NOTE ON AN IMPROVED SPECIFIC GRAVITY BOTTLE OR PYKNOMETER.[1]

By Edward R. Squibb.

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THE first attempt of the writer to improve the ordinary specific gravity bottle was described and illustrated in a paper published in the *Ephemeris*, **1**, 11, for September, 1883, p. 349. The next improvement, wherein the principle of the present bottle was first applied, was described and illustrated in the *Ephemeris* for May, 1884, **2**, No. 3, p. 528. The next improvement was described and illustrated in the *Ephemeris* for July, 1889, **3**, No. 4, p. 1162.

The present form, now to be described and illustrated, has been in use during the past five years with very satisfactory results.

The increasing importance of specific gravity of liquids, and the increasing frequency with which close determinations are required, make any improvement that can be suggested in the apparatus worth describing.

Different authorities give different temperatures, not only for the standard unit water volume, but also a different temperature of the compared volume from the standard volume. The standard volumes most commonly used are 0° C., 4° C., 10°C., 15° C., 15.6° C. = 60° F., 20° C., and 25° C. = 77° F., and it is very convenient to have a single bottle in which the standard water volume can be accurately measured at all these temperatures, and in which liquids can without loss be brought to room temperature for weighing. As the bottles illustrated on p. 113 accomplish these objects easily and accurately they are supposed to be improvements on the older form of bottles.

The control of error by expansion of liquid before weighing has recently been effected by Mr. J. C. Boot in his "New Form of Pyknometer," presented at a meeting of the New York Section of the American Chemical Society, held November 6, 1896.[2] In this bottle change of temperature is controlled by having the bottle made double with a vacuum interspace. But this bottle can be used only at a single standard unit water volume, and the provision by which change of temperature is prevented, also

[1] Read before the New York Section of the American Chemical Society, at the meeting of January 8, 1897.

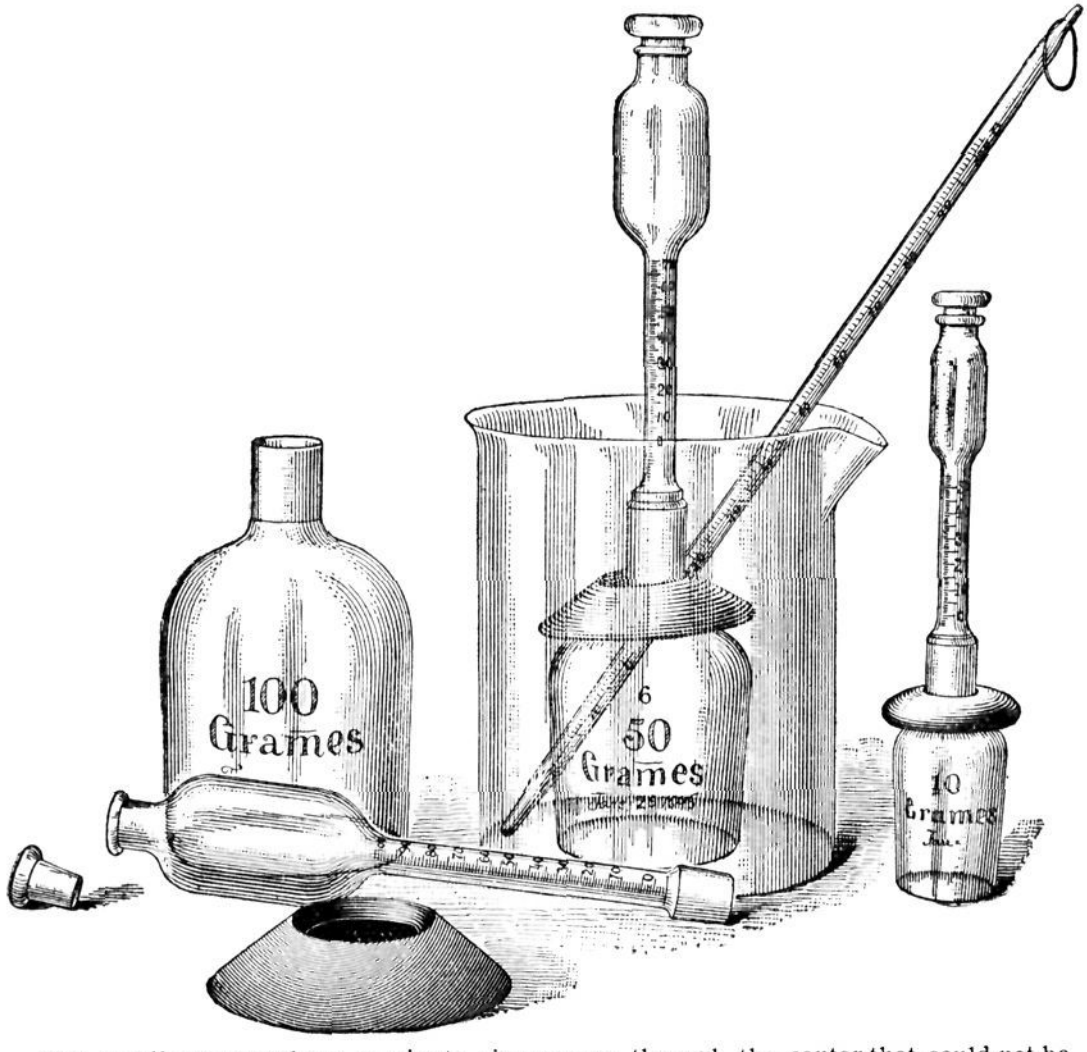
[2] See this Journal, January, 1897, p. 61.

prevents change in adjusting to standard temperature so that this adjustment has to be made before the liquid is put into the bottle, whereas in the improved bottle shown here any temperature of unit volume below 25° C. may be used, temperatures being always adjusted in a bath.

By the adjoining cut it will be seen that the mechanical construction is that of an ordinary thermometer, and as far as temperature is concerned, the principle of action is the same. It therefore has a thin light bulb (the bottle), a graduated stem, and a safety reservoir, the graduated stem being ground into the bottle for facility of filling and emptying. The graduation of the stem is arbitrary, and may be 0 to 50 or 0 to 100.

The use of the bottle and its parts will be easily understood from a description of its adjustment. As received from the glass blower the chemically cleaned and tared bottle should hold say 100 grams of recently boiled distilled water at 20° C. at about fifty-eight divisions of a scale of 0 to 100. In weighing 100 grams of water into the bottle the fine adjustment to 0.001 gram is made by very narrow strips of blotting board that will pass easily down the bore of the graduated stem and absorb minute quantities of liquid. When the 100 grams are in the bottle and the column stands at say 50 to 65 divisions of the scale, the little stopper is put in at the top and the leaden weight is put on the neck, and the whole is immersed in a bath at 0° C. until the column of water in the stem ceases to fall. It should then read at 0 or not much above it and the reading be noted. If it reads below 0 the bottle is too large and the stopper part of the stem must be ground farther into the bottle neck, until the reading on new trials brings the column above 0 at 0° C. Then the bottle is put into a bath at 25° C. and kept there with stirring of the bath until the column ceases to rise, when it should read somewhere from 90 to 100 of the scale. Should it read above 100 of scale, while the lower limit is far above the 0 of scale, then the bottle is too small and the end of the stopper must be ground off until the reading of the column is within the scale at both ends of the scale.

The 100 gram bottle figured in the illustration is one that has been many years in use, and during the first two years the column moved up as it will do in thermometers, but of late



The small stoppers have a minute air passage through the center that could not be shown in the cut.

IMPROVED SPECIFIC GRAVITY BOTTLE, OR PYKNOMETER.

years it has been constant. This bottle has the following scale readings when it contains 100 grams of recently boiled distilled water:

When the column has ceased to move at								4°	C.	the reading is		6.0
"	"	"	"	"	"	"	"	10°	C.	"	"	10.5
"	"	"	"	"	"	"	"	15°	C.	"	"	28.0
"	"	"	"	"	"	"	"	15.6°	C.	"	"	31.0
"	"	"	"	"	"	"	"	20°	C.	"	"	57.5
"	"	"	"	"	"	"	"	25°	C.	"	"	97.5

With such a bottle, specific gravity of liquids can be taken at any of the temperatures of the standard unit volume, to the sixth decimal place. But such accuracy is almost valueless if both

temperatures be not expressed. Fortunately this good practice of always giving both temperatures, as $\frac{4^{\circ}}{4^{\circ}}$ C., $\frac{15^{\circ}}{4^{\circ}}$ C., $\frac{15^{\circ}}{15^{\circ}}$ C., is now becoming common.

THE DETERMINATION OF SULPHUR IN PIG IRON.

BY ANDREW A. BLAIR.

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THERE are two general methods in use for the determination of sulphur in pig iron; the evolution method and the oxidation method. Attention has been repeatedly called to the fact that the residue from many pig irons after treatment with dilute hydrochloric acid contained sulphur, while in some the aggregate evolved as hydrogen sulphide and remaining unacted on in the residue was decidedly less than the amount obtained by the oxidation method. The cause of this discrepancy has been clearly pointed out by Prof. Phillips[1] in his admirable paper on the "Evolution Method for the Determination of Sulphur in White Cast Iron."

Following the line of Prof. Phillips' work I found that it was possible to convert all the volatile sulphur compounds into hydrogen sulphide by passing the evolved gases mixed with hydrogen through a tube filled with pumice and heated to redness. The long boiling that proved necessary and the passage of so much distilled hydrochloric acid and water through the red hot tube made the method too troublesome for ordinary use.

During this investigation I received a sample of pig iron for the determination of its sulphur contents, and used for this purpose not only the oxidation method but the new method as well. The results were as follows:

		Per cent.
1.	Sulphur by oxidation	0.032
2.	Sulphur evolved as hydrogen sulphide	0.000
3.	Sulphur obtained as hydrogen sulphide after passing through red hot pumice	0.005
	Sulphur obtained by fusion of residue	0.057
	Total sulphur	0.062

This seemed to point to the fact that the ferric chloride in the oxidation method held barium sulphate in solution. Mr. P. W.

[1] This Journal, 17, 891.