Elaterite: a Mineral-Tar in Old Red Sandstone, Ross-shire.

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Physical Properties.

THIS mineral tar, which, from its elasticity, though somewhat weak, resembles elaterite, is found at the Craig Well, near Dingwall.

It is an intensely black, lustrous, sticky substance, of the consistency of tar, and from its being associated with albertite it may be looked upon as a variety of that asphalt.

The streak of both is reddish-brown. They are both insoluble in acids and strong alkalies. They are equally so in alcohol. In paraffin oil the tar is soluble; the albertite is not. A compact variety of mineral-tar from Egypt—the bitumen of the embalmers—resembles albertite except in its being soluble in paraffin. In ether the Dingwall tar as well as the Egyptian variety is partially soluble, leaving an insoluble residue, which is inflammable. The solution in each case is reddish-brown in transmitted, dark green in reflected light. The Egyptian substance shows besides this dichroism a strong, broad absorption band near the D or sodium line of the spectrum. The Derbyshire elaterite, found in the Carboniferous Limestone of the district, is soluble to the same degree as these, but shows neither absorption bands nor dichroism. The solutions of elaterite, the Dingwall tar, and the Egyptian bitumen, when rapidly evaporated show a vivid green film, which for duration and brightness depends on which of the solutions are so treated. Neither ozokerite, amber, torbanite, nor albertite shows a like property.

Chemical Properties.

With dry distillation the Dingwall substance yields an inflammable oil, an inflammable gas, and water. It melts, as the Derbyshire elaterite does, at or about 140°C., leaving on ignition a slight ash which shows ferric oxide and lime. These latter are evidently from the pyrites and calcite particles which are included in the mass of the tar. Indeed, the chinks in which the tar is found are lined with calcite crystals and iron-pyrites indicating the previous open state of the fissure up which the tar flowed. The sandstone rock in which this tar is found is soft and porous. The minutest pores of the rock in the neighbourhood of the fissures are filled with the tar.

Geological Position.

The mineral albertite is found in fissures in the conglomerate above the Old Red, in the O. R. Sandstone itself, in the laminated shales beneath, and in the micaceous schists underlying these in turn. The tar is found in the porous sandstone only, overlying the shales proper, and in close proximity to veins of albertite, as in the conglomerate of quartzite overlying the Old Red in the cutting on the Highland Railway near the Craig Well.

The geological horizon of the shales in which these asphalts are found is the lowest in this country for asphalts; and, indeed, anywhere, unless we place the natural gas and oil-bearing rocks of Ontario and Pennsylvania on the same level with them. There those products are found as far down as the Trenton limestone of Silurian age. Here the bituminous shales rest on the micaceous schists of the N.W. Highlands. The presence of an asphalt in these schists underlying shales themselves penetrated by veins of asphalt raises the question as to whether these shales after all are the source of the asphalts, or whether they may not owe their bituminous contents to a deeper source. That the question is not an easy one to settle is seen from the prominence recently given to the rival theories of Mendelejeff and Williams. The latter holds that the asphalts are altogether from shales containing organic matter; the former that these hydrocarbons are formed by the synthesis of hydrocarbons from hydrogen set free from super-heated steam and carbon from carbides of iron in the depths of the earth. The solution of the problem in favour of either of these theories, as is obvious, is of the highest economic as well as scientific importance. What adds somewhat to Mendelejeff's theory, in my opinion, is the presence of sheets of siliceous rock—Lydian-stone—deeply impregnated with some form of hydro-carbon, which I found among the archæan rocks of Lewis, as may be seen at the head of Loch Shell, on the South-East of that island. This black flinty rock lies on the coarse crystalline gneiss of the district, and dips at a low angle to the N.W. The significance of this fact—that of Lydian-stone on so low a horizon—adds, I think, some weight to the chemical theory for the origin of asphalts, oil, and gas in such deep seated formations. The appearance of the Strathpeffer shales in many instances looks as if it were but saturated with an overflow of hydro-carbons from a subterranean source. There is, of course, much to be said for the organic —the "fish-bed"—theory of the shales, though no trace of any fossil other than that of a minute crustacean, recently found in one instance, is to be found in these Strathpeffer shales. This crustacean, I may mention, is of the genus *Estheria*, and was discovered by Mr. Hugh Miller, of H. M. Geological Survey.