On the Nomenclature of the Hydrocarbon Compounds, with a suggestion for a new classification.

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SINCE many of the minerals grouped as hydrocarbon compounds in Dana's Mineralogy have become extensively *exploited* for their commercial uses, allied questions in chemical geology and in their classification have bulked largely in scientific discussion. Thus their place as rocks or minerals in petrology has been mooted; for it is difficult to make out definite chemical composition or crystallographic form in many of the materials of the group now used for heating, lighting or paving. Notably the question, What is coal? has not been authoritatively removed from the range of scientific controversy—though the supply of the mineral which occasioned the great trial Gillespie *v.* Russel, nearly thirty years ago, was, until last year, considered exhausted. Diligently bored for to its exact position in the Scottish carboniferous series of rocks, no trace of it has been found except in its limited basin of four miles area or so around Torbanehill, Linlithgowshire. The centre of the basin, where the mineral was found, about two feet thick, has been thoroughly worked out for nearly fourteen years. But mining operations on the eastern and western extremities of the basin, both of which are much riddled by cross faults, have last year been rewarded by the finding of a few hundred tons, which have been sold on the Continent for gas enriching. So far, then, "Torbanite" and "Bathvillite" need not be regarded as extinct. But this nomenclature has not in the interval displaced the common use of "Boghead gas coal" or "Torbanehill Mineral" in popular use. Hence another plea against topographical names as applied to mineral species. The progress of the Scottish shale oil industry, which originated after the expiration of Young's Patent in 1863, when this mineral was considered exhausted, has thrown some side lights on its formation. During the "What is coal?" discussions of 1853 and the following years, it was clearly shown that the problem could only be fully solved by the study of individual mineral species of the class. Now oil shale, which at this period was hardly known either in commerce or mineralogy, presents at least many analogies to the Torbanehill material which formed the basis of Young's manufacture of paraffin and mineral oils. The substances approach each other in streak, sectility, texture and fracture. They are alike clayey beds, yielding crude oil in varying degrees; for while Torbanite gave commercially one hundred gallons per ton, a substance is reckoned a workable oil shale if it yields thirty gallons per ton. The shale-refuse left by the new retorts, which utilise all the carbonaceous matter either as oil or subsequently as fuel, is a clay showing a large proportion of iron in its composition. The peculiarly white silicate of alumina left by Torbanite, the "ghaist" from which no old woman could obtain domestic services at her fire, was held at the trial to be its grand characteristic—distinguishing it from the coke-yielding cannel coals. Now, so far as the argument from geological position is concerned, Torbanite stands just above the upper limestone supposed to indicate the basis of the coal-measures, while the workable shales appear as yet confined to the lower carboniferous series. But these shales appear also bounded by a limited area, of which the Bathgate Hills form one extremity and the hills above Burntisland another. In the East of Fife, for instance, a totally different order appears to characterise the same geological horizon; for here "rum coals," or shales having all the other mineralogical characteristics of bituminous coal, appear.

The limited geognostic conditions prevailing in the first area generally from Edinburgh to the Bathgate Hills, appear to have been specially favourable to the appearance of a basin containing a seam of Torbanite, as well as of several others containing six workable shale seams. In faults, and other rock crevices, as well as intimately connected with the unique trap ridges, ozokerite, elaterite and other petroleum compounds have been found. Indeed "salse" action appears a probable explanation of some special petrological peculiarities both in the traps and their surrounding metamorphosed limestones and sandstones. And as petroleum flows are regular concomitants in the action of mud volcanoes, it is no improbable conjecture that beds of clay may have been saturated with oleaginous matter just as they were formed. Plant remains are abundant in the shales, as well as in the Torbane hill mineral. But the Broxburn oil shales are now also marked as the geological horizon for rare species of fossil fishes, and the old hypothesis that useful oleaginous matters in coal and shale were derived from vegetable eremacausis appears thus to break down. For were not the foul smells of some crude oils derived from such shales as the Kimmeridge beds regarded as proofs of their animal origin? According to the late Alfred Swaine Taylor a bituminous shale is a clayey substance with coaly, bituminous matter in it. A bituminous coal had an overplus of the oily principle, with little ash when burned, and no clayey smell or appearance about it. "The greater or lesser quantity of clay makes the shale; and the greater or lesser quantity of bitumen, with a deficiency of clay or ash, makes the coal." Such was the gist of evidence given at the great trial, Binney and Company against the Clydesdale Chemical Company, in 1860. And, indeed, Professor Traill moved on similar lines when he designated the Torbanehill mineral, "Bitumenite," in 1853.* But manufacturing chemistry has demonstrated that these oil shales contain no bitumen, which belongs, along with petroleum, to the methyl series of hydrocarbons; and that their products belong to the ethyl or paraffin series, as also does ozokerite. At the great pitch Lake of Trinidad maltha hardens into asphalt or bitumen, while in another part of the lake the ozokerite compounds are simultaneously forming. Near at hand, too, lignite is being formed in proximity to an active mud volcano: all this apparently an extended protest against the opinion that coal can only be the product of decaying vegetation, or that a body in any respect approaching cannel coal can only have been formed through macerated leaves floating in shallow lakes. Bituminous shale became of legal importance when Du Buisson filed his English patent for distilling it, as he had previously successfully obtained paraffin oils from like material at Autun, in France. But the attempt to work this, in 1853, from the Kimmeridge shale was unsuccessful; so much so that attempts to utilise the Scottish oil shales shared much obloquy, because of anticipated foul smelling products like those from the Wareham deposit. Even now, the term "shale" is employed in law courts in such fashion as to show how a popular, easy-going, semi-scientific phrase may only darken knowledge—schist, slate and shale are defined in older books on rock-classification, such as that of Macculloch, as signifying a fissile structure characteristic of rock masses of most varied mineral constitution. The first two terms specially designated this in rocks of the so-called primary formations, while the term shale was confined to rocks having this structure, which can be seen alike in hæmatite and bituminous coal, and in rocks in the higher geological horizons. Torbanehill mineral was generally dug in cubical blocks; and last year isolated cubes mixed with unhardened clay were mostly dug out; but what is being presently mined shows a slaty structure. The term oil shale, recently introduced, appears too indefinite. Thus Professor Liversidge protests against the term "kerosene shale" being applied to the Torbanite of Hartley, New South Wales, now exported to Europe as a gas enricher.†

* *Trans. Roy. Soc. Edin.* Vol. 21.

† *Journ. Roy. Soc. New South Wales*, Vol. 14, p. 206.

It has not the characteristic lamellar or slaty structure of a shale; for even *in situ* the planes of stratification, quite invisible in hand specimens, are mainly apparent by the presence of layers or films of earthy matter. Like typical Torbanite, it gives a dull wooden sound when struck; the powder is light brown to grey, and the streak shining. It usually weathers to a light grey colour, the surfaces of the joints being often coated with a white film. Its broad conchoidal fracture, with concavities sometimes very deep in proportion to their breadth; its easy sectile characters, as well as its peculiar microscopic appearances, and its ash, sometimes practically white, all resemble the Torbanehill mineral. Many of its specimens show, when analysed, only half the fixed carbon of the latter, while it practically yields more gas and oil when distilled. Tourba from Brazil approaches Torbanite in many characters. It yields one hundred gallons crude oil per ton, burns readily in a candle, leaving the same matter as before, while the pure white residue of silicate of alumina is like that of Torbanite. Its greyish or brownish colour and felty texture reminds one of the streak shown by the knife on Torbanite or the "curley oil shale." According to Hartt, the section at Camamui Bay, Province of Bahia, Brazil, exhibits a variation from pure bitumen to arenaceous material interstratified with oil shales, suggesting the infiltration of oleaginous matter into sands or clays. In truth the three minerals just enumerated have similar properties, and are essentially one, though confused by inappropriate nomenclature. Professor Silliman proposed the name of *Wollongongite* for the New South Wales mineral; but this would only perpetuate a misleading topographical classification. The mineral at present shown as Boghead Coal in the Edinburgh International Exhibition, 1886, has a very yellow streak, indeed appears like consolidated Tourba; it is certainly not a coal. It is from the Alps above Vienna.

The grouping of the old class of the combustible minerals under the series of hydrocarbon compounds certainly indicates their usual geognostic relations. Thus Ozokerite, of the consistence of butter along with liquid oil, was found in a bore for shale at Broxburn in 1885, though not so abundantly as to inaugurate the mining of this Hungarian candle-stuff material in Scotland. Further, Mr. Galletly has described a bedded mineral, possessing all the external characters of Albertite, found interbedded in an oil shale seam at Addiewell, West Calder.* It yielded 88·75 gallons crude oil per ton, and its matrix only gave about 40 gallons. Like the Albertite of Canada and Ross-shire, as well as the surrounding

* *Trans. Edin. Geol. Soc.* Vol. II. p. 395.

shale, the large excess of hydrogen to carbon in its composition was similar to that in Torbanite. It approximated also in specific gravity to the last-named mineral. Now might not this family relationship be pictorially presented to the eye by graphic symbols? The result of retaining two or three old nomenclatures to describe minerals of such constant use, and with so many new relationships, is disastrous to specific designation; and consequently, a critical investigation of many of the individual species may lead to a new grouping, which might even alter the position of some presently recognised cannels and lignite. After all, symbols, even without the old names, might be employed to designate the present well-known compounds of the series. Whilst clearly demarcating the true bituminous and paraffin groups, a connection with the series of oxygen and the true hydrocarbons would have to be shown, as this undoubtedly occurs in nature. Thus a shale deposit at Blueskin, near Dunedin, New Zealand, shows such crystallised compounds of oxalates as Humboldtine and Whewellite imbedded in the main deposit, which yields about 50 gallons crude oil per ton. As the section is capped by basalt, it suggests a heat of 400° F., which is found necessary for the manufacture of wood-shavings into oxalic acid; and as similar associations of oxalates and brown coal or shale are known in Bohemia and Canada, such facts demand recognition in any scheme of natural classification. The natural relations betwixt bituminous coal, anthracite, graphite and the diamond would also have to be grouped. As discovery has progressed, it is certain that mere geological position has not influenced the genesis of the mineral series under discussion. Geognostic position, which may be duplicated from many geographic centres, appears to be the main requisite in the genesis of these minerals. The carboniferous system now only indicates where coal beds occur most abundantly; and oil wells and paraffin yielding deposits, or minerals like Torbanite, are now found in every geological formation.