



XXV. On the presence of phosphoric acid in rocks and minerals

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XXV. *On the Presence of Phosphoric Acid in Rocks and Minerals.* By WILLIAM SULLIVAN, Esq.*

IN a recent paper in the Philosophical Transactions, Dr. Fownes showed the presence of phosphoric acid in several igneous rocks, and having made some investigations on the same point, I may perhaps be allowed to state them here. About two years ago, Prof. Liebig mentioned to me the importance of examining different rocks in order to ascertain, if possible, the presence of phosphoric acid in them, as he considered very naturally that it must be universally present in all soils and in the rocks from which they are derived, as we invariably find it in the ashes of plants. In the winter of 1843-44, I made a number of analyses in order to see how far this idea could be borne out, and also to show that impure limestones were better adapted for agricultural purposes than those usually preferred. To these analyses I have since considerably added; but the only publicity I gave the matter up to the present time, was a short notice which was published in a Cork newspaper about a year and a half ago, intended principally for the information of the agriculturists of that locality.

The ordinary method employed for the detection of phosphoric acid I found not to answer where the quantity of that substance is very minute; and besides, it is likely to give erroneous results where large quantities of iron, alumina and lime are present: indeed, it is chiefly owing to phosphoric acid being thrown down along with these bases in the analyses of minerals containing this acid only in minute quantities, that its presence in most substances of mineral origin has hitherto escaped detection.

The mode which I adopted is capable of giving the most

* Communicated by the Author.

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accurate results,—in fact the most minute quantities possible may be detected with certainty. The following is the method:—

When the mineral was limestone, or a substance containing a large quantity of lime, I took about four ounces of it broken into fragments, introduced it into a covered crucible and exposed it for three or four hours to a strong white heat; the mass thus treated was then digested in water, when I suspected the substance contained potash or soda, in order to dissolve out these bodies, and strong hydrochloric acid poured on the remainder (if I did not wish to examine for potash, the ignited mass was directly treated with the hydrochloric acid); the whole was then evaporated to dryness, the dried mass moistened with a few drops of hydrochloric acid, and then treated with water and filtered to separate undissolved silica; ammonia was then added to the solution, the precipitate collected, well-washed and dissolved in hydrochloric acid; if the mineral contained no iron, or but little of that substance, a few drops of perchloride of iron were added to the solution and then excess of acetate of potash; if phosphoric acid was present in the most minute quantity, a precipitate, at first light brown, but gradually darkening as it falls to the bottom of the glass, of phosphate iron, was obtained, as this substance is totally insoluble in acetate of potash. If the precipitate do not immediately make its appearance, it should be allowed to stand for some time, when it will be perceptible. It sometimes happens, when the quantity of the phosphoric acid is extremely minute, that it does not deposit itself for twelve hours; and in one or two instances it did not occur until after twenty-four hours. When the precipitate obtained was large, which was usually the case from the large quantity of the substance employed in the analyses, I invariably verified the result by re-dissolving the precipitate thus obtained and testing with sulphate of magnesia and ammonia and nitrate of silver, which always afforded well-known results where phosphoric acid was present.

The substances which did not contain lime enough to be treated in the preceding manner were reduced to powder and fused with a mixture of carbonates of potash and soda, or where it was of importance to ascertain the presence of potash, with caustic barytes, and I then proceeded as in the other case.

It may not be unimportant to mention here, that potash, or rather potash and soda, appear to be as universally present as phosphoric acid: indeed, in none of the minerals which I examined was it totally wanting, though there was frequently but a mere trace.

The following is a list of the minerals which I examined for phosphoric acid. I have also noticed those in which potash and soda occur, that is, those rocks in which these substances had not hitherto been noticed.

Minerals.	Phosphoric acid.	Alkalies.
Nine varieties of <i>carboniferous limestone</i> from the neighbourhood of Cork.	In all I could detect its presence, and in one it occurred in sufficient quantity to be determined.	Potash was found present in all, but in such small quantity that I could not determine it. From the same cause I could not determine whether soda was present.
<i>Muschelkalk</i> and <i>dolomite</i> from the same formation, from near Fulda in Hesse-Cassel.	Present, but apparently more abundant, in the dolomite.	Minute traces.
<i>Roofing-slate</i> used at Giessen.	Considerable precipitate, but <i>wavellite</i> is found in some localities in the same rock.	Large precipitate, with chloride of platinum and a small trace of soda.
<i>Flags</i> used in the west of Ireland, supposed to be <i>millstone grit</i> .	Traces, but very minute.	Trace of potash, but could not ascertain if soda was present.
<i>Slate</i> from Corriganline, near Cork.	Precipitate large enough to examine quantitatively. [This is the best locality known, I believe, for <i>wavellite</i> .]	Decided precipitate with chloride of platinum. Sufficient soda to produce a precipitate with antimoniate of potash.
<i>Old red sandstone</i> , Cork.	Trace in one specimen, but a decided precipitate was obtained from three ounces of another.	Could not detect soda, but detected a trace of potash.

Minerals.	Phosphoric acid.
<i>Diorite</i> containing <i>augite</i> , from the valley of the Lahn, Nassau.	Obtained sufficient from two ounces to test with nitrate of silver.
<i>Clinkstone</i> , from Rhöngelbirge, Bavaria.	Abundant traces.
<i>Phonolitic Tufa</i> , Rhöngelbirge, Bavaria.	Considerable precipitate.
<i>Hornblende</i> in crystals, from Rhöngelbirge.	Minute traces.
<i>Olivine</i> , in a state of decomposition, from the Vogelsgebirge, Hesse-Darmstadt.	Sufficient to apply the test of nitrate of silver; but three ounces were employed.
<i>Augite</i> , crystalline, Rhöngelbirge.	Abundant traces.
<i>Compact basalt</i> , from Giessen.	Considerable traces.
<i>Trap rock</i> of the nature of greenstone, from the north of Ireland.	Only minute traces in one specimen, but in considerable quantity in another.
<i>Basalts</i> , Giant's Causeway.	Enough to produce a precipitate with sulphate of ammonia and magnesia from two ounces.
<i>Pumice stone</i> , from the Lake of Laach, near Andernach, on the Rhine.	Considerable precipitate from three ounces.

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Minerals.	Phosphoric acid.
<i>Sodalite</i> , Vesuvius.	Trace; had not enough for a second analysis.
Variety of <i>hypersthene</i> , occurring in the diorite on the Lahn, Nassau.	Distinct traces.
<i>Lepidolite</i> , locality unknown.	I obtained so large a precipitate, that I think it must form an important constituent of this mineral.
<i>Obsidian</i> , from Lipari.	Present in considerable quantity.
<i>Mica</i> , Spessart, Bavaria.	Minute traces, but more abundant in another specimen from Russia.
<i>Granite</i> , Odenwald, Germany.	Enough to give all the usual tests from about $1\frac{1}{2}$ ounce.
<i>Chlorite slate</i> , locality unknown.	Sufficient from two ounces to give a precipitate with nitrate of silver.
<i>Augite porphyry</i> , locality unknown.	Considerable traces.
<i>Mica slate</i> , locality unknown.	Enough for nitrate of silver test.
<i>Gneiss</i> , Odenwald, Germany.	Considerable traces from two ounces.
Two specimens of Scotch <i>granite</i> , localities unknown.	Large precipitate from two ounces.
<i>Tincal</i> , or native borax, from East Indies.	The quantity of phosphoric acid in this substance was very considerable, being equal in one instance to 2.13 per cent. I think most native borax will be found to contain phosphate of soda.
<i>Datholite</i> .	In one specimen of this mineral from Andreasberg in the Harz, the quantity of this acid present was sufficiently large to be estimated. I also detected its presence in a specimen from North America, but in neither case had I enough of the mineral to make another analysis.

It is very curious that such a large quantity of phosphoric acid should in these two cases be associated with boracic acid, which is of a decided volcanic origin. It would be very interesting if the substances occurring with the native boracic acid in Tuscany, and also the other minerals containing boracic acid, were examined for phosphoric acid. The quantitative determination of the phosphoric acid in rocks would, in my opinion, be of little importance, as phosphoric acid, although a constant, is a very variable constituent. This, however, does not apply to the simple minerals, such as olivine, of which it forms very probably a constant constituent.

Dublin, July 17, 1845.

XXVI. Some Observations on the Theory and Application of Electricity. By F. C. HENRICI*.

1. IT is usually considered, that in consequence of the supposed repulsion exerted between the particles of elec-

* From Poggendorff's *Annalen*, vol. lxiv. p. 345.