

trated extract. There is a capsule of chemical statics, of dynamics, of physical mixtures, of thermochemistry, of electrochemistry, &c. The same concentrated form of diet is continued throughout the volume unrelieved by any historical references or illustrations of apparatus.

There are numerous little inaccuracies, both of author and printer, which it would be well to correct in a future edition.

J. B. C.

LETTERS TO THE EDITOR.

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Residual Affinity.

SIR OLIVER LODGE and Prof. Frankland have indicated (pp. 176, 222) the way in which the electronic theory may afford an explanation of various chemical phenomena; notably so in the case of solutions: the apparent dissociation of the ions of the solute being a consequence of partial withdrawal of the bonds or electric charges uniting them, these bonds becoming occupied in connecting the ions with the molecules of the solvent, and dissociation into ions being thus a consequence of the chemical affinity of the dissolved substance for the solvent, instead of being a proof that no such thing as chemical combination exists in a solution.

I should like to point out that this view was developed by the writer nearly thirteen years ago in a paper entitled "The Theory of Residual Affinity as an Explanation of the Physical Nature of Solutions," which appeared in the *Berichte*, 1891 (pp. 3629-3447), and of which some account will be found in the last edition of Watts's "Dictionary of Chemistry" under the head of "Solutions," p. 495. The only difference in the explanation there given from that given by Sir Oliver and Prof. Frankland is that the atomic charges were spoken of as fluid charges surrounding the atoms instead of as Faraday bundles.

The view that the charge uniting atoms in a molecule is a variable quantity was developed by the writer at a still earlier date in a paper on atomic valency, read before the Chemical Society, December 3, 1885, but printed privately only; a further view was propounded in that communication that the bonds or charges of atoms of a different nature were not exactly equivalent to each other, and were not necessarily expressible by whole numbers. Such a view gives a somewhat striking explanation of many chemical facts which are otherwise difficult of explanation, but it is independent of the explanation of the nature of solutions given subsequently, and now put forward by Prof. Frankland, the basis of which is the mobility and divisibility of the atomic charges.

SPENCER PICKERING.

Harpenden, July 10.

A Volatile Product from Radium.

In the course of some recent experiments on the excited radio-activity from the radium emanation, some evidence has been obtained which points to the conclusion that the emanation X of radium at one stage of the changes which it undergoes after being deposited on a solid body is slightly volatile even at ordinary temperatures. The effect which gives rise to this conclusion was first noticed in some observations on the rate of decay of the part of the excited activity deposited on a plate of copper immersed for a short time in dilute hydrochloric acid, in which the activity from a platinum wire exposed for a time to the radium emanation had been dissolved. When the copper plate with its active deposit had been placed inside a testing vessel and removed after a few minutes, it was noticed that a temporary activity, in some cases equal in amount to one or two per cent. of the activity of the plate, was excited on the walls of the vessel. This activity increased to about three times its original value in the course of thirty minutes after the

removal of the active copper, and then decayed regularly to zero.

The amount of this radio-active deposit that can be obtained from a given amount of the direct radium excited seems to be increased by the solution and re-deposit of the emanation X, but it can also be observed from a wire just removed from the radium emanation. If the active wire is placed at once in the testing vessel without having had its temperature raised in any way and removed in a few minutes, an activity about 1/1000 of the whole activity shows itself on the walls of the vessel. The decay of the activity of this deposit is the same as that of the deposit obtained from the active copper. The following table gives the rate of change of the radiation from the walls of a vessel in which an active wire had been left for three minutes after its removal from the emanation:—

Time after removal in minutes	1	5	10	20	25	30	35	40	50	60
Activity	40	61	75	96	99	100	98	95	88	78

The active wire retains this power of exciting secondary activity for only a short time after removal from the emanation; after ten minutes the amount it excites is almost inappreciable. Merely washing the wire in a stream of running water and drying it over a gas flame, as is frequently done to prevent any trace of radium emanation clinging to the wire, increases the amount of the secondary activity to about 1/200 of the whole.

It is evident, then, that some sort of volatile product is given off from the active wire for a time which can excite an activity the rate of decay of which would indicate two changes in the active matter deposited, one producing rays and the other not giving rise to any radiation (E. Rutherford, "Radio-activity," p. 269). It is found that this volatile substance responds to none of the three tests for an emanation, it is not itself radio-active, it cannot pass without sensible loss through material substances such as paper and cotton-wool, and the activity due to it is not concentrated on the negative electrode in an electric field, but distributes itself evenly over all surfaces exposed to it.

The decay of the excited activity from the radium emanation has been explained by Prof. Rutherford on the assumption that there are three changes in the emanation X after its deposit on a solid body. In these three stages one-half the matter is changed in 3 minutes, 21 minutes, and 28 minutes respectively. In the first and third stages the change is accompanied by ionising rays, but the second is a rayless change. Now if it be supposed that after the first change has taken place the matter becomes slightly volatile, and some of it is concentrated on surrounding objects, a deposit would be obtained which would present the two remaining changes. From the equations for the radio-activity of such a deposit ("Radio-activity," p. 271), it is found that the radiation would increase for about 34 minutes, pass through a maximum, and then decay at the ordinary rate. This is very similar to the behaviour of the deposit obtained in the above experiments.

Curie and Danne (*Comptes rendus*, March 21) have obtained deposits showing similar characteristics by heating a radio-active wire within a cylinder and measuring the rate of decay of the activity of the cylinder.

HARRIET BROOKS.

McGill University, Montreal, June 28.

The Traction of Carriages.

It is a matter of general belief amongst drivers, owners, and builders of carriages that if the distance between the fore and hind wheels be increased so will the "draught" be heavier. I have put the following case before a builder: given two carriages weighing exactly the same, with the fore and hind wheels of each of the same height, but the body of one carriage much longer than that of the other, then the horse will have as much to do in the one case as in the other. The answer has been in more than one instance, the longer bodied carriage will be the heaviest to move. No reason has been given, nor can any explanation of the existence of this belief be offered. Can any of the readers of NATURE make any suggestion?

Ross, July 17.

E. WILLIAMS.