The agreement between the signs of the heats of solution and the course of the curve of solubility and the position of the minimum is very good.

The influence of temperature on the heat of solution is also very considerable.

It appears also from the table of the ordinary heats of solution that with dilute solutions the heat evolved increases with the temperature, owing to the fact that the specific heat of the solution is smaller than the sum of the values for solid salt and water. With concentrated solutions the reverse is the case. From this it follows that there must be a concentration where the heat of solution is independent of the temperature because the specific heat of this solution is equal to those of solid salt + water.

This appears to be the case with a solution with 22.5 H_2O.

In the graphic representation all the heat of solution curves intersect each other at the point corresponding to this concentration. For want of investigation of concentrated solutions, this peculiarity, which no doubt occurs with many substances, has up to the present escaped notice.

Chemistry. — Dr. ERNST COHEN: "*The Enantiotropy of Tin*" (VI) (Communicated by Prof. H. W. BAKHUIS ROOZEBOOM).

Contributions to the history of grey Tin.

1. In the journal *Prometheus* [1]) E. KRAUSE referring to my previous investigations on the Enantiotropy of Tin [2]) makes the following communication: "Schon die Alten wussten, dass dieses weiche Metall, welches „schreit", wenn man es biegt, seine Mucken habe und der Verfasser eines mit Recht oder Unrecht dem ARISTOTELES zugeschriebenen Buches (*de Mirabilibus Auscultationibus* Cap. 51 Edit. BECKMANN) sagt: das keltische Zinn habe unter anderen merkwürdigen Eigenschaften auch die, nicht bloss (wie die anderen Metalle) in der Wärme zu schmelzen, sondern auch eintretender Frost bewirke dasselbe.

Auch PLUTARCH in den *Tischreden* (VI, 8) berichtet von in strengen

[1]) Jahrgang XI, 44, S. 701 (1900).

[2]) These Proceedings 1899 and 1900 also Zeitschrift fur phys. Chemie 30, 601 (1899) 33, 57 (1900) 35, 588 (1900).

Wintern herabgestürzten Bildsäulen, weil das Metall, mit dem es in den Postamenten vergossen, durch den starken Frost geschmolzen sei.

Diese Thatsachen waren so bekannt, dass ARISTOTELES sich um eine physikalische Deutung bemühte. Das Metall, sagte er, ziehe sich im Froste so stark zusammen, dass die in seinen Poren enthaltene Wärme es durch die Zusammenpressung zum schmelzen bringe. Wie alles, was ARISTOTELES sagte, wurde dieser Angabe bis zur neueren Zeit Glauben geschenkt, und noch MONTAIGNE führt die Frost- und Hitzeschmelzung des Zinns zum Beweise dafür an, „dass sich die Extreme berühren".

As the question whether the Ancients were acquainted with the peculiar phenomenon shown by tin at low temperatures, interested me very much, I have endeavoured to find further particulars in connection with KRAUSE's communication.

It is only through the kind assistance of Prof. SPEYER of Groningen, to whom I here wish to express my hearty thanks, that it has been possible to control this matter; to him I am principally indebted for the following particulars.

2. In ARISTOTLE (or Pseudo-ARISTOTLE), *Περὶ θαυμασίων ἀκουσμάτων* 50, the following passage is found [1] *Τὸν κασσίτερον τὸν κελτικὸν τήκεσθαί φασι πολὺ τάχιον μολίβδου· σημεῖον δὲ τῆς εὐτηξίας, ὅτι τήκεσθαι δοκεῖ καὶ ἐν τῷ ὕδατι· χρώζει γοῦν, ὡς ἔοικε, ταχύ. τήκεται δὲ καὶ ἐν τοῖς ψύχεσιν, ὅταν γένηται πάγη, ἐγκαταλειομένου ἐντός, ὡς φασί, καὶ συνωθουμένου τοῦ θερμοῦ τοῦ ἐνυπάρχοντος αὐτῷ διὰ τὴν ἀσθένειαν.*

It is said that Celtic tin melts much more quickly than lead. A proof of the fusibility is the statement that it also melts in water; apparently it seizes [2] quickly. It also melts in the cold when frost has set in, because, as is said, the heat contained in it is inwardly confined and compressed on account of its weakness.

3. The passage from MONTAIGNE cited by KRAUSE is found in his *Essais des vaines subtilités* [3]: L'extreme froideur, et l'extreme

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[1] Bibliotheca scriptorum graecorum et romanorum Teubneriana, Lipsiae 1888. Editio OTTO APELT.

[2] Prof. SPEYER in commenting on the translation of *χρώζει* by *seizes* says: this translation does not satisfy me. The word means to touch, to catch, to stain, but *χρώζει* is active and I cannot see how it could mean here "it discolours". I am more inclined to believe that the idea is "it is sensitive to outside influences".

[3] I am quoting a Parisian edition (DESOER, librairie, rue Christine 1818). Nouvelle Edition, livre premier, LIV, pag. 104.

chaleur cuisent et rotissent: Aristote dict que les cueux de plomb se fondent et coulent de froid et de la rigueur de l'hyver, comme d'une chaleur vehemente.

At this passage the editor adds in a note: "Ici MONTAIGNE ne rapporte pas exactement la pensée d'ARISTOTE, qui, après avoir dit que l'étain des Celtes se fond plutôt que le plomb, puisqu'il se fond même dans l'eau, ajoute: L'étain se fond aussi par le froid quand il gèle etc. *de mirabilibus auscultationibus* p. 1154 Edit. Paris, Tome 1.

That MONTAIGNE made a mistake when he cited ARISTOTLE in this place appears from the fact that what he attributes to ARISTOTLE [1]) may be read in PLUTARCH (*Symposiaca* VI, 8).

Referring to the fact that ravenous hunger occurs after great fatigue, for instance after having walked through snow, and then disappears after partaking of only very small amounts of food, particularly a morsel of bread, one speaker contends that the heat being withdrawn from the interior and heaped up on the outside of the body, as for example the perspiration and the warm and tired hands and feet of the fatigued person, show, leaves inwardly a state of cold which causes a craving for food. Another says, no, the craving for food is not caused by the cold, but in the body something takes place similar to that which happens with metals in a very severe winter. There it is seen that cooling does not only cause congealing but also melting for in severe winters *ἀχφόναι μολίβδου* occasionally melt away, consequently something similar may be supposed to take place in the intestinal process, etc.

Probably, leaden grindstones are meant. (Plumbese cotes in WIJTTENBACH's translation, cueux de plomb in MONTAIGNE's).

4. According to a private communication from Dr. KRAUSE he has borrowed PLUTARCH's citation (see pag. 469) from a translation by KALTWASSER (Bd. 5, S. 594, Frankfurt a. M. 1793) where may be read:

Uebrigens ist es ausgemacht, dass die Kälte die Körper nicht nur verdichten, sondern sie auch zerschmelzen kann. In strengen Wintern geschieht es zuweilen, dass grosse Stücke Blei, womit die Bildsäulen an den Postamenten befestigt sind, zerschmolzen werden und herabfallen.

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[1]) Plutarchi chaeronensis varia scripta quae moralia vulgo vocantur. Lipsiae, ex officina Car. Tauchnitii 1820. Tomus IV, 339.

Of this, however, nothing is to be found in PLUTARCH himself at the place mentioned.

5. Whilst ARISTOTLE makes a very clear distinction between κασσίτερος (tin) and μόλυβδος (lead) the question might be put whether PLUTARCH when using this last word really means what we understand by lead or whether we have also to think there of *tin*.

BERTHELOT says in his *Introduction à l'Etude de la Chimie des Anciens et du Moyen Age* [1]: "tout métal et alliage blanc, fusible et altérable au feu, s' appelait à l'origine *plomb*. Plus tard on distingua deux variétés: le plomb noir, qui comprenait notre plomb et plus rarement, notre antimoine, etc.; et le plomb blanc, qui comprenait notre étain et certain alliages de plomb et d'argent."

Of importance is also what BERTHELOT [2]) afterwards wrote in his "La Chimie au Moyen Age (1893) where he devotes a chapter to the names of *tin*.

"Le nom que κασσίτερος, employé dans HOMÈRE, (± 800 a. Chr.) paraît signifier un alliage de l'argent avec le plomb, peut être associé à l'étain: il n'a pris son sens actuel, dans toute sa précision, que vers le temps d'Alexandre (356—323 a. Chr.) et des Ptolémées ... mais on s'exposerait à toutes sortes d'erreurs, en l'appliquant aux auteurs qui ont employé le même mot à des dates plus reculées."

We may, therefore, assume also in connection with the distinction made between κασσίτερος and μόλυβδος (see above), that in the time of ARISTOTLE (384—322 B. C.) the meaning of κασσίτερος corresponded with our idea of *tin* [3]).

It certainly seems worth while to study the behaviour of lead also at low temperatures.

Summarising, it appears from the above that there is reason to suppose that the changes which tin may undergo at low temperatures had already been observed at the time of ARISTOTLE, whilst nothing definite can, as yet, been said about an analogous conduct of lead.

Amsterdam, Chem. Lab. University, December 1900.

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1) Paris, 1889, p. 230—231.

2) Paris, Imprimerie nationale. Tome I, 367.

3) The statement that it also melts in water might make us again entertain a doubt.