forme de carbures métalliques. Lorsque l'eau est intervenue dans les réactions les carbures métalliques ont donné des carbures d'hydrogène et par oxydation de l'acide carbonique.

On pourrait peut être trouver un exemple de cette réaction dans les environs de St. Nectaire. Les granits qui forment en cet endroit la bordure du bassin tertiaire laissent échapper d'une façon continue et en grande quantité du gaz acide carbonique.

Nous estimons aussi que certains phénomènes volcaniques pourraient être attribués à l'action de l'eau sur des carbures métalliques facilement décomposables. Tous les géologues savent que la dernière manifestation d'un centre volcanique consiste dans des émanations carburées très variées, allant de l'asphalte et du pétrole au terme ultime de toute oxydation, à l'acide carbonique.

Un mouvement du sol mettant en présence l'eau et les carbures métalliques peut produire un dégagement violent de masses gazeuses. En même temps que la température s'élève, les phénomènes de polymérisation des carbures interviennent pour fournir toute une série de produits complexes.

Les composés hydrogénés du carbone peuvent donc se former tout d'abord. Les phénomènes d'oxydation apparaissent ensuite et viennent compliquer les réactions. En certains endroits, une fissure volcanique peut agir comme une puissante cheminée d'appel. On sait que la nature des gaz recueillis dans les fumerolles varie suivant que l'appareil volcanique est immergé dans l'océan ou baigné par l'air atmosphérique. A Santorin, par exemple, M. Fouqué a recueilli de l'hydrogène libre dans les bouches volcaniques immergées, tandis qu'il n'a rencontré que de la vapeur d'eau dans les fissures aériennes.

L'existence de ces carbures métalliques si facile à préparer aux hautes températures, et qui vraisemblablement doivent se rencontrer dans les masses profondes du globe,* permettrait donc d'expliquer dans quelques cas la formation des carbures d'hydrogène liquides ou solides et la cause de certaines éruptions volcaniques.

"Complete Freezing-point Curves of Binary Alloys containing Silver or Copper, together with another Metal." By C. T. Heycock, M.A., F.R.S., and F. H. Neville, M.A. Received June 6,—Read June 18, 1896.

(Abstract.)

The paper, of which the following is an abstract, contains the results of some experiments on the freezing points of alloys of two

* La différence entre la densité moyenne de la terre et celle de la couche superficielle semble indiquer l'existence d'une masse centrale riche en métal. La connaissance des météorites holosidères vient à l'appui de cette hypothèse.

metals, one of the two being in each case either silver or copper. It is an extension into temperatures as high as 1100° C., of experiments similar to those at lower temperatures with which we have been occupied for the last seven years. The results of our previous experiments, in which mercury thermometers were used, are published in the 'Journal of the Chemical Society.' In the work described in this paper the determinations of temperature were made by means of platinum electrical resistance pyrometers of the Callendar-Griffiths type.

The paper is divided into four sections.

Section I contains a short survey of certain points in the theory of concentrated solutions which bear on the interpretation of the experiments.

Section II is devoted to an account of the experimental method.

Section III contains the results of the experiments in a tabular form, each table being followed by notes and remarks taken from the experimental note books.

Section IV contains the results expressed graphically as complete freezing-point curves, together with a discussion and a statement of the conclusions that can be arrived at from a study of each curve.

Section I.

If we plot the percentage composition of an alloy horizontally, and the freezing point vertically we get the freezing-point curve. This, for a pair of metals, would consist of two branches, each starting from the freezing point of a pure metal, and descending until they meet in the eutectic point. Our silver-copper curve gives a fair idea of this case.

If the metals A and B form a stable compound C, then the theory as developed by Bakhuis, Rooseboom, and by Le Chatelier makes it probable that the curve will be divided into the systems A C and C B with two eutectic points, and an intermediate summit at C. This case is well illustrated by a complete freezing-point curve of copper-antimony by Professor Le Chatelier, in which two such summits occur.

Another not infrequent case is probably that of a compound, which when molten can only exist in a partially dissociated condition. Our silver-antimony curve resembles such a curve. Other points of Section I will be best deferred to the summary of Section IV.

Section II.

The alloys, weighing from 200 to 500 grams, were melted in plumbago (salamander) crucibles, placed in one of Fletcher's blast furnaces.

A current of coal gas or of hydrogen was passed through a pipe-stem into the crucible; and this gas, burning over the surface of the molten metal, proved a perfect protection against oxidation. The metal was stirred by a plunging stirrer of graphite. The alloys were made by adding weighed quantities of the second metal in succession to what was originally a weighed quantity of the first metal, and taking the freezing point after each addition.

Section III.

This section contains tables divided into parts and into series. The tables give the freezing point and the composition of each alloy, expressed in percentage weights of one of the constituent metals, and also in atomic percentages. By atomic percentage we understand the number of atomic weights of one metal contained in every 100 atomic weights of the two metals in the alloy.

Section IV.

The complete freezing-point curves given in the paper are for the following pairs of metals—Ag-Cu, Ag-Pb, Ag-Sn, Pb-Cu, Sn-Cu, Ag-Sb. But incomplete curves are also given, showing the freezing points of dilute solutions of Bi, Au, Ni, Fe, Al, in copper, and of Bi, Pt, Au, Al, and Tl, in silver.

It has not been our aim to make a special study of very dilute solutions, but the results we have obtained when utilised in the equations given in the paper give as the latent heat of fusion of a gram of copper the number 50 calories, and as the corresponding latent heat of silver 27 calories. This latter number is considerably greater than the 21 calories given by Person, and both numbers can only be regarded as provisional.

The silver-copper curve shows no indication of chemical combination, unless it be the unexpected fact that the eutectic alloy occurs exactly at the composition Ag_3Cu_2. The comparatively small value of the two atomic falls makes it improbable that the two metals form monatomic molecules in this alloy.

In the silver-lead and silver-tin curves, which have a good deal of likeness to each other, the eutectic alloy contains so little silver that the curve consists almost wholly of the branch starting from pure silver. For the first 20 atoms of added metal the lead curve agrees very well, and the tin curve fairly, with the ideal curve of equation (2); but with more lead or tin the total depression becomes much less than that of the ideal curve at the same concentration. We are disposed to see in this, not an evidence of chemical combination, but rather an aggregation of the lead or tin atoms into larger

molecules, a process which, in the case of the silver-lead, might almost amount to the separation of the alloy into conjugate liquids near 50 atomic percentages of lead.

The lead-copper affords an excellent example of a phenomenon which has been predicted, we believe, by Ostwald, but, so far as we know, has not hitherto been examined experimentally. It is that of the solidification of a system consisting of two conjugate liquids, a saturated solution of lead in copper, and a saturated solution of copper in lead. For dilute solutions of lead in copper, as far as 7 atoms of lead, the curve is in harmony with equation (2); but as more lead is added its effect rapidly decreases, and from 17 to 65 atoms of lead the freezing point remains constant at 954° C. With more lead the freezing point again falls, until it reaches the eutectic point. An examination of the solid alloys shows that the flat part of the curve corresponds to alloys which have separated into two layers, while still liquid.

The copper-tin curve embraces all the remarkable bronzes, gun metal, bell metal, speculum metal, and it is not surprising to find that it presents singularities. The rapid increase in the steepness of the curve as tin is added suggests that the tin is combining with the copper to form complex molecules, perhaps of $SnCu_3$ or $SnCu_4$, which exist in solution. An abrupt change, not only in the direction of the curve, but also in the character of the freezing point, and the nature of the precipitate at 15·2 atoms of tin is in accordance with the great changes in the physical and microscopical character of the alloy noted by Behrens as occurring here. The remarkably straight line of freezing points from here up to 20 atoms of tin is best explained on the assumption that an isomorphous mixture of $SnCu_4$ and another body are separating. The very flat part of the curve between 20 and 25 atoms of tin, along which each freezing point is an extremely constant temperature may be due to another case of isomorphism, or may be due to the separation of conjugate liquids. The existence of a body $SnCu_3$ is not clearly indicated by our curve, although not inconsistent with it. Double freezing points occur on the horizontal lines stretching to the left from 15·2 and 20 atoms of tin.

The silver-antimony curve shows an angle at Ag_3Sb, but the eutectic point, though near Ag_3Sb_2, is not at this formula.

It is worthy of note that in three cases in our curves an angular depression, and not a summit, occurs at a formula point.

We have made a few experiments on alloys of gold, nickel, and iron, in copper. The two latter cause a rise, but gold produces a fall in the freezing point.

From what we have hitherto done, silver bismuth promises to resemble silver-antimony, copper-bismuth to resemble copper-lead. The silver-gold curve, as is already known, rises above the freezing

point of silver; and the same is true of silver-platinum. The silver aluminium curve presents some singularities; but here, as with other aluminium alloys, we have been troubled by partial oxidation of the aluminium, and we therefore hope to revise our experiments with this metal, before publishing them in full.

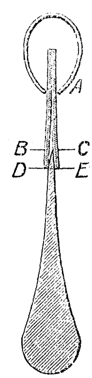
"Note of the Radius of Curvature of a Cutting Edge." By A. MALLOCK. Communicated by LORD KELVIN, F.R.S. Received June 9,—Read June 18, 1896.

The following note may be of interest, partly as indicating the extreme thinness to which a cutting edge may be brought by the ordinary process of grinding, and partly also as showing how readily the wave-length of light may be used, with only the simplest appliances, as a practical unit for the measurement of small distances.

The object in view was to find the thickness, or at any rate a superior limit to the thickness, of the cutting edge of a razor, and for this purpose two pieces of thin glass (such as is used for covering microscope slides) were prepared about $\frac{1}{2}$ inch long and $\frac{1}{16}$ wide.

These were pressed together by a small steel clip A, and the edge of the razor was inserted between them as shown in fig. (1).

FIG. 1.



The razor with the thin glasses in this position was then placed on the micrometer stage of a microscope and illuminated perpendicularly with light from a soda flame.

With the microscope, interference bands were of course visible between the thin glasses; and the number of bands, (N), counting from the spot where the clip pressed the glasses into optical contact