its adult form and may be termed *Leptocephalus diptychus*.

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VELOCITY OF IONS FROM ELECTRIC ARCS AND FROM HOT WIRES.

MUCH interest is being shown at present concerning ionization of gases and 'electron' theories of electricity. An investigation now in progress promises to throw further light on this subject, in fact to change one idea which has been held. It has been stated by eminent authorities that in the case of discharge through gases the negative ions always go faster than the positive under the same conditions. The present investigation shows that this is not always the case and a brief account of it may not be amiss.

The work had its origin in an attempt to explain the phenomena of the electric arc. It was shown in the *Physical Review* * that all the phenomena of the arc could be explained by assuming, first, that the current in the arc was carried by ions, and second, that the positive ions move the more rapidly. The second part of this hypothesis did not at first seem probable, since in all cases which had previously been investigated the negative ions had been found to move the more rapidly. Two sets of experiments were, however, given as tending to substantiate that hypothesis, but neither of them could be considered conclusive. †

More recently experiments have been performed with ions drawn out from an arc by a charged body in the neighborhood. ‡ The positive ions in this case were found to have the greater velocity. Quite recently the same fact has been shown by an application of a method used by Zeleny * for finding the velocity of ions produced by X-rays. These methods are entirely independent and the agreement of the results in the two cases leaves little reason to doubt the correctness of the conclusion that the positive ions here move the more rapidly.

Of course, this is not a proof that the positive ions in the arc itself move more rapidly than the negative, but since such an assumption would explain the phenomena of the arc and since the positive ions just outside the arc do have the greater velocity, it seems reasonable to assume that they do also within the arc.

It opens up, however, a still more interesting field of inquiry, *i. e.*, that concerning the condition under which the positive ions show this peculiarity. The discharge from hot platinum and iron wires was accordingly investigated. It has long been known that positive electricity escapes from hot metals easier than negative. An examination of the velocity of the ions from the hot metals showed that here also the positive ions move the more rapidly. Both the methods used in the previous investigation led to the same conclusion.

But in all these cases the action is complicated by the fact that both gases and solids are present. For example, in the case of discharge from hot platinum wire atoms of platinum are no doubt given off, since it is a well-known fact that platinum wire when heated to a white heat decreases in weight. † It may be that because of some contact difference of potential the negative ions of the metal never escape from the metal. A comparison of positive ions of one substance with negative of another would not be of great value. One would wish to know whether the positive ions move faster than the negative ions from which they have been separated.

The case of the arc is still more complicated, for many different solid and gaseous substances enter into the arc. The investigation by Arons ‡ on the arc between metals in H and N at different pressures shows that both the terminals of the arc and the gases about it must be considered.

* *Phys. Rev.*, 10, 151.

† Since publishing the above-mentioned article I find that part of the work there described had already been described by Dewar (*Chem. News*, 45, 37). My own work was performed without knowledge of that done by Dewar, and the method used was not the same as his. The results of the two investigations agree fully. The explanation of the results offered by myself was not suggested in his article.

‡ *Phys. Rev.*, 12, 137.

* *Phil. Trans. Roy. Soc. Lon.*, 195, 193.

† *Wied. Ann.*, 37, 319.

‡ *Drude Ann.*, 1, 700.

Fortunately one case has been studied which is not thus complicated, *i. e.*, the arc in mercury vapor between mercury terminals. In this case only one element is to be considered, and here Arons * found that the greater fall of potential was at the anode. In the light of the work now described we may interpret this to mean that the positive ions in such an arc move the more rapidly.

Warburg † found that in case of discharge in a vacuum tube containing some mercury vapor the fall of potential at the cathode was approximately the same as it was in nitrogen. Arons in discussing this calls attention to the fact that when discharge is taking place through a gas the greater fall of potential is at the cathode, when through a metal vapor at the anode. Possibly we may now modify this statement and say that when *gases are ionized the negative ions move the more rapidly, but that when metal vapors are ionized the positive ions move the more rapidly.* All the facts that have thus far been observed could be explained by such a hypothesis. If this should be shown to be correct, it will no doubt lead us to modify somewhat our ideas concerning the relation of metals to electricity.

C. D. CHILD.

MODULUS OF CONSTANT CROSS SECTION.

THE longitudinal rigidity of a solid, represented by Young's modulus, depending as it does upon both the volume elasticity and simple rigidity, leaves one condition unprovided for *viz.:* the case of longitudinal extension with cross section remaining unchanged. This case probably does not occur with an unrestricted stress, but it is easily conceived in theory. I can find no mention anywhere of a modulus of constant cross section, and have undertaken to approach the problem in this wise. Add to Young's modulus that fraction of the simple rigidity represented by Poisson's ratio. This preserves the longitudinal rigidity and restores to the new modulus the numerical measure of that portion of the strain called out by the change in lateral dimensions.

If this be a true modulus, it offers an easy method of determining approximately the mechanical equivalent of heat, and provides a practical experiment for laboratories not supplied with costly and complete apparatus. Thus a brass wire of density 8.5 ; sp. heat, of .09, coefficient of expansion .000018, volume elasticity 10×10^{11}, simple rigidity 3.7×10^{11}, and Young's modulus 10.4×10^{11} gives roughly,

$$\frac{\left[10.4 \times 10^{11} + \left(\frac{22.6}{67.4} \times 3.7 \times 10^{11}\right)\right]\frac{1}{2} \times .000018}{\frac{8.5 \times .09}{3}}$$

$$= 4.1 + \times 10^7$$

as the value of the calorie in C. G. S. units.

BENJ. H. BROWN.

NOTES ON INORGANIC CHEMISTRY.

WITHIN the past few years much has been added to our knowledge of the chemistry of the alums. To the aluminum, chromium, iron, gallium, and indium alums have been added those of titanium, vanadium, manganese, and cobalt. This completed the series of alums of the metals of the period from titanium to cobalt, but beyond this no alums were known of metals outside of the third group. In the last number of the *Zeitschrift für anorganische Chemie* Professor Piccini of Florence, the discoverer of the titanium and vanadium alums, has described a series of rhodium alums, including those of potassium, ammonium, rubidium, cesium and thallium. This is of peculiar interest, since rhodium belongs to a period in which no alums have been known, and opens the question as to whether there may be other alums in the same period, which includes molybdenum and columbium. Piccini is at present endeavoring to form iridium alums, which the preparation of the rhodium alums makes seem possible.

IN a paper in the last *Berichte* of the German Chemical Society, on radio-active lead, Professor K. A. Hofmann of Munich and Eduard Strauss describe two new substances which appear to be new chemical elements. Both are found in the lead chlorid obtained from pitchblende, and are separated from the lead by fractional crystallization. The one substance possesses no radio-activity and resembles some-

* *Wied. Ann.*, 58, 78.

† *Wied. Ann.*, 40, 10.