with ours. They seem rather to indicate that a different admixture was present in his material.

Returning to our results, it is interesting to note that the atomic volume of the Australian radioactive lead is very nearly the same as that of ordinary lead, because 206.3/11.288 = 18.276, whereas for ordinary lead 207.2/11.337 = 18.277. The difference between these values for the atomic volume is so small as to be no greater than the probable limit of error of the experiment. Hence it is clear that the atomic volume of radioactive lead is essentially equal to that of ordinary lead.

Of course, no one knows as yet what proportion of impurity exists in this radioactive sample, which doubtless contains some ordinary lead. If the true atomic weight of the pure isotope is really 206, this sample must have consisted chiefly of the isotope, and the atomic volume of the pure isotope must be very nearly 18.3. On the other hand, it is possible that the theory is incomplete and that the lowering of atomic weight and density is due to the admixture of a much smaller amount of a substance with much lower atomic weight. In that case the atomic volume of the admixture is, of course, less certain, but it probably is near 18.

It is a pleasure to express our indebtedness to the Carnegie Institution of Washington for generous pecuniary support in this investigation.

Summary.

The density of ordinary lead (having an atomic weight of 207.2) and of lead from Australian radioactive sources (having an atomic weight of 206.3) was carefully determined in a convenient pycnometer which is described in detail for the first time, although long in use. The density of ordinary lead reduced to the vacuum standard was found to be 11.337, and that of radioactive lead 11.288. Continued fractionation produced no change in this low density, and it could not have been due to any irregularity in preparing the metal since the samples were all prepared in the same way. This difference in density is especially interesting, because it almost exactly parallels the difference in atomic weight. Thus the atomic volume of radioactive lead is found to be almost exactly equal to that of ordinary lead, the figures being each very nearly 18.28.

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A THEORY OF CHEMICAL REACTION AND REACTIVITY. FURTHER NOTE.[1]

BY E. C. C. BALY.

Received December 26, 1915.

In the addenda to his original criticism, Dr. Dehn has carried the matter no further. I will therefore only add very few words.

[1] This reply was received too late to be published in the January number of THIS JOURNAL as was originally intended.—EDITOR.

In the first place, Dr. Dehn makes a statement that is absolutely untrue and to which I give unhesitating and categorical denial. He says that I devote more than half of my reply to "discussing new physical data not published by him (Baly) when his theory appeared in THIS JOURNAL." These data were published in the *Philosophical Magazine* many months before the paper under discussion.[1] Dr. Dehn's accusation is all the more strange in view of the fact that he includes these two papers in his list of my publications.

In the second place, referring to the changes in absorption with concentration, Dr. Dehn makes the surprising statement that "we must assume not only an infinite series of absorption curves but an infinite series of reactivities. * * * * * These results of course are contrary to fact *as acknowledged by Baly in his reply.*" I pointed out in my first reply that Dr. Dehn had got very mixed in his ideas as regards the effect of concentration and by the misuse of the word "band" where "band group" is meant. I said that his criticism therefore falls to the ground and that his statement is absurd. The only notice he takes of this is to add the words which I have italicized above. I am accused of a great sense of humor by Dr. Dehn, but I am sadly afraid that it is not as great as his.

In the third place, the new paragraph added by Dr. Dehn beginning "There can be no quibble that Baly believes, etc.," and indeed also the succeeding paragraphs reveal such a serious number of misconceptions and misconstructions, which I can no longer believe to be withour prejudice, that further discussion has become valueless.

THE UNIVERSITY, LIVERPOOL.

[CONTRIBUTION FROM THE KENT CHEMICAL LABORATORY OF THE UNIVERSITY OF CHICAGO.]

THE DROP WEIGHT METHOD FOR THE DETERMINATION OF SURFACE TENSION.[2]

(SURFACE TENSION I.)

BY WILLIAM D. HARKINS AND E. C. HUMPHERY.[3]

Received October 22, 1915.

The two methods in most general use for the determination of the capillary constants of liquids are the capillary tube and the drop weight methods. Of these two, the first is much the more sensitive to the action of impurities, since the surface of the liquid involved in the measurement is made very small, while in the drop weight method the surface is not

[1] *Phil. Mag.*, **27**, 632 (1914), and **29**, 223 (1915).

[2] Read before the National Academy of Sciences, December 7, 1914.

[3] This series of papers on surface tension has been presented to the University of Chicago by E. C. Humphery as a dissertation in part fulfilment of the requirements for the degree of Doctor of Philosophy.