THE OCCURRENCE OF BARIUM IN THE SPRING WATER OF
BOSTON SPA.

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(Read at the Meeting, December 5, 1900.)

THE presence of any considerable amount of a soluble barium salt in a natural water is of such rare occurrence that the present paper may prove of interest to the Society.

The village of Boston Spa, with its neighbour Thorp Arch, lies on the banks of the river Wharfe, about ten miles from Harrogate. About 100 years ago the place

enjoyed quite a reputation for the medicinal properties of its water, then thought to be chalybeate in character.

With the rise of Harrogate the popularity of this Spa declined, until at the present day only a comparatively few people know the spring, and these are mainly visitors to the village during the summer months.

In "York and East Riding," vol. i., 1855, there is a very old analysis of the water, stated to have been made by Dr. Adam Humber, of Leeds, in the year 1784. The figures obtained are given below :

WATER OF BOSTON SPA.

Contents of One Wine Gallon.

	Grains.
Muriate of soda	562·00
Muriate of lime	12·25
Muriate of magnesia	7·25
Carbonate of iron	1·75
Silica	0·75
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	584·00
<i>Gases :</i>	Cubic Inches.
Carbonic acid	10·56
Azotic gas	6·00

A short time ago I had the opportunity of making an analysis of the water with a view of ascertaining whether there was an important amount of iron present or not. For this purpose I visited the spring, and took some samples myself.

When first pumped to the surface the water was perfectly bright, clear, and sparkling, with a slightly bitter taste. After standing for about an hour, even in a stoppered bottle, it became opalescent, and finally deposited a small precipitate, which consisted mainly of oxide of iron. It was found upon examination that comparatively very little of this metal was present, but that the water contained a distinct amount of the unsuspected element barium.

The figures obtained upon analysis are given below :

WATER OF BOSTON SPA.

Results expressed in Parts per 100,000.

Total solid constituents (dried at 100° C.)	1271·00
Total solid loss on ignition	251·00
Saline residue	1020·00
Total alkalinity (calculated as CaCO ₃)	25·10
Alkalinity after boiling (calculated at CaCO ₃)	1·50
Ferric oxide (Fe ₂ O ₃)	1·01
Calcium oxide (CaO)	49·64
Barium oxide (BaO)	30·16
Magnesium oxide (MgO)	24·06
Potassium oxide (K ₂ O)	1·10

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Sodium oxide (Na_2O)	...	...	...	...	555.11
Silica (SiO_2)	...	...	...	...	1.21
Free and saline ammonia (NH_3)	...	...	...	...	0.22
Albuminoid ammonia	...	...	...	...	0.008
Sulphuric anhydride	...	...	...	...	nil
Phosphoric anhydride	...	...	...	...	nil
Chlorine	...	...	...	...	735.22
Bromine	...	...	...	...	0.60
Iodine	...	...	...	...	nil

Specific gravity at 15°C .: 1010.

Appearance in 2-foot tube: brownish green.

<i>Dissolved Gases:</i>					Cub. In. per Gal.
Nitrogen	...	...	...	...	3.27
Carbonic acid	...	...	...	...	17.87

The water apparently varies in composition to a certain extent, and this is shown by the following figures, taken from the results of another analysis made six months after the first:

Parts per 100,000.

Barium oxide	...	...	...	...	25.81
Calcium oxide	...	...	...	...	46.08
Magnesium oxide	...	...	...	...	20.78
Sodium oxide	...	...	...	...	457.83
Chlorine	...	...	...	...	614.28
Total solid constituents	...	...	...	...	1050.00

The following probably represents the actual salts present in the water calculated on the first analysis:

Results expressed in Parts per 100,000.

Barium chloride	...	...	...	...	41.00
Calcium chloride	...	...	...	...	69.94
Magnesium chloride	...	...	...	...	56.91
Sodium chloride	...	...	...	...	1047.59
Potassium chloride	...	...	...	...	1.71
Sodium bromide	...	...	...	...	0.77
Calcium carbonate	...	...	...	...	25.10
Ferrous carbonate	...	...	...	...	1.50
Silica	...	...	...	...	1.21

The water was tested spectroscopically for strontium, but failed to give any evidence of the presence of that element.

The soil of the neighbourhood consists of sand, clay, and magnesia limestone, but the rocks are chiefly calcareous. Barium has been found on one or two occasions previously in natural waters both in England and Wales. In the water of the Llangammarch Well it occurs, according to the analyses of Dupré and S. A. Vasey, to the extent of about 9.45 parts per 100,000. Again, in an interesting paper read before this Society by J. White in January, 1899, analyses were given of waters

drawn from deep-well borings at Ilkeston, Derbyshire, containing as much as 38·5 to 40·7 parts per 100,000 of barium chloride.

These waters have all very much the same character, containing considerable amounts of calcium and magnesium chlorides, together with a very large proportion of sodium chloride.

A curious point about the Boston Spa spring is that the water has been taken internally, under the guise of a chalybeate water, for more than 100 years without the presence of the barium being in the least suspected.

DISCUSSION.

Mr. John WHITE said that the chief points of difference between the Boston Spa water and the samples from Ilkeston, which he had examined, were that, while the former contained more barium oxide than the latter, it only contained about half the quantity of solid matter and half the quantity of chlorides as compared with the amounts present in the Ilkeston waters. In the case of the Ilkeston waters he (Mr. White) had come to the conclusion that the barium existed as carbonate, in one instance, and as chloride in the others. The author had not referred to carbonate, but had calculated the barium present as chloride, with which view he agreed.

Mr. FAIRLEY said that most of the Harrogate waters contained barium, generally in very small quantity, but as a rule sufficient to prevent the finding of any sulphuric acid in solution. The quantity of barium being small, it went down with the silica as barium sulphate, and unless the silica was carefully examined the barium might be overlooked. In the detection of strontium it was necessary to apply a process of careful separation and concentration to the calcium precipitate; and even then very small a quantity of strontia was easily missed.