follows:

Shale, heavy bed above.

Coal, *ten feet* exposed in the bank, but somewhat contorted; a six-foot bed at least indicated.

Black Slate, highly bituminous, approaching cannel coal, two and a half feet thick.

Fire Clay and *Sandy Shale*, below.

The Shale upon this coal is followed above by sandstone, above which again, is another *coal bed*, said to be three feet thick.

1067. *Wiley's Bank*, about half a mile to the right of the *Coal Creek Gap*, in Anderson County. The following is the section:

<i>Shale</i> ,.....	
Coal ,.....	1 foot.
<i>Clay Seam</i> ,.....	2 to 3 inches.
Coal ,.....	3½ feet.
<i>Black Slate</i> , with <i>Stigmara</i> ,.....	6 inches.
Coal ,.....	1 foot.
<i>Fire Clay</i> ,	1 to 2 feet.
<i>Sandy Shale</i> ,.....	4 feet.
<i>Thin Sandstones</i> ,.....	10 to 15 feet.
<i>Sandy Shales</i> ,.....	40 feet.
<i>Shale</i> , with <i>Clay Ironstones</i> , running down to the creek,.....	55 feet.

1068. *Bank* in the vicinity of the *Salt-works* (Winter's Gap,) in Anderson. Bank (1854) about one mile from the Gap, and about 60 feet above the branch; the coal of first quality, and from six to seven feet in thickness. Knoxville has obtained the most of its coal here. It is a solid, bituminous, gas-making coal.

I do not assert positively, that the bed here is the same as that of the three banks mentioned above, though I think it is. This is a point to be definitely settled hereafter. Its general topographical and stratigraphical relations are about the same.

1069. This great bed, which we may call throughout, the *Wheeler Coal*, presents, to say nothing of other beds, an amount of fuel which many generations will not exhaust. Being near the base of the mountain, it is easily approached, and will be extensively mined when the Knoxville and Kentucky Railroad is completed.

1070. I am not prepared to say, as yet, what bed of Lesley's classification the *Wheeler Coal* is to be referred to. If called upon to fix it *provisionally*, I would make it *Bed B*, the *Sewanee*. (§ 980.) How far it may be above the Conglomerate I know not. The Gap in Walden's Ridge,* (§§ 183, 184,) through which Coal Creek runs, presents a section which, if there be no fault, would throw it more than 600 feet above the Conglomerate, but this is hardly admissible.

1071. About Montgomery and Wartburg, there are three beds of *coal*. One, opposite Montgomery, appears to be a four-foot bed of good quality. As to the character of the others, I am not informed. These beds doubtless occur at numerous points in the slopes and hills bounding the valley of the Emery River. Scores of banks might be opened along this stream.

1072. *Rocks of Special Use, Minerals, and Agricultural Features of the Coal Measures.* The great mineral product of this formation, is, of course, *Stone-coal*. This is incomparably more important than all of the other mineral substances of the formation, susceptible of application to special use, taken together.

1073. Outside of coal, *Iron-ore* may be mentioned. This is at some points, quite abundant in the shales of the formation. It occurs in nodules, balls, and in flattened concretions arranged in layers in the shales, or scattered through them, and forming what are called *clay-ironstones*. This ore is quite different from anything worked in Tennessee. It consists of *carbonate of iron*, more or less mixed with clay or sand. It is an important ore in Pennsylvania and Ohio, and is extensively used in those States in making iron. The clay-ironstones are mentioned in a number of the sections given on previous pages. They are

* It may be remarked that the skirting Walden's Ridge in Anderson, and in counties further north, is mostly made up of strata belonging to the lower part of the Coal Formation. Some of the lower Sandstones, and the Conglomerate itself, are seen in this ridge, as great, highly inclined, or sometimes vertical, plates, between which are shales and sometimes coal. These strata come out from under the main mountain, and turn abruptly up, at a high angle.

quite abundant in the lowest bed of shale in the Wiley Bank Section.
(§ 1067.)

1074. *Flag-stones* of good quality may be obtained at many points in this formation. Near Wartburg, in Morgan, are good quarries.

1074 a. The sandstones of the Coal Formation are often an excellent building material. When these are white, and of good grain, they make a handsome building. The name *freestone* is given to some sandstones, on account of the ease with which they may be cut in any direction.

1075. The topographical features of the area underlaid by the Coal Measures, or, in other words, of the Table-land, have been given in the first part of the Report. (See page 66, and on.) The surface of the Table-land has many attractions; its clear, pure water; its comparatively mild and salubrious climate; and in many parts, its wild, native scenery, make it an inviting region. Its soils, however, are light, and not comparable with those of the great limestone valleys and areas of the lower portions of the State. They are derived from sandstones and shales, interstratified with which are no limestones, and are, therefore, sandy loams, without calcareous matter. The soils are usually of fine texture and easily tilled, and with proper manipulation, are productive. The addition of composts with lime, will make them highly so.

1076. As we have seen, the surface of the Table-land is more or less cut up into valleys of moderate depth, and wide, flat-topped ridges. Arable land occurs both in the valleys and on the ridges, though the latter are sometimes too poor for cultivation. The native growth is mostly made up of oaks, chestnuts and hickories.

At some points yellow pine abounds. Along some of the streams, or on slopes richer than usual, poplars, maples, and walnuts, are met with. Some of the slopes of the high mountain-ridges in the Northeastern Division are covered with a heavy growth of timber, and are among the most fertile parts of the Table-land.

1077. As stated in § 171, this portion of the State is, as yet, thinly settled. The towns located upon it are *Huntsville*, *Jamestown*, *Montgomery*, *Crossville*, *Spencer* and *Altamont*. In

addition, *Wartburg*, near Montgomery, and *Tracy City*, might be mentioned.

The agricultural features of the Table-land will be further noticed hereafter.

1078. *Fossil Plants of the Main Sewanee and Jackson Coal Horizon*.—This is the list referred to in § 980. The specimens have been seen by Prof. *L. Lesquereux*, and were labelled by him.

- (1) *Neuropteris heterophylla*, Brgt. *Main Sewanee*, Tracy City; *Jackson*, R. R. cut near "Lower Mines," (Porter and Logan Banks.)
- (2) *Neuropteris Loschii*, Brgt. *Jackson*, R. R. cut near Lower Mines.
- (3) *Hymenophyllites giganteus*, Lsqx. *Main Sewanee*, Tracy City.
- (4) *Alethopteris Serlii*, Gopp. *Jackson*, R. R. cut near Lower Mines.
- (5) *Alethopteris lomchitidis* [*lonchiticus*?], Sternb. *Main Sewanee*, Tracy City.
- (6) *Asterophyllites grandis*, Sternb. *Jackson*, R. R. cut near Lower Mines.
- (7) *Calamites cruciatus*, Sternb. *Main Sewanee*, Tracy City.
- (8) *Stigmaria ficoides*, Brgt. *Main Sewanee* in under-clay, Tracy City.
- (9) *Sigillaria Brardii*? Brgt. *Main Sewanee*, Tracy City.
- (10) *Sigillaria Menardi*? Brgt. *Main Sewanee*, Tracy City.
- (11) *Sigillaria tessellata*, Brgt. *Main Sewanee*, Tracy City.
- (12) *Sigillaria elegans*, Brgt. *Main Sewanee*, Tracy City.
- (13) *Sigillaria attenuata*, Lsqx. *Main Sewanee*, same locality as the last.
- (14) *Sigillaria alveolaris*, Brgt. *Main Sewanee*, Tracy City. (This and the last species may be the same.)
- (15) *Syrigodendron* [*Syringodendron*] *cyclostegium*, Brgt. *Main Sewanee*, locality as the last.
- (16) *Syrigodendron* [""] *pachyderma*, Brgt. *Main Sewanee*, locality as above.
- (17) *Lepidodendron obovatum*, Sternb. *Main Sewanee*, Tracy City.
- (18) *Lepidodendron aculeatum*, Sternb. *Main Sewanee*, located as above.
- (19) *Lepidodendron elegans*, Brgt. *Main Sewanee*, located as above.
- (20) *Lepidodendron vestitum*, Lsqx. *Main Sewanee*, Tracy City.
- (21) *Lepidodendron rimosum*, Sternb. *Main Sewanee*, locality as above.

- (22) *Lepidostrobus ornatus*, Lind. & Hutt. Jackson, R. R. cut near Lower Mines, and Main Sewanee, Tracy City.
- (23) *Trigonocarpum*. Main Sewanee, Tracy City.
- (24) *Rhabdocarpus venosus*, Lsqx. Main Sewanee, located as last.

1079. Specimens of the following species have been obtained at the *Ætna Mines*, from the *Main Ætna* or *Cliff- Vein Horizon*:

- (1) *Sphenopteris tridactylites*?
- (2) *Hymenophyllites Hildreti*, Lsqx.
- (3) *Lepidodendron rugosum*, Sternb.
- (4) *Lepidodendron rimosum*, Sternb.
- (5) *Lepidodendron modulatum*. Lsqx.

1980. The following are the fossil *nuts* found at the base of the Coal Measures on the Sewanee Railroad. (See section in § 925.)

- (1) *Trigonocarpon Saffordi*, Lsqx.
- (2) *Trigonocarpon olivæformis*, Lind. & Hutt
- (3) *Trigonocarpon Næggerathii*, Brgt.