

CHAPTER XVII.

MINERALS NOT CONSIDERED ORES, AND ROCKS OF SPECIAL
USE.

1298. Having considered the ores and metals, we take up now the minerals not used as ores, and the rock-material of the formations susceptible of useful application. Many of these substances have been described, and will be but little more than enumerated here.

SECTION 1.

STONE COAL. (1.)

1299. In considering the *Coal Measures*, the coal was necessarily included. The reader is, therefore, referred to chapter XII, where this formation is described, for the principal facts as to the coal, and coal beds. What is added here, is supplementary.

1300. *Amount of Coal*.—It is a difficult matter to make a reliable estimate of the aggregate amount of coal in Tennessee. The superficial area of the coal-field is 5,100 square miles, as given in § 945. I once estimated the amount of coal to be equal to a solid stratum eight feet thick, and co-extensive with the Table-land.* This would be equal in volume to a solid block, 8 feet high, 51 miles wide, and 100 long. As to how this approximates to the truth, the reader can form some idea by studying chapter XII., and its sections. It is, perhaps, a maximum estimate.

1301. *Quality*.—All the Tennessee coals are bituminous; but, as such, they present many varieties. Some are highly

* Reconnaissance, page 95.

bituminous, gas-making coals; others, are semi-bituminous; some, open, free-burning, while others are coking coals. The coals beneath the Conglomerate appear to be as variable in quality as they are in volume. I am inclined to think that the Tennessee coals, in general, contain less pyrite than usual. Of this, however, I cannot be certain, until further observations are made.

1302. I will not attempt any classification of the coals, as to quality. The data are not yet sufficient for this. Below, are a number of analyses of Tennessee coals, collected from a variety of sources:

ANALYSES OF TENNESSEE COALS.

No.	County.	Name of bank.	Specific gravity.	ANALYSES.		
				Carbon.	Volatile matter.	Ashes.
1	Roane.....	Kimbrough's.....	1.45	71.00	17.00	12.00
2	Rhea.....	Gillenwater's.....	"	69.00	14.00	17.00
3	? .....	.....	.....	76.00	17.00	7.00
4	Grundy.....	Sewanee.....	.....	65.50	29.00	5.50
5	" .....	" .....	.....	59.38	34.50	6.12
6	Marion.....	"Upper Seam." .....	.....	59.50	38.00	2.50
7	" .....	" .....	.....	56.50	41.50	2.50
8	"	"Lower Seam." .....	.....	49.50	43.00	7.50
9	"	Etna.....	.....	65.00	32.50	2.50
10	" .....	" .....	.....	74.20	21.39	4.41
11	Hamilton.....	§ 1004 (a).....	.....	63.90	26.80	9.30
12	"	Sale Creek.....	.....	56.75	40.75	2.50
13	Anderson.....	Coal Creek .....	.....	55.00	40.00	5.00

Nos. 1, 2 and 3, are by Dr. Troost.

No. 4, is by F. Zwickl, of New York.

Nos. 5, 6, 7, 8, 9, 12 and 13, are by Prof. W. M. Stewart, of Glenwood, near Clarksville.

No. 10, is by Dr. Julius J. Pohle.

No. 11, is by T. Sterry Hunt, of Canada.

Ashes of 6 and 7, light drab; of 8, dark gray; of 10, fawn-colored; of 11 and 12, reddish gray; of 13, light gray.

The ashes of 10 are made to include: moisture, 1.30; sulphur, 0.71; and ashes, 2.40.

Nos. 6 and 7, above, are from the region in which the sections §§ 961 and 962 were taken. Considerable work has been done recently in this vicinity by Lewis & Co., but as to the developments, I am not informed.

1303. The following statement from Mr. J. H. Kendrick, Secretary of the Nashville Gas Light Company, is interesting with reference to Tennessee gas coals:

Gas Coals.—The old Sewanee coal is now being used in large quantities for gas at Nashville. This coal gives the very *best coke*, and gives a fair yield of gas, the quality of which is made to equal to *Pittsburg coal gas*, by using, say, two and a half pounds of crude resin to every bushel of coal.

The Anderson County coal, is the best *gas coal* in the eastern portion of the State; it compares well with Pittsburg coal.

The New Coal, from the mines of Lewis & Co., on the Jasper Branch Railroad, shows itself by experiments so far, to be equal to any thing in the State, and if they improve as the mines are opened the coal may equal any Pittsburg coal for any use.

1304. *Production, etc.*—At this time the principal points at which coal-mining is done in Tennessee, are *Tracy City*, in Grundy, and the *Ætna Mines*, in Marion. There are many other points at which Coal is mined, a large aggregate amount being thus produced; but by far the greater part of the Coal taken to market comes from the two localities mentioned.

The *Ætna Mines* are active, but I have no statements from them.

1305. The following letter from A. S. Colyar, Esq., President of the Tennessee Coal and Railroad Company, gives us satisfactory information in reference to the condition and operations of the *Sewanee Mines*.

An analysis by Mr. Yaryan is also added, which makes three in all, that we have of this Coal.

NASHVILLE, March 22, 1869.

DR. SAFFORD:

Dear Sir:—In answer to your inquiry, I have to state that the Sewanee Mines, now being worked by the Tennessee Coal and Railroad Company, have been gradually improving in appearance and quality since they were opened. The mine is thoroughly opened, there being now about $4\frac{1}{2}$ miles of railroad track under the ground. The openings are by three main entries from the outside; one extending over 700 yards, the others about 300 yards each. These entries, and the crossings, penetrate enough of the hills on both sides of the railroad to demonstrate, that this single bed of coal has an extent of at least 1500 acres. The entire vein is level, being about 15 feet above the railroad.

The work of this Company for three years, has been to increase the facilities for shipping coal, and it is now shipping about 6000 bushels per day. The next year's work will amount to 80,000 tons, or 2,000,000 bushels. The demand for coal is increasing to such an extent that this Company lacks more

of supplying the demand, shipping 25 cars per day, than it did 3 years ago, shipping 5 cars per day.

The coal is usually 4 feet 8 or 10 inches; but there is much coal 7 feet thick. Since penetrating the mountain, however, a considerable distance, the vein is quite uniform at from 4½ to 5 feet. This coal is much harder, and in every way superior to the coal taken out for several years after the mine was opened.

A remarkable fact has occurred in the use of this coal in engines. The argument against burning coal instead of wood in engines is, generally, that it burns out the fire-box. This Company is now using two engines which have been in constant use 12 years. They have both been rebuilt in the last two years, having run ten years with the same fire-boxes. The machinist in rebuilding one of these engines would have put back the same fire-box, but that it was broken in taking the engine to pieces. Mechanics say there is scarcely such another instance recorded.

The composition of this coal, by the analysis lately made by Mr. Yaryan, of this city, is

Fixed Carbon	63.5
Volatile Matter	29.9
Ash	6.6
	100.0
Specific gravity	1.312.
Coke	70.1

After considerable tests, it is pretty well settled, that this coal will make iron without coking. It is now used in preference to any other tried at the *Vulcan Works* at Chattanooga, and at the large Rolling Mill of Scofield & Gray, at Atlanta.

The mining of this coal costs about 3 cents per bushel; and all the railroads South have reduced the freight on coal until it can now be shipped over any of the roads south of Nashville, including the Nashville & Chattanooga Railroad, at prices as low as those the roads in Pennsylvania are charging.

Truly,

A. S. COLYAR, *President.*

1306. As a part of the history of the mining and consumption of coal in Tennessee, I add the following table. The facts embraced were obtained in 1855, by the author, in most cases from the proprietors of the banks themselves.

The entire amount of coal mined in 1854, is seen by the table to have been 247,400 bushels, or 8,836 tons: *

* In Tennessee a bushel of coal is 80 pounds; a ton, therefore is 28 bushels.

PRODUCTION AND CONSUMPTION OF TENNESSEE COAL IN 1854.

COUNTY.	BUSHEL RAISED.	REMARKS.
CLAIBORNE	500	Used by blacksmiths mostly. Two thousand bushels in addition were brought from Kentucky.
CAMPBELL.....	4000	Consumed by blacksmiths mostly. Fine banks occur, from 4 to 6 feet thick.
ANDERSON. (a) Coal Creek.....	3000	Used by blacksmiths mostly.
(b) Poplar Creek...	35,000	Coal consumed for manufacturing and domestic purposes in Knoxville, North Alabama, and by blacksmiths of the county. Excellent banks, 6 and 7 feet thick. Fifty thousand bushels estimated production of 1855. Coal in Knoxville is worth from 18 to 25 cents per bushel.
ROANE. Kimbrough's Bank.	83,000*	One-third made into coke, and sent to Knoxville, Georgia and Alabama. Sold near the bank at 15 and 12½ cents per 40 lbs. The remainder consumed in Loudon and Knoxville for manufacturing and domestic purposes. Sold near the bank at 12½ and 10 cents per each 70 lbs.
HAMILTON & MARION (a) Jack's Bank.....	1000	In 1853, raised 15,500 bushels. Sold at 7 cents at the bank.
(b) Clift & McCree's	25,000?	Perhaps more.
(c) Tennessee River.	14,000	Two or three banks where the river breaks through Walden's Ridge. Coal delivered on the bank at about 10 cents, and consumed mostly in North Alabama.
(d) Raccoon Mou'tn.	24,500	Banks near the railroad. Coal sent to Nashville, Chattanooga and Georgia. Consumed as above. Estimated production of 1855, 300,000 bushels.†
(e) Battle Creek.....	11,000	Two or three banks.

* A larger amount was given us, but estimated at seventy pounds to the bushel.

† Not having the exact amount, we have estimated the production of these banks, in 1855, at 9009 tons.

COUNTY.	BUSHEL RAISED.	REMARKS.
RHEA. Roddy's Bank*.....	2000	Used in the vicinity. In 1853, about 20,000 bushels were raised at this bank, and consumed at Eagle Furnace, Chattanooga, and in Georgia, for purposes as above.
FRANKLIN	15,000?	Used mostly in Winchester for domestic purposes, and by blacksmiths, etc.
GRUNDY..... WARREN..... VAN BUREN.....	8500	Used in the counties mostly by blacksmiths. Coal delivered in McMinnville costs about 20 cents.
WHITE.....	15,000	Used within the county, mostly in Sparta, both by blacksmiths and for domestic purposes. In great part obtained from two banks, from 3½ to 4½ feet thick.
PUTNAM..... OVERTON	1400	Used by blacksmiths. Considerable coal was sent, a few years ago, from Fentress to the Nashville market.
SCOTT..... MORGAN..... BLEDSE.....	4500	Used by blacksmiths mostly. Numerous exposures of coal, from 1 to 6 feet, many of them of excellent quality.

1307. In 1855 there was a great increase in the quantity of coal mined. This was due,

First, to the greater activity of operations at the Raccoon banks;

Secondly, to the beginning of coal-mining by the *Sewanee Company*.

1308. The estimated production of the Raccoon banks during this year, (1855,) was 9000 tons, an increase of 8125 over the yield of 1854.

1309. The *Sewanee Mining Company* was organized in January, 1854. At the start, they took the coal out of the hill at the "*Lower Mines*." (See §§ 976 (2), and 983,) and sent the first

*Or, Gillenwater's. (See table, § 1302.)

car-load of coal to Nashville in June, 1855. Up to the last of December, of the same year, 3823 tons had been delivered at the city depot.

1310. The production of 1855 will, therefore, stand in tons, as follows:

Increase over last year at Raccoon banks,.....	8125
Sewanee banks,.....	3823
Production of last year,.....	8836
Total production of last year,.....	20,784

In this we allow nothing for the increased quantity of coal raised at other banks, which would swell the total amount to 21,000 or 22,000 tons. The aggregates for succeeding years have not been made out.

SECTION II.

LIGNITE OR BROWN COAL. (2.)

1311. Lignite presents itself as a half-made stone coal. It occurs in the beds much like coal, and has analogous geological relations, the strata of sand corresponding to sandstones, and the laminated clays to shales. The lignite beds at several localities in the Mississippi Bluff, (§ 279,) are a conspicuous feature. They occur at numerous points, and often have a volume of three or four feet, rarely swelling out to five and six.

I have already spoken of the Lignite of the Mississippi Bluff, and of the formation containing it. See §§ 1135 to 1140.

1312. In Carter County, lignite occurs with clay in an isolated deposit, a few miles north of Elizabethton, at the termination of the Holston Mountain. Its lateral extent appears to be limited. A pit has been sunk through the clay into the lignite, penetrating the latter, as I was informed, nine feet. At the time of my visit, the excavations were partly filled with water, which prevented as thorough an examination as I desired.

1313. So long as coal is cheap, and wood plenty, there will be no demand for lignite. As fuel, it is much inferior to either of the former.

SECTION III.

PETROLEUM AND ALLIED SUBSTANCES. (3.)

1314. These substances are mixtures, and not simple minerals. The more fluid kinds, like ordinary naphtha and petroleum, consist, generally, of a number of simple hydrocarbons; the viscid and solid kinds contain oxygenated hydrocarbons.* They may be conveniently classified as follows:

- (1) *Petroleum*; liquids or oils; characteristic constituents, (though the ethylenes and paraffines are most abundant,) hydrocarbons of the Marsh-gas series.
- (2) *Pittasphalts*; viscid oils, mineral tar; characteristic ingredients, hydrocarbons of the Ethylene Series.
- (3) *Asphalts*; mostly solid; mineral pitch; contain oxygenated and nitrogenous hydrocarbons.

These substances run into each other through a multitude of gradations.

1315. The occurrence of *Petroleum* is mentioned on pages 268, 284, 319, 334, 336, 350, and 363.

Since the paragraph on page 350 was written, I have received the following communication from Col. C. H. Irvin, with reference to the Spring Creek oil wells, and also, as to the well on Jones' Creek, in Dickson County, and others on Eagle Creek in Overton.

NASHVILLE, TENN., April 14, 1869.

DR. J. M. SAFFORD:

Dear Sir:—Wells have been sunk on Spring Creek for oil, as follows:

The *Jackson Company's Well*, 600 feet deep; no oil.

The *Newman Well* struck oil of 32° gravity, at 19 feet, in 1866. About 2,000 barrels were pumped at this depth. This well failed, and was then bored to a depth of 52 feet, when about 2,000 barrels more were taken out. The well was abandoned in 1867, on account of the difficulty of transportation. In 1868, it was pumped again, and gave every indication of pro-

*See system of Mineralogy; J. D. Dana; Fifth Ed., pp. 720 to 752.

ducing at least 100 barrels per day. The pump valves got foul, and it was necessary to take up the tubing, since which no oil has been obtained from this well. Mr. Pedrick is now engaged in boring it deeper.

The *Douglass Well*, which is about 75 feet from the Newman Well, produced at the rate of about 30 barrels per day, at a depth of 22 feet, and ceased producing at the same time the Newman Well first failed. This well has never been operated since.

The *Hoosier Well*, about 250 feet from the last named well, got oil, in 1867, at a depth of 35 feet. It is operated by the Tennessee Oil Refining Company. They have obtained 5,000 barrels of oil from this well, at the rate of 50 barrels per day. The well failed in the fall of 1868, and has since been bored to the depths of about 70 feet. Three weeks ago oil was struck again, and the well is now pumping at the rate of 50 barrels per day. The last report from the well is that the quantity is daily increasing.

The oil, to be refined, is now brought to Nashville, by wagons 50 miles to McMinnville, and thence by rail to Nashville, 104 miles.

The South-Western Railroad, now in course of construction, will pass within one mile of these wells, and the Tennessee & Pacific Railroad will pass not further than 15 miles from them.

The same parties are boring who first commenced explorations in 1865, and are still firm in the belief that the Spring Creek oil field will prove as good as any in Pennsylvania.

The well owned by Messrs. Hudson & Co., on Jones' Creek, in Dickson County, produced about 100 barrels in the fall of 1867, at a depth of 132 feet. The well has since been sunk to the depth of 340 feet. Mr. Hudson has lately procured new machinery, and intends boring 1,000 feet, unless oil is met with at a less depth. The indications are very favorable.

Three wells have been bored on Eagle Creek, and some oil obtained from all of them, but the difficulty of access, and low price of oil, caused them to be abandoned in the latter part of 1866.

Your obedient servant,

CHARLES H. IRVIN.

1316. *Pittasphalt* is mentioned on pages 268 and 284. There is a locality of this in Hickman County, on a fork of Blue Buck Creek, called Ugly. Blue Buck is a tributary of Swan Creek. The locality is at Perry's. The *pittasphalt*, or *asphalt*, for the substance appears to be intermediate in character, occurs tolerably plentifully in thin, vertical seams, running through a thick layer of limestone, lying about twelve feet below the Black Shale. The formation is *Nashville*, upon which the Black Shale in this region rests.

1317. *Asphalt* is enumerated, with other minerals, on pages 284 and 334.

SECTION IV.

SALT, NITRE. ALUM, EPSOMITE, GYPSUM, BARITE, COPPERAS, CHALCANTHITE, PYRITE AND BLACK MANGANESE.

SALT. (4.)

1318. Some salt was formerly manufactured in Tennessee, and there are a dozen or more old "saltworks" in the State. But of late years, little has been done in the way of making salt. Within two or three years, an establishment has been built, and put in operation on Obey River, the *brine* being obtained from the wells bored for petroleum. I have not learned what success has attended the enterprise.

The manufacture, hitherto, has been mostly confined to White and Anderson counties.

1319. About the year 1820, Mr. William Simpson, as I am informed, made fifty bushels of salt per day, for months, at the old saltworks on the Calf-killer, in White, three and a half miles northeast of Sparta. After a few months of successful work, the property became involved in a law suit, which embarrassed, and finally stopped operations. The well, 386 feet deep, has been sunk through the *Siliceous Group*, and appears to terminate in the *Black Shale*. When this depth was first reached, large quantities of gas and salt-water were blown out. In about ninety days the gas, in good part, ceased; after this the water was obtained by pumping.

1320. The saltworks of Anderson are situated immediately at the eastern base of the Cumberland Table-land. The well, which is now about one thousand feet in depth, passes through nearly horizontal strata of sandstones, shales, and coal, very near the line of an immense dislocation, (§ 786,) which has brought the *Coal Measures* down to the level of the Valley, and in contact with the Shale of the Knox Group. Such a location is certainly favorable. The water obtained, is, however, weak.

The works were once in the possession of Capt. M. Winters, but afterwards came under the control of Mr. Joseph Estabrook, now deceased, who, with characteristic energy, labored

to make them productive. Had Mr. Estabrook been permitted to carry out his plans, he would have probably succeeded.

1321. In Middle Tennessee, salt water was met with in most of the borings made since the war, for petroleum. Brine was thus obtained in Warren, Van Buren, Overton and Jackson. In many cases it was strong, and so far as quality is concerned, would have done well for boiling. With the exception of the water from some of the wells on Obey, it has not been made use of. The principal trouble in the manufacture of salt in Middle Tennessee, has been the failure of the brine after a few years.

NITRE. (5.)

1322. There are hundreds of caves in the limestone formations of Tennessee, and especially in the limestones of the Cumberland Table-land, which afford *nitrous earth* for the manufacture of *nitre*. During the first part of this century, (in the years 1812-1814 especially,) these caves were well ransacked, and the most accessible parts of the earth raised and leached. It is surprising to see how much work was done. In many of the larger caves remains of the old hoppers and troughs are still to be seen. The marks of the picks and shovels upon the parts of the walls of the caves laid bare by the removal of earth, are as fresh as if done yesterday. (See also § 932 (6).)

1323. In some of the caves the earth first worked has acquired considerable strength again, though nothing like that of the original earth, much of which was exceedingly sharp to the tongue. Since 1860, and during the war, some work was done in these caves, but in no case did it amount to much.

1324. The nitrous matter in the earth of the caves is mainly a *lime-salt peter*, (*nitrocalcite*.) This is leached out, concentrated by boiling, and while in solution, converted into *potash-salt peter*, or common *nitre*, by the introduction of potash.

Most of the nitre of commerce comes from India; some from Spain and Egypt.

ALUM. (6.)

1325. The principal source of native alum in the State, is the Black Shale. The mineral has been spoken of in connec-

tion with this formation on pages 334 and 335, to which the reader is referred.

See, also, paragraphs 450, 473 and 474.

EPSOMITE. (7.)

1326. *Epsomite*, or *Epsom Salt*, is one of the products of oxidation, found with *alum*, *copperas*, and *nitrocalite*, in caves and "rockhouses." Alum Cave, in Sevier County, is an interesting locality. (See § 473, and also § 932.)

GYPSUM. (8.)

1327. I know of no beds of gypsum in Tennessee extensive enough to be of practical importance. It is to be hoped that such beds may yet be discovered.

Localities, affording elegant cabinet specimens, are numerous. At "Gray's Cave," in the north part of Sumner County, fine specimens of transparent cleavable gypsum (*selenite*) are found, some of it in crystals, as well as masses of snowy gypsum, and elegant rosettes.

See, also, pages 254, 283, 357, and 362. In addition, the occasional occurrence of elegant crystals of gypsum, in the limonite pots of the Western Iron-Region, has been mentioned.

BARITE. (9.)

1328. This mineral is sometimes called *heavy spar*, on account of its weight. Other names are, *barytes* and *sulphate of baryta*. It occurs in veins, as a part of the gangue, or matrix, of the ore. It is often the matrix of lead ore.

The white varieties are ground up and used as a substitute for white lead, in paint.

Barite is met with at numerous points in Tennessee. The formations in which it occurs, and a few localities, are mentioned on pages 224, 254, 268, 283, and 362. In Roane County, it is the gangue of the vein containing galenite.

COPPERAS. (10.)

1329. *Copperas* (*melanterite*) is composed of sulphuric acid, protoxide of iron, and water. It results, generally, from the

decomposition of pyrite, and it is common to meet with it in sheltered places, where the rocks contain this mineral.

Large quantities of copperas were manufactured, during the war, from the heaps of pyrite and rubbish which had accumulated around the openings of the Ducktown Copper Mines.

See, also, pages 179, 196, 197, 334, and 335. As an appendix to § 871, I will add, that at the locality of pittasphalt, mentioned in § 1316, I saw, a few years ago, a stone-fence, and the half-built walls of a new house, constructed out of slabs of the Black Shale. The fence, at several points, was crumbling down into heaps, like those at Blount Springs, and the house was getting ready to follow, showing at once the folly of using such material for building purposes, and its availability as an alum and copperas-producing rock.

CHALCANTHITE. (11.)

1330. This is commonly known as *blue vitriol*, or *blue stone*. It is a *sulphate of copper*. The mineral occurs as one of the oxidized ores, in the upper portions of the Ducktown veins. It is also found in solution in the waters which flow from the mines, constituting an item of considerable importance. The blue stone is decomposed, and the copper precipitated, by causing the water holding the sulphate in solution to pass through a very long and continuous line of troughs, which are half filled with scrap iron. The iron and copper exchange places; the latter is precipitated in the metallic form, while the iron flows off with the water held in solution as copperas. See the section, in the last chapter, on copper.

PYRITE. (12.)

1331. *Pyrite*, also called *pyrites*, is composed of *sulphur* and *iron*. It occurs, associated with another mineral, composed of the same elements, and called *magnetic pyrites*, (*pyrrhotite*,) in large quantities, in the Ducktown veins.

This mineral has been frequently mentioned. See pages 179, 196, 197, 223, 254, 268, 284, 319, and 329; also, the notice of the Eastern Iron-Region. Pyrite is also mentioned in connection with the Cretaceous Formation. The locality spoken of on page 223, is on the land of Mr. James Lowrey, and about three miles a little west of south, from Greeneville.

BLACK MANGANESE. (13.)

1332. *Black Manganese*, including several oxides of Manganese (*pyrolusite*, *psilomelane* and *wad*) occurs, associated with limonite, at numerous localities. At most of the ore banks both in the Eastern and Western iron-regions, more or less of it is found.

A little metallic manganese in cast-iron makes the latter all the better fitted for making some kinds of steel; and iron is now manufactured in Greene County for this purpose, from limonite, containing more or less oxide of manganese.

1333. This mineral is easily distinguished, as a general thing, from iron ores, by the black, sometimes earthy black, color of its powder. It is not used as an ore, excepting in the way above mentioned, metallic manganese, as such, not being employed in the arts. The oxides are used extensively for decomposing muriatic acid and furnishing chlorine; as a cheap source of oxygen; as a coloring material in the manufacture of glass and enamels; as a flux in the preparation of cast-steel; and as the source of a useful mordant in calico printing.

As to the occurrence of this mineral, or rather of this group of minerals, in the Knox Dolomite, see page 224.

Dr. Troost, in his Fifth Report, says, "There is," in the northern part of Cocke, near Stone's Creek, "a vein of excellent black oxyd of manganese, which appears to be abundant."

By "vein," I suppose the Doctor means deposit, like others occurring with limonite.

1334. For the notices of other minerals naturally classified with those given in this section, but of less practical importance, such as *quartz*, *calcite*, *fluorite*, *native sulphur*, etc., the reader is referred to Part Second. The pages on which they are mentioned can be found by referring to the Index.

SECTION V.

MARBLE. (14.)

1335. Great interest and importance are attached to the marble of Tennessee. It is now, in the columns and balustrades which, within, adorn the building, one of the chief ornaments of our own noble Capitol, as it is also, and in a much greater degree, of the National Capitol, at Washington.

1336. The principal varieties of marble* in Tennessee, are as follows:

1. REDDISH VARIEGATED FOSSILIFEROUS MARBLE; most abundant and most important.
2. WHITISH VARIEGATED FOSSILIFEROUS MARBLE; runs by gradations into that above.
3. DULL VARIEGATED MAGNESIAN MARBLE; often an excellent and available building material.
4. BLACK AND DARK-BLUE MARBLES; sometimes having white reticulating calcite veins.
5. BRECCIA AND CONGLOMERATE MARBLES, of the Unaka coves and valleys.

1. REDDISH VARIEGATED MARBLE.

1337. This, the most important variety, occurs in East, Middle and West Tennessee, but is most abundant and of the finest quality, in the first mentioned division of the State.

1338. In West Tennessee there are beds of this marble, which are rendered the more valuable, from the circumstance of their presenting almost the last outcrop of limestone seen in going west towards the Mississippi. In Henry County there is a quarry from which considerable marble, for building purposes and for tombstones, has been taken. Some of it has been carried to Paris, more than twelve miles distant, and used in the construction of the foundation of the Court House, and for other purposes.

In Benton, as for instance, a few miles from Rockport, on the Tennessee, the residence of Col. A. P. Hall, the same rock occurs. It is also seen farther south, in Decatur. See §§ 811 and 822.

1339. In Middle Tennessee, in Franklin County, there are

* A *marble* may be defined to be a durable limestone, pure or impure, susceptible of a good polish, and presenting a pleasing appearance when polished.

many localities of marble, and several extensive beds. It was worked here, to a limited extent, for several years. See § 737; and, also, § 738.

The upper part of the Mountain Limestone at Bon Air, in White, affords a clouded white, from which a few tombstones have been taken.

1340. In the Valley of East Tennessee, the Reddish Variegated Marble occurs in the following counties: *Hawkins*, Hancock, Grainger, Jefferson, Knox, Roane, Blount, Monroe, McMinn and Bradley. Some of it also occurs in Meigs, Anderson, Union and Campbell. Its presentations and characters have been already given in the Second Part of the Report, and to this reference must be made. It will be seen that there are two distinct beds of this marble. One of these, the lower part of which is sometimes whitish marble, is described on pages 236-239; the other on pages 244 and 245. Both of them are confined to the belts on the Map colored blue.* Each of them outcrops in several long narrow ranges.

1341. The lithological character of these marbles is given in §§ 606 and 633. The marble of Middle and West Tennessee is of the same nature and equal to much of that of East Tennessee, but inferior to the best.

1342. In the Eastern Valley this variety appertains to the Trenton and Nashville Series; in Franklin County it is *Nashville*, and in the Western Valley *Meniscus*, or *Niagara*.

1143. *Production*.—This marble has been extensively quarried at several points in East Tennessee. *Sloan's Quarry*, in Knox County, is mentioned in § 608, and the *National Quarry* in Hawkins, in § 609.

I have very recently been informed that a quarry has been opened on the farm of Dr. James Blair, in the vicinity of Loudon, and that variegated marble is now being shipped north from this point.

There is no limit to the quantity, and Tennessee could supply the world.

1344. The systematic working of marble appears to have been commenced in Hawkins County. The marble in this

* To two of these blue belts I have given special names; the *wide* one running through Knox County is the *Red Belt*, (§ 610;) the greater one, the course of which lies east of the last, is the *Gray Belt*, (§ 640.) It must not be understood that all of the Red Belt is marble. Its area is made up for the most part, of other rocks, interstratified with which are the marble beds.

county outcrops in a line which is about twelve miles long, and runs in a northeasterly and southwesterly course, through a portion of the valley next west of that in which Rogersville is located. It is not represented on the Map, but the *belt of Trenton and Nashville rocks*, of which it is one of the members, is, (§ 613.) This belt is the blue band next west of Rogersville, and in this the marble lies. (See section in § 751.) Several quarries, at distant points, were opened on this line many years ago, and furnished marble of the first quality.

1345. In April, 1838, the "Rogersville Marble Company" was formed, by gentlemen in and near Rogersville, for the purpose of "sawing marble, and establishing a marble factory in the vicinity of Rogersville."* Orville Rice, Esq., was elected President, and S. D. Mitchell, Secretary. The company operated to a limited extent, for several years, erected a mill, and sold several thousand dollars' worth of marble annually, which was mostly distributed in East Tennessee.

In 1844, the company sold out to Mr. Rice, who, on a moderate scale, has perseveringly and successfully carried on the business ever since.†

1346. Mr. R. sent a block of the "light mottled strawberry variety" to the Washington Monument. This was called the "*Hawkins County Block*," and bears the inscription, "*From Hawkins County, Tennessee*." Another block of one of the best varieties, was sent by act of the Legislature, which was called the "*State Block*."

1347. These blocks attracted the attention of the Building Committee of the National Capitol, who, although they had numerous specimens from all parts of the Union before them, decided in favor of the East Tennessee marble.

An agent was soon after sent by them to ascertain whether or not it could be obtained in quantity, who, when on the ground, had no difficulty in satisfying himself as to that point.

1348. As the result of these circumstances, an extensive quarry affording an excellent material, was opened at a point about nine miles southwest of Rogersville, where the Holston

*It appears that attention, resulting in anything practical, was first called to the Hawkins marble by the favorable opinion expressed with reference to it by Dr. Troost.

†The elegant residence, "Marble Hall," four miles below Rogersville, and built by Mr. Rice, is really a museum of the finest marble East Tennessee affords.

River intersects the marble range. The rock here is in good part, massive, and several hundred feet in width. The location of the quarry is excellent, and admits of the easy transportation of the blocks to the boats. Many thousand cubic feet of marble was sent off. It was taken down the river, and then by railroad to Charleston or Savannah, where it was shipped for Washington.

1349. A good use has been made of this marble in the Capitol at Washington. The balustrades and columns of the stairs leading up to the House and Senate galleries, the walls of the Marble Room, and other parts of the building, are of Tennessee marble. It doubtless forms half the ornamental marble there. As an ornamental material, it has few superiors of its kind.

1350. Mr. James Sloan opened his quarry (§ 608) in 1852. The range is intersected by the East Tennessee & Virginia Railroad, and also by the Holston River. It has been stated that the variegated marble of the Capitol, at Nashville, came from this point. Mr. S. also furnished marble from the same quarry for the State Capitol of Ohio.

In 1856, manufactured marble sold in Knoxville at an average price of \$3.00 per cubic foot, and in Nashville at 4.50.

2. WHITISH VARIEGATED MARBLE.

1351. This variety forms the lower part of the *Red and Gray Marble Bed* already referred to on page 236, and is particularly spoken of in § 607.

It is a coralline, sparry, and as stated, a grayish white rock. The white ground of much of it is mottled with pink or reddish spots; it is then called *Strawberry Marble*. The reddish variegated, sometimes presents the same character. The two varieties, indeed, run into each other, there being no essential difference between them.

1352. I have already mentioned Col. Williams' quarry, near Knoxville. (See § 607, and note at the bottom of page 237.)

A large amount of marble has been taken from this quarry. Several factories in Knoxville have worked it extensively. There is no superior building rock in the State.

1343. Five miles east of Knoxville, at Mecklenburg, a beautiful bluff of the same marble is boldly exposed on the French Broad River, near its mouth. This has already been mentioned. The upper part is variegated with light flesh-colored points and patches.

Similar gray marble occurs about a mile east of Athens, in McMinn, and at many other points.

3. DULL VARIEGATED MAGNESIAN MARBLE.

1354. The extreme upper part of the Knox Dolomite is often a gray and dull reddish-brown, mottled rock, which makes a good building material, and, sometimes, a fair marble. This has, however, been sufficiently described. (See §§ 539 and 554.)

1355. At Chattanooga, associated with the marble above, are layers highly argillaceous, which, when weathered, form a variegated material, easily cut, and worked into fancy objects. The Union soldiers, during the war, amused themselves by cutting, or turning, ink-stands, pipes, paperweights, boxes, picture-frames, etc., out of this material. These were sent home as memorials, and as specimens of "Chattanooga Marble." There were two or three workshops where the manufacture of these articles was carried on in a business like way.

4. BLACK AND DARK BLUE MARBLES.

1356. At many points in East Tennessee, are black or dark-blue limestones, especially in the extreme eastern counties, which are susceptible of a good polish, and would make handsome marble slabs. At many points, moreover, these rocks are traversed by white veins of calcite, and in such cases, particularly if of the proper grain, might be worked up into desirable marble. I have, however, spoken of these already. See §§ 555 and 556. In some parts of the Valley, especially, eastward and southward, the Maclurea Limestone, (page 232.) is compact and almost black, and would make a fair marble. Much of it also is traversed by a network of white veins.

5. BRECCIA AND CONGLOMERATE MARBLES.

1357. A *breccia* is any rock composed of angular fragments, or at most, of fragments but little rounded, firmly cemented in a solid mass. A limestone of this character, if made up of fragments of different colors, or of different shades of color, and susceptible at the same time, of a good polish, constitutes a marble which is often very beautiful. A slab of it is, in fact, a *native mosaic*, the component pieces of which, are irregular in outline, and promiscuously arranged.

1358. Marbles of this sort occur in the valleys and coves among and bordering the Unaka ridges. They have been referred to in §§ 476 and 557.

Dr. Troost, in his Fourth Report, referring to the marbles of East Tennessee generally, says: "I have seen there, brec-

cia marble, which surpasses any thing I know." He doubtless refers to those of the Unaka region.

1359. A locality of *conglomerate marble*—a rock in which the component fragments are rounded and a polished section of which presents a variety of circular, instead of angular patches—has been observed at the end of Star's Mountain in McMinn. Another occurs in Greene County. Such marble is also seen on the Little Tennessee, in Blount and Monroe counties, and at other points.

These breccia and conglomerate dolomites and limestones, are comparatively of limited extent.

SECTION VI.

MILLSTONES, ROOFING SLATES, FLAGSTONES, AND BUILDING MATERIALS.

MILLSTONES. (15.)

1360. Several of the Tennessee formations supply millstones, some of which are of excellent quality.

The *gneissoid* and *white quartz* millstones, of the Metamorphic Group, are spoken of in § 411.

The *chert* of the Knox Dolomite supplies excellent millstones. (See § 559.) This has been made into millstones at a number of points in East Tennessee. At Big Spring, in Claiborne County, Col. Hugh Jones manufactured, during his life time, not many less than 100 pairs of stones from this chert. They were quite in demand, and were considered to be equal to the French buhrstone.

The Nashville Formation furnishes a bed of millstone-grit in Sumner County. (See § 739.)

Millstones for grinding corn have frequently been made from the conglomerate of the Coal Measures.

Dr. Troost, in his Third Report, speaks of a superior kind of "siliceous millstone" near Harpeth River. I have not seen this, but suppose it to be some layer of chert, in the Siliceous Group.

The chert of the Knox Dolomite, where used as above, is a true *buhrstone*.

ROOFING SLATES. (16.)

1361. The roofing slates of Tennessee are confined to the Ocoee Group. They may be found in the counties of Polk, McMinn, Monroe, Blount, Sevier, and Cocke. See §§ 436, 472. (Compare § 871.)

The great presentation of slate on the West Fork of Little Pigeon, in Sevier County, is unusual. See §§ 448 and 449.

1362. Dr. Troost, in his Sixth Report, thus speaks of one of the bands of roofing-slate found in the southeastern part of Sevier: "This is a very extensive tract of slate, and from the superficial examination to which I could subject it, no quarries having yet been made in it, seems to be of an excellent quality. I have seen slabs of it, which have been detached by some natural cause, from ten to twelve feet square, and of uniform thickness, perfectly level and sonorous."

1363. Slate used for roofing is generally of a dark-bluish or purplish color. The color is not, however, important. "To be a good material for roofing, it should split easily into even slates, and admit of being pierced for nails without fracturing. Moreover, it should not be absorbent of water, either by the surface or edges, which may be tested by weighing, after immersion for a while in water. It should also be free from pyrites, and every thing that can undergo decomposition on exposure."*

FLAGSTONES. (17.)

1364. When rocks split readily into thin tough layers, or slabs, they are called flagstones, and are used for paving purposes.

Such slabs, of good quality, are greatly in demand in cities and large towns, and a quarry of them, favorably located for transportation, is often valuable. As an evidence of this, I refer to the fact that in Nashville now, as a substitute, masses of limestone are slowly *sawed*, at comparatively great expense, into paving stones.

1365. Excellent sandstone flags occur in Morgan County, not far from Montgomery.

Many of the roofing slates of the Unaka region might be used as flagstones. They could, also, be manufactured into

* Dana's Manual of Mineralogy.

mantles, slabs for tables, and other similar articles. Slate has been used of late years to a considerable extent, as a substitute for marble.

See, also, with reference to flagstones, §§ 622, 699, 735, and 934.

BUILDING MATERIALS. (18.)

1366. It may appear superfluous to speak of the building materials of a State in which limestones and sandstones are so abundant; nevertheless, much might be said with reference even to our common rocks, that would be suggestive, and have a direct practical bearing. It is not proposed, however, to enter upon a general consideration of these materials, but simply to bring together the paragraphs of the Report in which special rocks have been mentioned.

Tennessee "*granite*," as a building material, has been spoken of in § 410. For notices of other materials, see §§ 554, 665, 698, 726,* 735, 822, 884, 934 and the last of Chapter XII. The section on marble might be included with these references. (Compare § 871.)

SECTION VII.

HYDRAULIC LIMESTONES, CLAYS, GREEN SAND, AND MINERAL WATERS.

HYDRAULIC LIMESTONES. (19.)

1367. The fact has been mentioned that the blue limestone flags exposed at many points on and in the vicinity of the Tennessee River, in Hardin, Wayne, Perry and Decatur counties, will, when burnt, yield *hydraulic cement*. See §§ 716 to 718. But little attention has been paid to the manufacture of this material outside of the region specified.

Near Knoxville, hydraulic cement has been made from the Brown Shale. See § 638.

Large quantities of cement are used in Tennessee. It comes

* With reference to the rock out of which the Capitol, at Nashville, is built, see (2) under this paragraph, on pages 277 and 278.

mostly from abroad. We ought, and it is hoped soon will, manufacture every pound we use.

1368. The following is from the "Geology of Canada," p. 804. It is a good presentation of the character of cement-making limestone:

"Certain impure limestones yield by calcination, a substance which, instead of slaking with water, like ordinary lime, forms with it a paste, which after a greater or less lapse of lime, sets or becomes hard, even under water.

This property is now known to depend upon an admixture of clay or silicate of alumina, containing an alkali; and artificial mixtures are prepared by mingling chalk, or any other carbonate of lime, with a proper quantity of clay, and calcining the mixture. In this way the so-called *Portland Cement*, and many other similar compositions, are prepared, both in England and in France. The *pozzuolana* of the Italians, and the trass of the Germans, are argillaceous materials of volcanic origin, which, when mingled with pure lime, yield hydraulic cements; and these substances may also be imitated by calcining ordinary clays, and then grinding them to powder. When, however, natural admixtures of clay and carbonate of lime can be obtained in abundance, it is more advantageous to employ them than to resort to artificial preparations. When a limestone contains ten or fifteen per cent. of clay, it yields a mortar which hardens almost immediately under water. The proportion of clay may even rise to sixty per cent., without destroying this property. Magnesian limes yield hydraulic cements equally good with those of pure lime; and, as already noticed, a mixture of magnesia with *pozzuolana* or with calcined clay, forms a valuable water cement."

CLAYS. (20.)

1369. The *under-clays* of the coal beds at very many points, are a good *fire-clay*. Most of the coal seams have such under-clays. See pages, 370, 372, 370, 374 and 380; also, *Ætna Section*, page 383; and *Lookout Mountain Section*, page 385; as well as most of the remaining sections of the Coal Measures, in Chapter XII. See, also, notices of clay in §§ 907, 908 and 1141.

1370. At many points in Hickman, Perry, and the counties in the vicinity of the Tennessee River, the shales of the *Meniscus Formation*, (§§ 807 and 811,) yield by weathering, *potter's clay*. On the Sulphur Fork of Beaver Dam, in Hickman, such clay is used by Mr. Adam Coble for making a brick red stone-ware. Mr. C. colors some of his ware with black manganese obtained in the vicinity. The clay is obtained from beneath the Black Shale.

I also call attention here to the *siliceous*, chalky material of Wayne, in § 885.

GREEN SAND, OR GREEN MARL. (21.)

1371. This substance, and the use to which it may be applied, have been noticed in §§ 1097, 1112 and 1113.*

The following are analyses of the green sand of McNairy County, by Troost. Phosphoric acid, which is doubtless present in the marl, does not appear to have been separated:

No.	Silica.	Alumina.	Protoxyd of Iron.	Potash.	Carbonate of Lime.	Water.	Loss
1	48.00	7.00	20.70	10.10	5.70	8.00	.50
2	45.30	6.20	18.00	10.40	10.80	8.50	.80
3	51.70	6.50	21.20	11.30	2.00	7.30	.00

1372. In the State of New Jersey green-sand similar to that of West Tennessee, has been extensively used as a fertilizer. The following are analyses of some of the best samples of the green-sand, or marl, raised and sold in that State.†

	1	2	3	4	5	6
Phosphoric acid.....						
Sulphuric acid.....	0.38	1.12	1.70	3.73	4.54	2.69
Silicic acid.....	0.20	1.54	.....	2.44	0.43	0.26
Carbonic acid.....	53.10	48.86	51.20	49.68	51.16	49.40
Potash.....	.....	.....	.....	.....	.....	.....
Lime.....	3.78	6.24	2.96	4.98	4.27	6.31
Carbonate of lime.....	.....	1.81	1.51	4.14	3.48	2.52
Magnesia.....	12.10	.....	.....	.....	.....	.....
Oxide of iron.....	0.70	2.13	1.50	0.47	2.04	3.25
Alumina.....	15.39 ‡	17.78 ‡	23.67	} 28.71 {	17.67	18.66
Water.....	6.30	7.6	11.90		6.10	8.90
	8.64	12.03	5.53	5.54	9.13	7.55
	100.59	98.67	99.97	99.69	98.82	99.54

1373. It is stated in § 1097, that Green Sand contains grains of a soft greenish mineral, called *glauconite*. The following

*Dr. Troost mentions the marl of West Tennessee in his Third Report, as far back as 1835; as well as in several of his succeeding reports.

†From the "Geology of New Jersey," by George H. Cook, State Geologist, 1868.

‡ Protoxide.

analyses of the *pure* mineral are taken from the New Jersey Report, page 281 :

	A	B	C	D	E	F
Silica	42.643	48.639	49.152	51.110	48.977	50.923
Peroxide of iron.....	23.223	19.802	18.481	18.231	20.466	19.353
Alumina.....	7.093	6.842	8.519	6.214	8.566	7.503
Protoxide of iron.....	4.718	4.236	3.219	4.033	4.135	3.909
Magnesia.....	2.366	2.326	2.790	3.134	2.647	2.918
Potash.....	9.071	9.087	8.750	7.607	7.262	7.505
Water lost at 212 degrees.....	6.668	4.629	3.527	5.165	7.947	7.889
Water lost above 212 °°.....	4.218	4.439	5.222	4.506		
	100,000	100,000	100,000	100,000	100,000	100,000

1374. It is seen from this table, that glauconite, when pure, does not contain *phosphoric acid*, the most important constituent of Green Sand. The value of the marl as a fertilizer, does not depend upon the relative proportion of glauconite, as stated in § 1112, unless we include with this the phosphoric acid.

1375. The constituents which give value to the Green Sand are *phosphoric acid*, *potash*, *sulphuric acid* in combination with lime as *gypsum*, *soluble silica*, *oxide of iron*, and, perhaps, *magnesia*.—Cook. To these must be added, in calcareous marls, *carbonate of lime*. Prof. Cook, in order to supply data for the determination of the value of any sample of marl to the farmer, estimates the most important ingredients to be worth (in the marl) as follows:

Phosphoric Acid.....	\$12.50 per 100 lbs.
Sulphuric Acid.....	80 " " "
Potash	1.00 " " "
Carbonate of Lime.....	40 " " "

That is to say, a quantity of marl containing as much as 100 pounds of phosphoric acid, will be worth \$12.50 for this ingredient alone, and if it contain also 200 lbs. of potash, it will be worth \$2 more, making \$14.50 for both ingredients, and so with the rest, each adding something to the value.

1376. About *one million* tons of Green Sand are used annually, as marl, in New Jersey. It sells for from 35 to 75 cents a ton at the pits, according to quality.

1377. These facts are stated, in order to call the attention

of enterprising farmers in West Tennessee to the value of this substance as a fertilizer. I quote further from the *Geology of New Jersey*.

"The marl which has been described in the preceding pages has been of incalculable value to the country in which it is found. It has raised it from the lowest stage of agricultural exhaustion to a high state of improvement. Found in places where no capital and but little labor were needed to get it, the poorest have been able to avail themselves of its benefits. Lands which, in the old style of cultivation, had to lie fallow, by the use of marl produce heavy crops of clover, and grow rich while resting. Thousands of acres of land, which had been worn out and left in commons, are now, by the use of this fertilizer, yielding crops of the finest quality. Instances are pointed out everywhere in the marl district of farms, which, in former times, would not support a family, but are now making their owners rich from their productiveness. Bare sands by the application of marl are made to grow clover, and then crops of corn, potatoes and wheat. What are supposed to be pine barrens, by the use of marl are made into fruitful land. The price of land in this region was considerably below that in the northern part of the State forty years ago; now that the lands are improved their prices are higher than those in the northern part of the State, though even there they are higher than any where else in the United States. In 1830, Thomas Gordon said of these lands:

'It would be difficult to calculate the advantages which the State has gained, and will yet derive from the use of marl. It has already saved some districts from depopulation, and increased the inhabitants of others, and may, one day contribute to convert the sandy and pine deserts into regions of agricultural wealth.' "*—Gordon's History and Gazetteer of New Jersey—Part 2, p. 5.*

This prediction is fast being fulfilled.

* * * * *

"The marl is in the form of an earth, and is dug with spades, or, if very compact, is loosened by grubbing hoes; and, when fairly crumbled, as it soon is by the sun and air, it is as easily handled as sand. It can then be spread evenly over the surface of the ground. The quantity used varies with the quality of the marl, and the crop to which it is applied. In Eastern Monmouth, where the Lower Marl Bed is largely developed, and is rich in powdered carbonate of lime and poor in phosphoric acid, it is used in enormous quantities, and never injures crops, but on the contrary is of the greatest utility. From one hundred to two hundred tons to the acre are not uncommon. Marls of any kind, which are acid from containing sulphate of iron or sulphate of alumina, are applied sparingly and with care. If put on potatoes in the hill the sprouts are killed by them, and a dressing of fifty tons to the acre has sometimes destroyed all vegetation. The safe way of using such marls is found to be upon well limed lands, or else in dressings of from ten to twenty tons per acre, or else composted with lime. Those marls which contain no carbonate of lime, but are rich in phosphoric acid, are used in quantities of from five to twenty tons per acre.

"In some places the marl is so strongly acid that it is not used, the labor of composting it with lime being more than it is thought worth. It cannot, however, be too strongly insisted upon, that lime will certainly correct the injurious effects of such marls, and no cases can probably be found but what one bushel of slaked lime to ten bushels of marl will be sufficient for the purpose, and generally a half, or even a quarter of that amount, will be enough. The effect of the lime is to decompose the sulphate of iron or alumina and form sulphate of lime (plaster,) which is a valuable fertilizer, and would greatly improve the quality and effects of the marls, so that these *poison* or *black* marls, when properly corrected, are more valuable than those which are not poisonous. This is abundantly verified by the experience of good farmers."

1378. Professor Cook, after giving many details and facts bearing upon the application of the marls in New Jersey, draws the following practical conclusions:

1. That the most valuable marls, and those which will best pay the cost of long transportation, are those which contain the largest percentage of phosphoric acid.
2. That the most durable marls are those containing carbonate of lime, the more the better.
3. That greensands containing but little of either phosphoric acid or carbonate of lime, become active fertilizers when composted with quick-lime.
4. That marls which are acid and burning from containing sulphate of iron, can be rendered mild in properties and useful as fertilizers, by composting them with lime.
5. That crops particularly improved by it are all forage crops, grass, clover, etc.; for these the green marl may be spread upon the surface to the amount of from one hundred to four hundred bushels per acre. The crop is generally doubled, and in some cases quadrupled, by this application. Other marls must be used in larger quantities, but will produce good results.

Potatoes. For this crop marl seems to be a specific. It does not materially increase the growth of vines, and the yield is not much greater, but the potatoes are smoother and fairer in the skin and dryer, and of better quality when boiled. The marl is put on the potatoes in the hill at planting; if not acid, it is thrown directly on the tuber; if acid, the potato is first covered by earth and the marl thrown on or beside that. From five to thirty tons may be used on an acre.

Buckwheat. Most remarkable effects upon this crop are produced by marl. Two and a half tons or fifty bushels to the acre, spread on after sowing, have caused an equal amount of buckwheat to grow on land which otherwise was not worth cultivating.

Wheat, rye, oats and corn, are improved by the use of marl, though not with the striking results seen on the crops before mentioned. It is applied as a top-dressing on the prepared ground, is spread on the surface before plowing, is worked in the hill or drill, or is composted with barnyard manure

and spread on the ground according to the farmer's judgment. From five to thirty tons and even more, may be used upon an acre.

With any kind of garden or field-crop it may be used, and will be beneficial both to the crop and soil. It is free from the seeds of weeds, is dry, and convenient to handle—all of which recommend it to any snug farmer."

1379. *Bat Manure*.—It may be well to mention in this place, the fact of the occurrence of heaps and beds of bat excrements in many of the limestone caves of Tennessee. This substance is in considerable quantity in the parts of the caves that have not been disturbed by the nitre-makers. The heaps met with are the accumulations of scores of years. This manure is valuable as a fertilizer, and has been used locally with good effect. I have recently received the following information:

Dr. I. W. Sparks, of Baltimore, is now manufacturing a fertilizer which he terms "nitro-ammoniated guano," at the Hebeling Cave, in Warren County, Tennessee. It is composed of bat manure, nitrous earth, and the leached ashes which have been used in the manufacture of saltpetre. Dr. Sparks claims that there are at least 30,000 tons of bat manure in the portion of the cave he has explored, and that the nitrous earth is inexhaustible. He ships this material to Baltimore. The trials made with it last year have demonstrated its value as a fertilizer for tobacco and all root crops.

MINERAL WATERS. (22)

1380. Mineral springs in Tennessee are very numerous, and of many varieties. A full account of them would make a volume in itself. No thorough investigation of these springs has been made, and but few complete analyses.

1. *Sulphur Springs* abound in all divisions of the State.

They flow often from limestone formations; as, for example, in the Western Valley. (See §§ 265-268.) The well known Sulphur Spring, at Nashville, is also an example. The *Black Shale* is, however, most prolific in springs of this character. (See § 873a.) The sulphur springs mentioned in §419 have their origin in this formation.

2. *Chalybeate Springs* also, are plentiful, and are found in all the divisions of the State. The cool, inviting summer-retreats of the Cumberland Table-land, like Beersheba and Bon Air, look to these mainly, for their supply of mineral water. (See

§ 197.) Chalybeate waters are especially characteristic of the Coal Measures.

3. *Epsom Salt*, and *Alum Springs*, occasionally occur. Of the first class is the water of Montvale Springs in Blount County, (§ 801, and diagram, page 190.) The water of the sulphur springs frequently contains Epsom Salt, or epsomite. The sulphur springs at Bon Aqua, for example, west of Nashville, contain more or less of this salt. There is also, a chalybeate spring at this watering place.

The Alum Well in Hawkins, is mentioned in § 864.

SECTION VIII.

METEORITES. (23.)

1381. The following notice of a meteorite, which was seen to fall in this State, was published in 1856, in my Reconnoissance:

The Lincoln Meteorite.—Within a few months, another small meteoric mass has been added to the list of those extra-terrestrial bodies which have fallen within the limits of Tennessee. This recent visitor is a stone, weighing, when first obtained, three pounds.

An esteemed friend, the Rev. T. C. Blake, of Cumberland University,* to whose zeal we owe a knowledge of this interesting specimen, has furnished the following particulars in regard to its history.

It fell two miles west of Petersburg, and fifteen northwest of Fayetteville, in Lincoln County, about half-past three o'clock, PM., August 5, 1855, during, or just before, a severe rain-storm. Its fall was preceded by a loud report, resembling that of a large cannon, followed by four or five less reports; these were heard by many persons in the surrounding country. Immediately after, the mass or fragment, was seen by James B. Dooley, Esq., to fall to the ground. It approached him from the east, appeared, while falling, to be surrounded by a "milky" halo, two feet in diameter, and fell one hundred and fifty or two hundred yards from him, burying itself about eighteen inches in the soil. When first dug out, it was too hot to be handled.

This specimen, which now lies before us, has an edge broken off, revealing the character of the interior. Within it is of an ashen-gray color, varied by patches of white, yellowish, and dark minerals.

* Now, T. C. Blake, D. D., of the *Banner of Peace*, at Nashville.

With the exception of the broken edge, it is covered, and when first obtained was entirely covered, as most meteorites of this kind are, with a very thin "black, shining crust, as if it had been coated with pitch;" this was doubtless formed by the fusion of its outer surface in its rapid passage through the air.

One end or face, which may be regarded as the base, has an irregular rhomboidal outline, averaging $2\frac{3}{4}$ by $2\frac{1}{2}$ inches. Placing the stone upon this end, the body of it presents the form of an irregular, slightly oblique, rhomboidal prism. The upper end, however, is not well defined, but runs up to one side in a flattened protuberance, giving the entire specimen a form approaching roughly, an oblique pyramid. The length from the base to the apex is $4\frac{1}{2}$ inches.

Three adjacent sides are rough, being covered with cavities and pits. It is likely that the stone has been torn off from a larger mass, or from other fragments, along these faces.

The other sides are smoother, and rounded, and appear to have constituted a portion of the surface of the larger mass.

The specimen acts upon the needle; fragments of it readily yield particles of nickeliferous iron by trituration in a mortar. The specific gravity of the entire specimen is 3.20. Its weight, in its present condition, 3.83 lbs.

Professor J. Lawrence Smith, of the Medical Department of the University of Louisville, has analyzed fragments of this meteorite, and has kindly furnished us with a copy of the result.

The minerals found in the meteorite are:-

"Pyroxene—principal portion of the mass;

Olivine and } —disseminated through the mass;
Orthoclase, }

Nickeliferous iron—forming about one half per cent. of the mass.

In addition to these, there are specks of a black, shining mineral, not yet examined.

The general analysis is as follows:—

Silica.....	49.21
Alumina.....	11.05
Protoxyd of Iron.....	20.41
Lime.....	9.01
Magnesia.....	8.13
Manganese.....	.04
Iron.....	.50
Nickel.....	trace
Phosphorus.....	trace
Sulphur.....	.06
Soda.....	.82
	99.23

1382. *Tennessee Meteorites in General*—There are *three* different Tennessee meteorites the time of the falling of which is known. Besides these, many others have been discovered,

which are known, from their character, to be of the same origin. Our State has proved itself rich in these wonderful messengers from the sky.

For the benefit of those who may desire such information, a table is added including all, so far as I know, that have been described.

TABLE OF TENNESSEE METEORITES.

No.	County in which found.	General Character	Weight.	Time of falling.	By whom and when described	Through whom made known.
1	Sumner	Stony.	11 lbs.	May, 9 '27	Seybert.	
2	Cocke	Malleable iron.	2000 "	Unknown	Troost, 1840.	Hon. Jacob Peck.
3	Dickson	"	9 "	July or Aug. 1835	" 1845.	J. Voorhies, Esq.,
4	Greene	"	20 "	Unknown	" 1845.	Mr. Jos. Estabrook & Hon. Jacob Peck.
5	DeKalb	"	36 "	"	" 1845.	
6	Jackson	"	15 oz.	"	" 1846.	Col. S. D. Morgan.
7	Smith	"	280 lbs.	"	" 1846.	Col. S. D. Morgan.
8	Rutherford	"	19 "	"	" 1848.	
9?	Jefferson	"	2½ lbs	"	Shepherd, 1854	Hon. Jacob Peck.
10	Claiborne	"	60 lbs.	"	Smith, 1854.	Prof. J. B. Mitchell..
11	Campbell	"	4½ oz.	"	" 1855.	Prof. J. B. Mitchell.
12	Lincoln	Stony.	3 lbs.	Aug. 5, '55	Safford, 1856. & Smith, 1856.	Dr. T. C. Blake.
13	Robertson	Iron.	37 "	Unknown	Smith, 1861.	Dr. J. B. Lindsley.