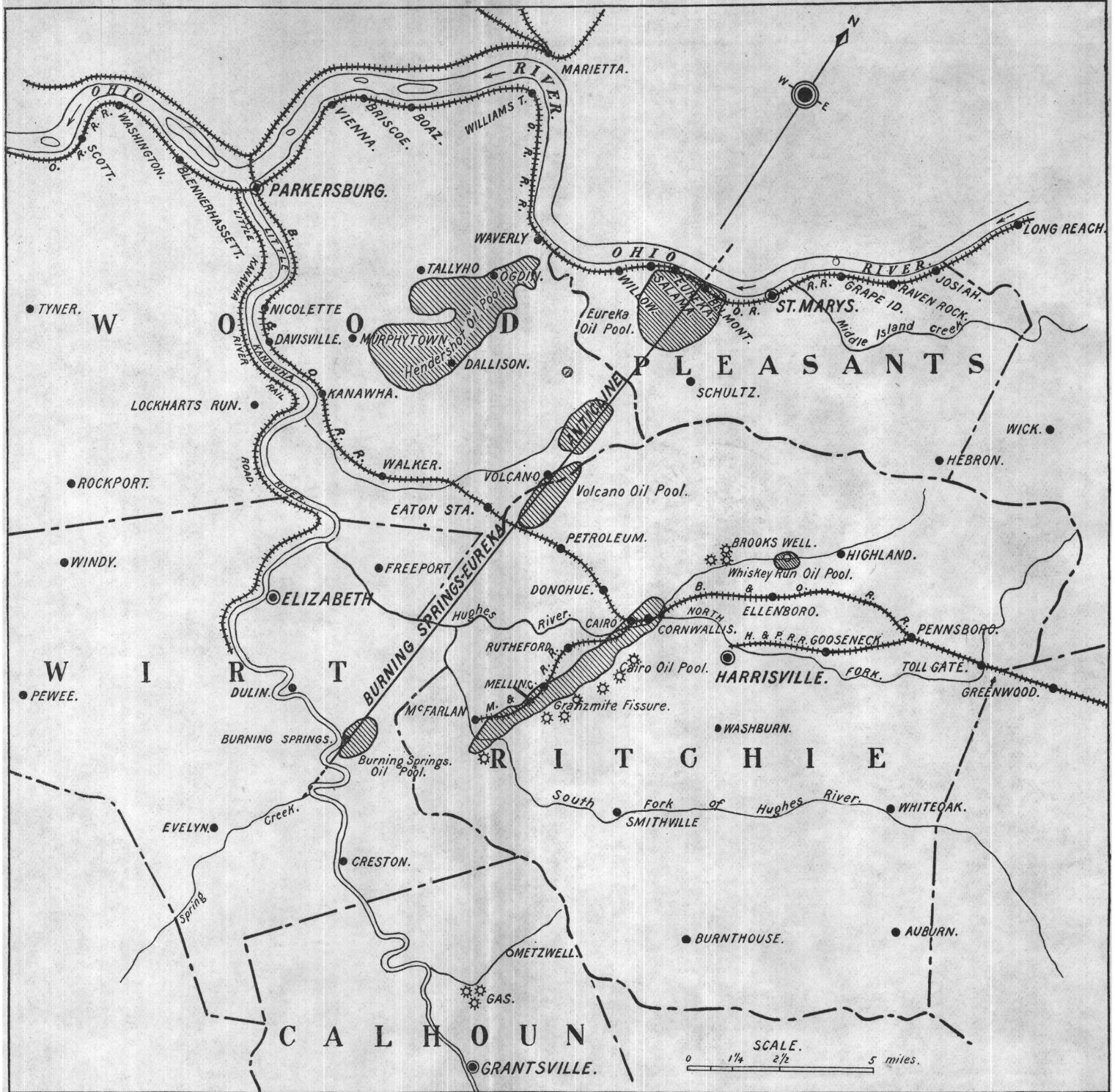

RELATION OF GRAHAMITE FISSURE OF RITCHIE COUNTY, WEST VIRGINIA, TO BURNING SPRINGS-EUREKA ANTICLINAL

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ORIGIN OF GRAHAMITE

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ORIGIN OF NAME

The grahamite deposit of Ritchie county, West Virginia, was first described by Professor J. P. Lesley in a paper read before the American Philosophical Society March 20, 1863. The name (in honor of the Messrs Graham, who were largely interested in the mine) was given the mineral by Mr Henry Wurtz, the chemist, of New York city, who in 1865 published a "Report upon a mineral formation in West Virginia" for the Ritchie Mineral Resin and Oil Company of Baltimore, a corporation owning and operating the mine for the manufacture of illuminating gas and mineral oil.

In a paper dated October 14, 1873, and published in volume vi, second series, of the American Journal of Science, Professor William M. Fontaine gives a very full description of the mineral and its geological sur-

roundings, and as this was only a few months before the mine was closed and abandoned, his paper gives the last and best description of the mine.

Investigations by Others

By reference to the papers in question the reader will discover that the grahamite fills a vertical fissure about two-thirds of a mile long, varying in width from a few inches at the ends to 4 and 5 feet in the center. The direction of the fissure is north 12 degrees west, and exactly at right angles to the great "Oil Break" anticlinal which, with dips from 30 to 70 degrees, crosses the measures about 7 miles west of the deposit.

Fontaine recognized the connection of the fissure with the upheaval of the measures on this Burning Springs-Eureka anticlinal, and the gifted Lesley foretold the origin of the grahamite in his first paper as follows: "This gash was once, no doubt, an open fissure, communicating with some reservoir of coal oil (petroleum) which still, it may be, lies beneath it undisturbed."

This hypothesis of Lesley, made 35 years ago, and without his ever having seen the region, has recently been verified in every particular.

Results of Exploration by Drilling

In 1890 a well was drilled for oil near Cairo, Ritchie county, 10 miles north of Ritchie mines, the locality of the grahamite, and an oil-pool developed in the basal member of the Pottsville conglomerate, or "salt sand" of the drillers. Since that time operations have gradually extended southward, until in 1897 the developments reached the region of the asphaltic deposit, and there, at a depth of 1,500 to 1,600 feet below the surface, was found, as Lesley had predicted, the pool of oil from which the grahamite was undoubtedly derived, since a prolific oil-field has been discovered in the immediate vicinity. The first well drilled in the region was located within 300 feet of the fissure, and hence, although some oil was obtained (one barrel daily), it was not in paying quantity, and no more drilling was done for several years.

The following record of the well drilled on MacFarlan run, Ritchie county, West Virginia, nearest the fissure, will give an idea of the geological succession in the region:

Record of Ritchie Mines Well

Material.	Feet.	Feet.
Unrecorded (cased 7⅝ inches at 247 feet)	600 to	600
Black slate	57	657

Material.	Feet.	Feet.
Red rock	15 to	672
Black slate and shale	28	700
Red rock	40	740
Limestone and shells	10	750
Red rock	10	760
Light red shale	5	765
Red rock	20	785
Blue sand and limestone	15	800
Sand, gray, with show of oil	30	830
Hard shell of flint and limestone	10	840
Sand and slate (cased 6¼ inches)	30	870
Slate	10	880
Sand with limestone	10	890
Slate, dark	55	945
Sand, gray, with shell to bottom	15	960
Slate, light	10	970
Sand, gray	10	980
Coal	5	985
Slate, black	5	990
Sand, gray	15	1,005
Slate and sand	10	1,015
Slate	5	1,020
Sand, light gray and soft	25	1,045
Slate, dark	5	1,050
Sand	20	1,070
Slate	20	1,090
Sand, white (gas enough to run boiler)	15	1,105
Unrecorded	37	1,142
Sand, white	33	1,175
Break of slate	5	1,180
Sand, white	30	1,210
Slate	150	1,360
Sand, gray and coarse	20	1,380
Slate	8	1,388
Sand, gray and coarse	12	1,400
Shell	2	1,402
Slate, black	88	1,490
White sand ("salt," gas) .... 25 Sand (oil at 1,530) ..... 15 } Cairo Oil sand	40	1,530
Sand	26	1,556
Slate	4	1,560
Sand, base of Pottsville	23	1,583
Limestone (Greenbrier)	67	1,650
Top of "Big Injun" sand (Pocono)		1,652

This well begins 140 feet below the Washington coal, and thus a few

feet under the base of the Waynesburg sandstone. The coal at 980 feet is probably the Upper Freeport, though it may be lower than that coal.

Extent of Grahamite-bearing Fissure

The fissure holding the grahamite extends from the little valley of Mine run (a tributary of MacFarlan, where the well starts) up through the Washington coal and on to the tops of the hills 100 feet higher, while downward it extends to an unknown depth. When Professor Fontaine visited the locality the mine had been operated through a vertical distance of 300 feet, and he gives the following section of the beds exposed within the fissure in descending order:

Material.	Feet.
Gray shale	45
Sandstone	35
Gray shale (Washington coal in middle)	55
Sandstome, Waynesburg	95
Gray shale (boring begins in this)	55
Sandstone	30
Gray shale	20
Red shale to bottom.	

The higher summits above the top of the section are made up of a succession of red shales and brown or gray sandstones, typical members of the Dunkard Creek or Permian series.

Conversion of Petroleum into Grahamite

The development of the oil-field in this region of the grahamite deposit has been carried on chiefly by the Cairo Oil company, of which Mr W. K. Jacobs, of Cairo, West Virginia, is the superintendent. Mr Jacobs informs me that wells drilled near the fissure obtain good sand, but it acts like a drained or exhausted field, and produces oil in small quantity only, but that when the wells are located from 800 to 1,000 feet distant from the fissure good producers are obtained; hence there can be no doubt whatever that the fissure made by tension from the Burning Springs-Eureka uplift was filled with petroleum largely from the sand at 1,530 feet, which is the main producing rock of this region, though the "Big Injun" sand, below at 1,652 feet, may also have contributed something. Then the oil filling the fissure was gradually converted by subsequent oxidation from infiltrating water, etcetera, into grahamite without any heat other than that afforded by the temperature of the earth, since there is no evidence whatever of any disturbance of the rocks in the immediate region, aside from a gentle tilt common to the rocks of every oil-field. Hence the views of Wurtz and others that the grahamite originated from

great heat, frying or baking the residuum out of bituminous shales and forcing it in a pasty condition into the fissure, is entirely erroneous, since the exhausted oil sand immediately under the region fully accounts for the formation of the grahamite.

Artificial production of Grahamite

Then, too, Mr Walter P. Jenney, in the April number of the American Chemist for 1875, describes how he produced in the laboratory a substance precisely similar in chemical composition to grahamite by passing heated air through Pennsylvania petroleum for several hours, so there can be no doubt of the derivation of grahamite from oil through the gradual escape of its volatile constituents and the oxidation of the residuum.

Origin of similar Substances

A corollary from this conclusion would be that the albertite of Nova Scotia has originated in the same way, and that gilsonite, uintaite, wurtzilite, etcetera, are all forms of oxidized petroleum, while Mr Diller, of the United States Geological Survey, believes that the "pitch" coal of Coos bay, Oregon, has also been derived from the same source.

The wonderful deposit of asphalt on the island of Trinidad, South America, has evidently originated from the upheaval, and the removal by erosion of the cover of an immense pool of oil, thus subjecting the oil to volatilization and oxidation. Had the clays, quicksands, and gravels which cover the great deposit of petroleum at Baku, on the Caspian sea, been elevated and eroded we should have a deposit of asphalt there similar to that on the island of Trinidad.

The graphites and other deposits of carbon in the Cambrian and pre-Cambrian beds are simply sheet-like outflows of petroleum oxidized and metamorphosed by atmospheric and igneous agencies respectively.

Relationship between Grahamite and Petroleum Deposits

Another corollary to be drawn from the conclusion that grahamite, albertite, and similar substances are derived from petroleum would be that in regions where these asphaltic deposits occur we may expect to find accumulations of petroleum, provided the rocks remain in a normal condition and are not too greatly disturbed.

Bituminous Material from Brooks Well

PLACE AND MODE OF OCCURRENCE

The Whiskey Run oil-pool was developed in Ritchie county early in 1898, and it lies about as far north from Cairo as the grahamite deposit

does south from it. The oil occurs in the Big Injun sand, and in one of the wells on the Brooks farm a peculiar bituminous substance was encountered saturated with petroleum, and described by the drillers as tough and hard to penetrate—"drilling like rubber," as one expressed it. The deposit was reported as 8 feet thick, and lying directly on top of the Greenbrier limestone, or 67 feet above the Big Injun oil sand. Some of the material was washed out of the sand pumpings by Professor John F. Carll, the geologist, who kindly gave me samples for analysis, since its singular geological horizon suggested the idea that it might be grahamite.

GEOLOGICAL RELATIONS

The following record of Books well number 1, Whiskey Run oil-pool, received from Mr Carll, will show the geological relations of the mineral in question:

Record of Brooks Well Number 1

Material.		Feet.	Feet.
Unrecorded		530 to	530
Pittsburg coal		5	535
Unrecorded		505	1,040
Limy shale and sand		10	1,050
Unrecorded		50	1,100
Sand, grayish white		10	1,110
Unrecorded		90	1,200
Sand		20	1,220
Unrecorded		30	1,250
Sand		40	1,290
Coal, thin		..	....
Sand		10	1,300
Unrecorded		150	1,450
Coal		5	1,455
Unrecorded		145	1,600
Slate		10	1,610
Sand, white		70	1,680
Coal (?) (asphalt), saturated with oil		8	1,688
Big Lime (Greenbrier)		67	1,755
Big Injun	sand, fine, soft (oil at 1,761 feet) 10	73	1,828
	sand, white 5		
	sand and slate 4		
	sand to bottom 54		

SUGGESTED ORIGIN

The coaly material at 1,680 feet was found only in this Brooks well number 1, although many other wells have been drilled within short distances from it on the Brooks farm and others adjoining; hence it is

possible that it may be some type of asphalt derived from the underlying petroleum of the Pocono or Big Injun oil sand.

CHEMICAL ANALYSES

Specimens of the material pulverized by the drill and preserved by Mr Carll gave the following proximate analysis to Professor B. H. Hite, chemist of the West Virginia Agricultural Experiment Station, compared with an analysis of grahamite made at the same time:

Material.	Brooks No. 1.	Grahamite.
Moisture	00.21	00.26
Petroleum	1.40	....
Volatile matter	34.21	58.37
Fixed carbon	48.82	39.24
Ash	15.36	2.13
Total	100.00	100.00
Sulphur	1.13	1.25

An ultimate analysis of another sample by Professor Hite gave the following results, compared with Mr Wurtz' analysis of grahamite:

Material.	Brooks No. 1.	Grahamite.
Carbon	59.20	76.45
Hydrogen	5.77	7.83
Oxygen	14.68	13.46
Nitrogen	1.01	....
Ash	19.34	2.26
Total	100.00	100.00

EFFECT OF SOLVENTS

The chemical composition of the material from the Brooks well, especially in its large quantity of oxygen, thus appears to be in fair agreement with grahamite, considering the large amount of ash or earthy material which it contains. The main doubt about its asphaltic nature is its behavior with the solvents of grahamite. It is only slightly soluble in them, and hence this leaves the question open for still further investigation, though its "drilling like rubber," limited (to Brooks well number 1) occurrence, and saturation with petroleum would appear to be strong evidence against its being coal.

OCCURRENCE AT OTHER LOCALITIES

Of the hundreds of oil wells drilled in the region, only one other has reported any *coaly material* at this horizon, and that was in Calhoun county, 30 miles south from Cairo. Here, on Leading creek, the Cairo Oil com-

pany drilled a well on the Metz land which gave the following succession, according to Mr W. K. Jacobs, superintendent:

Material.	Feet.	Feet.
Unrecorded	1,380 to	1,380
Sand	60	1,440
Slate	20	1,460
Unrecorded	85	1,545
"Salt Sand"	58	1,603
Slate	..	....
Unrecorded and sand	28	1,631
Coal (?) (asphalt)	5	1,636
Sand	2	1,638
Big Lime (Greenbrier)	106	1,744
Big Injun sand (gas, 1,788; oil, 1,809)	68	1,812
Slate and shells to bottom	25	1,837

The bituminous matter at 1,631, reported as coal by the drillers, may possibly have been of asphaltic origin, since it is situated along the same belt of country where the grahamite of Ritchie county occurs, and about the same distance east from the Burning Springs-Eureka anticlinal disturbance as the Brooks farm in the Whiskey Run oil-pool, where the other anomalous deposit of bituminous material was discovered.

Summary of Conclusions

From the foregoing there are drawn the following conclusions:

The fissure which encloses the grahamite of Ritchie county, West Virginia, was made by tension due to the upheaval of the measures along the Burning Springs-Eureka anticlinal.

Grahamite, albertite, gilsonite, and asphalt are all derived from the oxidation of petroleum.

The presence of these substances in undisturbed strata may be used as a guide to the discovery of oil pools.

Petroleum accumulations have taken place in all sedimentary beds from the earliest to the latest, and the graphite beds of the Cambrian rocks originated from oxidized outflows of oil.

Some outflows of petroleum appear to have occurred in the Cairo region of West Virginia at the close of the Lower Carboniferous epoch.