LETTERS TO THE EDITOR.

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The Atomic Weight of "Thorium" Lead.

IN continuation of preliminary work published by Mr. H. Hyman and myself (Trans. Chem. Soc., 1914, cv., 1402) I gave an account in NATURE, February 4, 1915, p. 615, of the preparation of 80 grams of lead from Ceylon thorite and of the determination of its density in comparison with that of ordinary lead, which proved the thorite lead to be 0·26 per cent. denser. Taking the new international figure, 207·20, for the atomic weight of common lead, that for the thorite lead would be 207·74 on the assumption that the atomic volume of isotopic elements is constant.

This lead and the comparison sample were each distilled in three fractions, and the atomic weights of the two middle fractions were determined from the ratio, Pb : $PbCl_2$, by converting the metal into chloride, *via* nitrate, in a quartz vessel. Only single determinations were done, which gave the values 207·694 and 207·199 respectively, which are in the ratio of 100·24 to 100.

This result, which indicated clearly that the atomic volume of isotopic elements is constant, was communicated in a lecture to the Royal Institution, May 15, 1915, and to Section A of the British Association at Birmingham, 1915.

Since then Prof. T. W. Richards and Mr. Wadsworth at Harvard have shown that the density of lead derived from uranium minerals is less than that of common lead, but, as in the case of thorium lead, the atomic volume is constant. Varieties of lead of atomic weight from 206·08 to 207·18 varied in density from 11·273 to 11·337. The latter values refer to common lead.

Dr. R. W. Lawson, at present interned in Vienna but allowed full liberty to continue his investigations at the Radium Institut under Prof. Stefan Meyer, communicated to me in July last year the desire of the investigators in that institute to examine independently the atomic weight of some of my thorite lead, and I accordingly sent him the first fraction of the distilled lead, weighing some 12 grams. He has now written to me, and it is a pleasant duty first to mention that he speaks in the warmest terms of the utmost kindness and consideration shown him by the staff of the institute and of the courtesy and consideration of the police and other authorities during his internment. He reports that Prof. Hönigschmid has made four determinations of the atomic weight of my lead, according to the method of gravimetric titration and the relation of chloride to silver, and four by gravimetric analysis, whereby the weights of the chloride and silver chloride were determined. The complete mean of the eight results was $207·77 \pm 0·014$, which is in excellent agreement with my own figure, 207·74, found indirectly from the density, and shows that my single atomic-weight determination, 207·694, was not seriously in error.

It is especially gratifying to have the conclusion that the atomic weight of thorium lead is higher than that of common lead confirmed by an investigator of the training and experience of Prof. Hönigschmid. For, although the converse proposition that the atomic weight of lead from uranium minerals is lower than that of ordinary lead has, since the publication of the first paper by Mr. Hyman and myself on thorite lead, been thoroughly and conclusively established by the work of many investigators at Harvard, in Vienna, and in Paris, several of them famous for their atomic-weight determinations, doubt has lingered with regard to our results for the very much more difficult case of thorium lead. In the first place, no one but myself has been able to obtain a suitable material by which to test the question, and I, of course, can claim no previous experience of atomic-weight work. In the second place, there has been an unfortunate confusion between my material, Ceylon thorite, and thorianite, a totally distinct mixed thorium and uranium Ceylon mineral. Lastly, there has been the widespread view, due to Holmes and Lawson, Fajans, and others, mainly derived from geological evidence, that thorium-E, the isotope of lead resulting from the ultimate change of thorium, was not sufficiently stable to accumulate over geological periods of time. This confirmation from Vienna thus clears up many controversial matters, and we now know of varieties of lead differing from 206·08 to 207·77 in atomic weight, and from 11·273 to 11·376 in density, the atomic volume in all cases examined being constant.

According to analyses by Miss A. F. R. Hitchins and myself, the 20 kilos of selected thorite worked upon contained 0·4 per cent. of lead, 57 per cent. of thorium, 1·03 per cent. of uranium, and 0·5 c.c. of helium per gram. Taking the ratio of the period of thorium to that of uranium as 3·2, and assuming that *the whole of the lead is of radioactive origin and is stable,* 94·5 per cent. is derived from thorium, and 5·5 per cent. from uranium. If 206·0 is the true atomic weight of uranium lead, Prof. Hönigschmid's value, 207·77, for thorite lead gives the figure 207·87 for the atomic weight of thorium lead, whilst his figure, 232·12, for the atomic weight of thorium gives a total loss of 0·25 unit of mass in the six α- and four β-ray changes suffered by the thorium atom. From these data and from Silberstein's and his own theories of mutual electromagnetic mass, perhaps Prof. Nicholson may be able to give us further information as to the constitution of the nucleus of the thorium atom.

FREDERICK SODDY.

Marischal College, Aberdeen, February 1.

The Bursting of Bubbles.

PRESUMABLY all bubbles when they burst on the surface of a liquid commence to do so at the top and thus give rise to gaseous vortices. In the ordinary way these are not apparent, but recently we have accidentally discovered a neat way of making them easily visible. The method consists in creating the bubbles by sparking with a Ruhmkorff coil between two wires beneath the surface of some resin oil and thus gasifying the latter. As the bubbles are full of smoke, when they burst the vortex effect is clearly indicated by the formation of beautiful little smoke rings. The size of the bubbles and of the rings depends upon the viscosity of the oil, greater viscosity causing bubbles and rings to become larger. This can easily be shown by cooling or warming the oil.

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A Plea for a Scientific Quadruple Entente.

THE letter of Prof. Eugenio Rignano in NATURE of January 25 may have recalled to some a discussion on literature which took place in Section D at the British Association meeting at Manchester in 1915, a discussion which was introduced almost precisely from the same point of view as that now given by Prof. Rignano. It is the fact that Germany, by welcoming and publishing papers in French, Italian, and English, as well as in German, and by printing the material practically as fast as it arrived, had gained