XIV. *On the ACTION of ORGANIC MATTER on PEROXIDE of IRON,
as observed in the POST-TERTIARY SANDS of GLASGOW.*
By J. WALLACE YOUNG.

(Read, April 1, 1889.)

HAVING visited, last summer, the excavations at Stobcross for the New Docks, I made a few observations which may be interesting to those who study chemical geology.

Underneath a few feet of ordinary brown river sand, containing hazel nuts, and fragments of decayed wood, a dark-coloured bed of sand, charged with vegetable matter, occurs.

This dark-coloured sand had a disagreeable smell, gave no effervescence with hydrochloric acid, but on gently heating, the odour of sulphuretted hydrogen was at once perceptible. The acid solution contained protoxide of iron, alumina, a little lime, and a considerable quantity of magnesia. The iron existed as mono-sulphide. When treated with water, the sand gave up a little sulphate of lime.

The sulphuric acid, and the sulphur existing as sulphide of iron were estimated in a portion of the sand previously dried at 100° c.

Sulphuric Acid,.....	·10 p.c.
Sulphur,.....	1·49.

The sulphuric acid would be equal to ·21 p.c. of sulphate of lime ($\text{Ca}'' \text{SO}_4 2\text{Aq.}$) and the sulphur equal to 4·09 p.c. of the mono-sulphide of iron (Fe S.)

Some of the twigs freed from extraneous matter by washing, left a residue of peroxide of iron when burned, the iron existing originally as sulphide.

Two oak trees which had been turned up by the workmen, were quite black exteriorly, and had an intensely styptic taste. A portion boiled with water, gave a solution very acid to test paper, and containing free sulphuric acid and sulphate of iron.

The sulphate of iron and sulphuric acid were probably derived from the oxidation of the sulphide of iron with which the wood had been originally charged. It would have been interesting to have examined the interior of these trees, but on a subsequent visit it was found that they had been removed.

Dried at 100° c. the oakwood left 6·04 p.c. of ash containing 3·90 of peroxide of iron.

The presence of sulphide of iron in the sand and vegetable debris, may be explained by the reducing action of decaying organic matter on peroxide of iron and sulphate of lime. Carbonate of iron and sulphide of calcium would be first formed, and then immediately decomposed into sulphide of iron and carbonate of lime.

In the brown sand situated above the dark coloured layer, the remains of the hazel nuts and drift wood are often surrounded with much peroxide of iron. In all these cases the vegetable matter had completely decayed away, leaving only an external cast in the sand. In some cases the sand was so firmly cemented around the fragments of driftwood, with peroxide of iron, that they preserved their form after the decay of the wood, and it was curious to observe these empty tubes sticking out from the face of the cutting. One of these sand-tubes I obtained, measured about 9 inches in length, $1\frac{3}{4}$ inches in diameter, and about $\frac{1}{8}$ of an inch thick. They all lie horizontally in the sand, and the smaller ones are very frequent. In many of these tubes I estimated the peroxide of iron, and it varied from 23 to 30 p.c., specimens dried previously at 100° c. The origin of these tubes is by no means very clear; they certainly have not been formed by segregation from the surrounding matrix. They must have been formed before the driftwood had lost its original shape, and appear to be due to some local causes, as at other parts of the cutting, fragments of wood and hazel nuts perfectly well preserved, are found. Further researches, however, will clear up this and other doubtful points. I may here refer to specimens of these sand-tubes exhibited this session by Mr. John Donald Campbell, from Loch Melfort, Argyleshire.¹ They seem to occur in a deposit of a similar nature to that at Stobcross, and consist of sand cemented together around what have been originally fragments of wood. A specimen gave 25·36 p.c. peroxide of iron. Here, as at Stobcross, in the same section, fragments of wood and hazel nuts are found in good preservation.

In the face of the cutting, at Stobcross, large holes have been frequently observed, the surrounding sand being considerably hardened by peroxide of iron. These were found to be due to driftwood, which had subsequently decayed, the sand being hardened sufficiently to retain the original form. One large hole, 9 inches in diameter, was observed, with the remains of the decayed wood lying at the bottom. The wood was very soft, and, rubbed

¹ Proceedings, 5th November, 1868.

to a paste between the fingers, on drying and burning, a reddish ash was left. Dried at 100° c. the wood contained 5.30 p.c. of iron (Fe) which existed partly as protoxide and partly as peroxide. These holes were quite different from the sand-tubes, although both have been caused by the driftwood. In the one case we have thin tubes from $\frac{1}{8}$ to $\frac{1}{4}$ inch thick formed, the sand surrounding these containing no great quantity of iron, and being all of a uniform tint throughout. In the other case the sand for several feet around has been simply hardened sufficiently by peroxide of iron to preserve the form of a cavity after the decay of the driftwood. In the post-tertiary clays, in many parts around Glasgow, certain tubular concretions concentrically disposed around roots and twigs, are frequently observed. These were found to consist of clay and sand cemented together by peroxide of iron. Specimens of them were first given me a considerable time since by Mr. Bennie; two varieties gave respectively 25.14 and 29.97 p.c. of peroxide of iron. These tubular concretions have generally been considered to have been formed by a species of segregation, but having had an opportunity of examining into this subject more minutely, I have been led to attribute them to a different cause.

In a cutting, recently made for a common sewer, in Springfield Road, Dalmarnock, the workmen passed through about $1\frac{1}{2}$ feet of road metal, then 5 feet of brown sandy clay, in which the iron existed as peroxide; underneath was about 2 feet of fine blueish grey clay, the iron existing as protoxide; then a bed of sand and gravel; and underneath that again, at about $11\frac{1}{2}$ feet down, was stiff brown clay. In the upper bed of brown sandy clay the tubular concretions I have spoken of, are found in great abundance. Vegetable twigs, &c., appear to have become mixed with the sand and clay, and after becoming firm and compact, the vegetable tissue has decayed away, leaving small holes, through which water has carried down iron in some form or another, and gradually cemented together the surrounding clay and sand. On breaking open pieces of the brown clay, I have seen them perfectly crowded with holes, some merely surrounded with a stain of peroxide of iron, and, in all stages, up to the perfect tubes. The iron in the surrounding clay appears to be equally distributed throughout, and there can be little doubt that the excess of iron oxide has come from some extraneous source, and has not been segregated from the surrounding matrix.

I have estimated the iron in the tubular concretions found in this cutting, and also in the surrounding clay. Specimens dried at 100° c.

	Peroxide of Iron p.c.
In concretions,.....	29·13.
In the clay,	2·14.

Some parts of the clay were highly charged with vegetable debris, and in this mono-sulphide of iron was found. Some of the driftwood, which was very plentiful, was of a black colour, which was due likewise to the sulphide. Dilute hydrochloric acid discharged the black colour, sulphuretted hydrogen being disengaged, and a protosalt of iron formed in the liquid. A portion of this wood dried at 100° c. gave 8·64 p.c. of iron (Fe), 2·95 p.c. of sulphur, or mono-sulphide of iron 8·11 p.c., excess of iron combined in some other form 3·8 grs. Another piece gave 12·75 p.c. of iron (Fe). When exposed to the air in the moist state sulphate of iron was formed, and could be extracted by water. On cutting some pieces of this driftwood with a penknife, the blade came frequently against some gritty substance, running parallel with, and embedded amongst the tissue. On separating a portion of this, it was found to be iron pyrites (Fe S₂). We have thus present, in this driftwood, two sulphides of iron, the one decomposed by very dilute hydrochloric acid, the other quite unacted on.

XV. *On the ARRAN CLAYSTONES.* By Rev. JOHN F. POTTS, B.A.

(Read November 5, 1868.)

THE rocks which are the subject of this paper are not all of them strictly claystones. That term is restricted by mineralogists to the softer varieties of felspathic rocks; but as it is impossible to draw any line of demarcation between these softer varieties, and many other closely related rocks, and as such a line of demarcation, if drawn, would be of no avail towards our present object, but would rather be a stumbling block and a hindrance, I have taken the liberty of referring to all that ever-varying group of the Arran rocks, of which the base is a felspathic paste, under the familiar Saxon term which stands at the head of this paper. Not that there is any connection existing between these rocks and the substance familiarly known as *clay*; for like many other terms in