

CHAPTER X.

THE BLACK SHALE; FORMATION VII.

851. This formation is sometimes denominated the *Black Shale*.

Although comparatively very thin it is, on several accounts, one of the most interesting formations in the State. It is wonderfully persistent, appearing in place, with rare exceptions, wherever its horizon is presented at the surface. It outcrops on that old *gulf shore*, the western beveled slope of the older formations of which we have spoken, (§ 832,) and it appears at the other end of the State, under the brow of Chilhowee Mountain. (§ 801.) It is the geologist's plane of reference, as well as puzzle, the would-be coal digger's *ignis fatuus*, a source of mineral waters, the alum and coperas maker's stock, an oil-schist and a pyroschist.

852. The characteristic and principal mass of this formation is a nearly black, bituminous, rather tough shale, or slate, which can frequently be obtained in plates a yard or more across. This shale contains, very generally, grains and nodules of *pyrite* scattered through its mass. At some localities, the pyrite occurs most abundantly in certain layers of the formation, as, for instance, at the top or bottom. The presence of bituminous matter is also characteristic. The shale generally contains so much of this as to be readily ignited, and to burn for a while with considerable energy when in large heaps, or when fragments of it are thrown upon glowing coals. For this reason it is sometimes called a *pyroschist*. It does not, however, like stone coal, burn to ashes. The bulk, after burning, is the same as before, their being little else consumed beside a small per centage of bituminous matter. It loses, however, its color, by the process, the mass becoming reddish gray. It is often taken as an indication of stone coal, and, in Tennessee, thousands of dollars, and a vast deal of enterprise, have been wasted, in drifting into it.

853. The shale yields by distillation in close vessels, from one to fifteen, or even twenty per cent. of oily matter allied to petroleum, and can be used as a source of oils for illuminating, lubricating, and other purposes.

854. West of the Cumberland Table-land, in most of the counties, the formation does not consist alone of the characteristic Black Shale. The latter has here, at its top, a thin layer of argillaceous, very fetid, concretionary bodies, which I have sometimes called *kidneys*, a name which has already been used with reference to them. These bodies are round, oval, kidney-shaped, and usually more or less flattened. They vary in size from that of a peach-stone to thick, cake-like masses two feet across, and occur packed, often closely, with bluish shale, in a layer from two to twelve inches thick. The kidneys vary in size with the thickness of the layer. These bodies have been mentioned in the sections given respectively in paragraphs 729, 732 and 821.

855. In addition to the kidneys at its top, the shale has immediately below it, very generally, a dark-gray, bituminous, fetid *sandstone*, usually fine-grained, and from a few inches to 15 feet in thickness. In Wayne, Hardin, and in the southwestern part of Lewis, this sandstone is often thick enough to be quite conspicuous, forming ledges along the slopes of the hills, and sometimes small local plateaus.

856. In the counties mentioned, it is frequently the only representative of the group, the kidneys and the Black Shale being absent or replaced by it. Thus it is on Green River, below Waynesboro', where the sandstone is from ten to fifteen feet thick, with the blue shale of the Siliceous Group above, and the Meniscus Limestone immediately below. In the section, also, near the White Sulphur Springs, in Hardin County, (§ 841,) the sandstone, for the most part, represents the group. On Indian Creek, in the region of Esquire Gant's and Craven's Mills, (§ 845,) the Black Shale appears to be represented by an alternation of blue shales and thin, fine sandstones, resting upon the lower member. (See also, § 817.)

857. North and east of Wayne, Hardin and Lewis, the sandstone below the Black Shale is not as thick, in fact, it very often measures but the fraction of a foot. At Montgomery's Mill, (§ 821,) it hardly reaches twelve inches, and at numerous other points it is but three or four.

The sandstone is seen in place on the eastern side of the Cumberland Table-land in the section on the Chattanooga Railroad, above Lookout Station. (§ 779.)

858. This rock, in addition to the *Lingula* of the shale, frequently contains multitudes of individuals of a minute globular spiral shell, which has not been studied. It also shows occasionally, fragmentary remains of plants, and certain curious bodies not understood.

859. The following section presents the Black Shale Formation in its triple character. It was taken in Wayne County at T. A. White's Mill, on Buffalo River, a point a few miles below the mouth of Green River. The section also shows the total absence of Helderberg rocks at this locality, which, by the way, is the case on Buffalo and Green Rivers, east and south, respectively, from the region of the mill. The character of the Siliceous Group above the Black Shale, is also illustrated to some extent.

- (4) A thin bed of *Gravel* (water-worn pebbles) on top, with some loose, angular chert. The gravel is found at the top of all the high ridges in this region. Specimens of *Lithostrocion Canadense* (not water-worn) are also found loose on the surface.

(3) *Siliceous Group*,

Rocks concealed, surface covered with small, angular, cherty masses, 199 feet to top of ridge.

Bluish shale with layers of chert, 15 feet.

Bluish shale, 24 feet.

In all, 238 feet.

(2) *Black Shale Group*.

(c.) Layer of kidneys, 6 inches.

(b.) Black Shale, 2 feet.

(a.) Sandstone, at top thin bedded, surfaces abounding in *Lingula*, 9 feet.

In all, 11½ feet.

(1) *Meniscus Limestone*. (Niagara.)

Gray, mostly crinoidal limestone; contains the characteristic *Haplocrinus hemisphericus* immediately below the sandstone; the *Meniscus* down to the section, 67

860. The *Black Shale Group* is, as the sections already given indicate, of variable thickness. Its maximum is in the East Tennessee Valley where it is often 100 feet, and at some localities more.

In Middle Tennessee, including certain bluish shales, as in the Indian Creek section, (§ 845,) its thickness rises as high as

70 feet. Excluding these, it rarely reaches 50. The *Black Shale*, itself, is of all thicknesses, below 50, averaging, perhaps, about 25 feet. In some parts of Wayne and Hardin counties, it is as we have seen, entirely wanting.

Including the sandstone, however, or taking the *group*, I have never found it absent from its proper horizon but at one point, and that is at the foot of the "big hill," five miles from Mount Pleasant, on the Waynesboro' road. Here the siliceous cherty layers, rest directly on Nashville rocks, all intervening formations being absent. Very soon, however, to the right and left, both the Black Shale and the Meniscus Limestone, come in.

861. The Black Shale Group is usually characterized by the presence of a *lingula* which is doubtless *L. subspatulata* of Meek and Worthen. (Geol. of Illinois, Vol. III, p. 437.) Their figure is that of a large sized specimen. In addition to this, there appears to be another species. A *discina* also occurs in the black shale. I have also met with a species of *chonetes*, as well as beautiful specimens of wood converted into pyrites. The fossiliferous character of the sandstone has been spoken of above. (§ 858.)

862. The lateral extent of the Black Shale has been referred to in § 323. In the Valley of East Tennessee it is often associated with the Dyestone and Siliceous groups in the Dyestone Ridges, forming, with them, the *trio* of which I have spoken, (§ 783.) It is, however, frequently wanting in these ridges, being, with the Siliceous Group, cut off by the faults. (Compare §§ 509-511.) The extreme southeasterly outcrop of the Black Shale is near Montvale Springs. (See § 801.) There is a long outcrop of it at the southeastern base of Clinch Mountain, forming Poor Valley.

863. In Hawkins county, to the southeast of the mountain mentioned, the great fault, which, in Tennessee at least, lies not far from the base of Clinch, throughout its whole length, bends in a bow considerably to the east, allowing the presence of an interesting synclinal trough, several miles wide, holding Lower Carboniferous strata. On the northeast side of this synclinal, the Black Shale comes up, and forms the outcrop in Poor Valley. On the southeast side, the formation outcrops in a curving and broken line, running not far from the western and northern base of the Devil's Nose.

864. At a point on this outcrop of the Black Shale, about six miles in a

northwesterly direction from Rogersville, a shaft was sunk, a number of years ago, for copper. The copper was not found, as might have been anticipated, but the shaft soon became filled with strong alum-water, and is now a medicinal well of considerable reputation.

865. Linear outcrops of the Black Shale skirt the Dyestone rocks in Powell's Mountain, Newman's Ridge, and in White Oak Mountain. Sneedville, as we have seen, is located upon it. (See §§ 753-774.) As to its occurrence in the Dyestone Ridges, and its manner of outcrop in East Tennessee, from beneath the Carboniferous limestones of the Table-land, including Lookout Mountain and Walden's Ridge, see §§ 756, 779, 785-791, and the diagrams on pages 139, 142, 190, 208, as well as the Map.

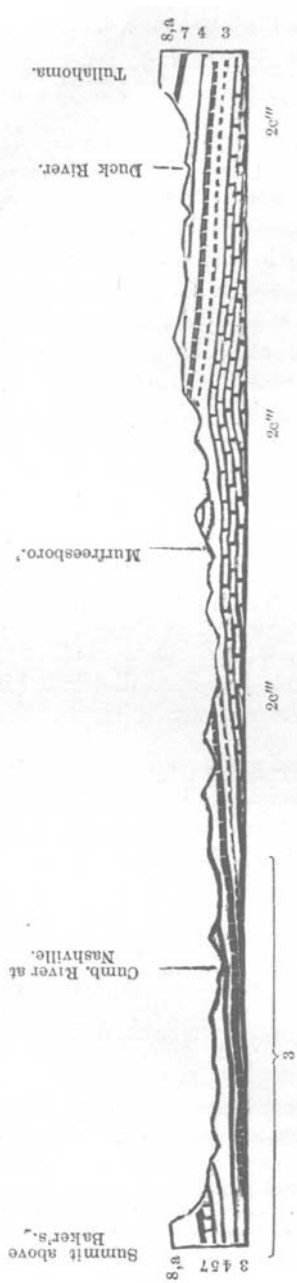
866. In Middle Tennessee, the Black Shale outcrops all around on the slopes of the Central Basin, and on the slopes of the high ridges within it. It is brought down lower in the hills on the west side of the Basin than it is on the other, and even sinks below the level of the Cumberland and Duck rivers, before re-appearing in the Western Valley. It forms, by its outcrop, one of the concentric rings around the central area of the Wells Creek Basin. (§§ 364, 553.) Its position in relation to other formations in Middle Tennessee, has been illustrated in a number of sections, to which reference may be made. See §§ 729, 732, 831, and the Map.

867. The diagram on next page presents a section running quite across the Central Basin, from Tullahoma, through Murfreesboro' and Nashville, to the summit of the steep grade above Baker's Station, on the Edgefield and Kentucky Railroad. (§ 732.) It illustrates both the geological and topographical features of the Basin. The section has already been referred to several times, and is especially spoken of in § 665. It exhibits clearly the position the Black Shale Group holds on each side of the Basin, as well as the relation it sustains to the other formations.

868. It may be well to add here, that the diagram illustrates what has been said in § 336, and especially in § 367, as to the elevation of the strata in Middle Tennessee in a *dome*. In § 336 the summit of the dome is stated to have been, before denudation, over the *central* part of Rutherford; it was rather over the *southern* part of this county. See, also, §§ 208 and 209.

869. *Minerals of the Black Shale, and what it may be made to*

SECTION ACROSS THE CENTRAL BASIN.—Length of Section, 90 Miles. Vertical Scale, 2000 Feet to the Inch.



20m. Knox Dolomite, not seen at the surface within the Basin. 3. Trenton; in this the double broken line represents the Glade Limestone, the blank space above it the Carter's Creek Limestone, that below, the Ridge; the single broken line is the Pierre Limestone, and the blank space below it the Carboniferous upon the Knoxville Dolomite. 4. Nashville Formation in contact above with the Black Shale on the right, and with the Mississippian (Niagara) on the left, the Meniscus Formation (Niagara) wanting on the right; between the Nashville and the Black Shale on the left. 7. Black Shale Group, the heavy black line of each end of the diagram, and lying next below 8a. 8a. Silurian Group the cap-rock of the Highlands around the Basin.

yield. The principal minerals occurring in connection with the Black Shale, are as follows:

(1) *Pyrite*, (Sulphuret of Iron,) already mentioned (§ 852.)

(2) *Bitumen*, (Asphaltum.) The shale is impregnated with it, (§ 852.) Also occurs, rarely pure, in thin seams, from the eighth of an inch to an inch in thickness. The bitumen of these shales is hardly an asphaltum, being generally, perhaps, more like the bitumen of cannel coal.

(3) *Petroleum*, oozes from the formation at a few points in the valley of Obey's River, in Overton County.

(4) *Copperas*, in efflorescences and incrustations on the shales in sheltered places—"rock houses." Localities very numerous, and in all the counties in which the formation outcrops to any considerable extent. This mineral comes from the decomposition of the pyrite in the shale.

(5) *Alum*, both iron and potash alum; the first most abundant. This mineral occurs, like the last, in efflorescences and incrus-

tations in the "rock houses," and quite abundantly. In many of these places, are cart loads of material, made up of earth, crumbling shale, copperas and alum. The localities are, perhaps, the most numerous in Jackson, Overton, Putnam, DeKalb, Cannon, Coffee, Franklin, Lincoln and Giles counties.

870. The Black Shale might be used profitably at many points, in the vicinity of the railroads, for the manufacture of both copperas and alum. The pyrite in the rock contains both sulphur and iron, and when moist and exposed to the air, spontaneously changes into copperas. When this change takes place in contact with shale, as it generally does, both copperas and alum are formed. The shale contains alumina, one of the essential ingredients of alum, and the pyrite, for the most part, supplies the others. This produces an iron alum, but the addition of potash would convert it into common alum.* It is not proposed to give the details of the process by which the substances mentioned may be manufactured from the shale. Anyone interested in this matter can find these in Ure's Dictionary of Arts, Manufactures and Mines, and in works on Chemical Technology. It is very certain that alum and copperas could be manufactured from this shale, on a large scale, in Tennessee, under very favorable conditions as to material and its accessibility.

871. Were it not for the presence of pyrite, which, in decomposing, disintegrates the shale, the formation would be a source of roofing slate, and would afford, also, smooth and very large flags; but the mineral that makes it an alum and copperas-producing rock, unfits it for these purposes. For the same reason it is worthless as a building material. Stone-fences, or walls, built of it, last but a few years. They crumble down into heaps of shaly stuff, which, when protected from the rains, is well mixed with copperas and alum. A notable instance of the worthlessness of this rock as a building material, is seen at Blount Springs, in Alabama. At that place, a number of years ago, several cottages, for the accommodation of guests, were built of it. In 1866, the writer was there, and the *slate cottages*

* Many of the "rock houses" have been frequented by Indians and hunters, some of them, perhaps, regularly inhabited. This has been the means of bringing ashes, and hence potash, into them, to which, perhaps, the formation of small quantities of common alum are due.

had crumbled into just such heaps as those mentioned, and, where sheltered, were ready for the alum maker.

872. An interesting circumstance connected with the Black Shale is, that it can be made, as stated in § 853, to yield *oils*, suitable for illuminating, lubricating, and other purposes, by distilling it in close vessels. The bituminous (or hydro-carbonaceous) matter in the shale (§ 852) is decomposed by the heat, and converted into the oils, which are distilled over and condensed in suitable vessels. The richest of the shales will produce from thirty to forty gallons of oil to the ton, but ordinarily they yield much less than this.

From this it is seen that the Black Shale is a source of supply of "coal oil," as the fluid in use is called in parts of Tennessee, to fall back upon when the petroleum wells are exhausted.

873. Below is an extract taken from the Report on the Geology of Canada, (1863, p. 784,) giving an account of the production of oil from bituminous shales in that country. The shales in Bosanquet, mentioned in the latter part of the extract, are, most likely, synchronous with those of the Tennessee Black Shale:

In 1859, works for obtaining these oils were erected on the locality of this shale, near the town of Collingwood. Twenty-four longitudinal cast-iron retorts were set in two ranges, and heated by means of wood; of which twenty-five cords are said to have been required weekly. The shale, broken into small fragments, was heated for two or three hours; from eight to ten charges being distilled in twenty-four hours. In this way, it is said, from thirty to thirty-six tons of shale were distilled daily, and made to yield 250 gallons of crude oil, corresponding to about three per cent. of the rock. By a farther continuance of the heat, a small additional proportion of oil was obtained from the shale; but it was found more economical to withdraw the charge after two hours and a half. The bed of shale available for the purpose, adjoins the works, and was furnished, ready broken, at twenty cents the ton. The cost of crude oil from the shale, was stated by the manufacturers to be fourteen cents the gallon. When rectified and deodorized, it gave from forty to fifty per cent. of burning oil, and from twenty to twenty-five per cent. of pitch and waste, the remaining being a heavy oil, fitted for lubricating purposes. After two or three unsuccessful trials, and the repeated destruction of the works by fire, they were at last, in 1860, got into successful operation, and a ready market was found for the oils. Data are, however, wanting to show whether the enterprise was remunerative; and it was after some time

abandoned, partly, it is probable, on account of the competition of the petroleum of Enniskillen, which was about that time brought into market in large quantities, and at a very low price. Should it, however, at any time, be found advantageous to renew the experiment of distilling the bituminous shales of this formation, those of Collingwood offer very favorable conditions, from their accessible position, and also from the ready means of transport afforded both by the lake and the railway.

The shales of the Devonian series in Bosanquet, are not less rich in combustible materials than those of Collingwood. An experiment made on a small scale, gave 4.2 per cent. of oil, which is equal to about ten gallons to the ton of shale. The specimen was obtained from Cape Ipperwash, where a section of twelve or fourteen feet of the shale is exposed. They here contain so much organic matter, that the broken shale, which forms the shingle of the beach, is said, when set on fire, to continue burning for a considerable time. Large portions have been thus burned, and have assumed a reddish color. These shales are also seen in Warwick and Brooke.

873a. The Black Shale is the source of hundreds of "Sulphur Springs." The so-called sulphur-water is water impregnated with sulphureted hydrogen gas, one of the substances resulting from the decomposition of the pyrite (sulphide of iron) contained in the shale. The sulphur-water of White's Creek Springs, in Davidson county, of the Epperson and Red Sulphur Springs, in Macon, Winchester Springs, in Franklin, Elkmont Springs, in Giles, and of many other more or less frequented places, both in Middle and East Tennessee, flows from this formation.

The alum well, located in the Black Shale in Hawkins County, has been mentioned. (§ 864).

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