to any discovery of practical value, although the foundations of future valuable discoveries may be laid. There is much to be said in favour of rewards for good work done, as well as for providing means for doing it. It would probably be found in practice that

the difficulties are not so great as might appear. It may be suggested that funds might be voted to the Medical Research Council and to the Department of Scientific and Industrial Research for the special purpose indicated.

The Identity of Geber.

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IT is generally agreed that the masterpieces of medieval chemical literature are the "Investigation of Perfection," the "Sum of Perfection," the "Invention of Verity," and the "Book of Furnaces," ascribed to "Geber, the Most Famous Arabian Prince and Philosopher." They are written in clear and definite language and are free from the enigmas and allegories which disfigure so large a proportion of alchemical books, and they contain much precise chemical information. The earliest Latin manuscripts of these works appear to be of the late thirteenth century, and they profess to be translations from the Arabic of Jābir ibn Ḥaiyān, who lived in the eighth century A.D.

The Arabic origin of Geber's works was universally accepted until the middle of the nineteenth century, when Kopp first expressed doubts as to their authenticity. Kopp, however, knew no Arabic and was not acquainted with any Arabic works of Jābir, so that his suggestion was merely tentative. Additional evidence was secured by Berthelot, who caused translations to be made of a few Arabic manuscripts containing works ascribed to Jābir ibn Ḥaiyān, and compared these translations with the Latin works mentioned above. He came to the conclusion that Geber's works were European forgeries of the thirteenth century and could certainly not be regarded as translations of works of Jābir ibn Ḥaiyān. Up to the present no one has challenged Berthelot's conclusion, and all historians of chemistry have followed him blindly, without critical examination of the material upon which his conclusion was based. I hope to show in the present article that there is a good deal more in the problem than Berthelot seemed to realise, and, while not claiming to have proved definitely that Geber and Jābir are identical, I believe that the evidence now accumulated renders this identity extremely probable.

It is necessary in the first place to consider the data which Berthelot had at his disposal, and to estimate their value; and secondly, to enumerate the definite points in his argument. A fact of prime importance is that Berthelot was completely ignorant of Arabic and was therefore not in a position to draw conclusions from considerations of style—yet this is what he continually attempted to do. This habit of Berthelot's has been severely criticised by von Lippmann ("Entstehung und Ausbreitung der Alchemie," Berlin, 1919), and I need not enlarge upon it here.

Berthelot's acquaintance with Arabic alchemy was limited in two senses, for, in addition to his want of knowledge of the language, he knew even in translation only thirteen small works, nine of which are attributed to Jābir. While, therefore, one has the greatest admiration for Berthelot's invaluable pioneer work,

one is justified in holding that the foundation of the edifice which he reared is somewhat insecure. The more I investigate the subject the more do I feel, with Berthelot's countryman Prof. E. Blochet, that "il faudrait des années d'un labeur ininterrompu pour tirer des manuscrits la doctrine arabe de la chimie."¹

According to the "Kitāb al-Fihrist," a Muslim encyclopædia of the tenth century A.D., Jābir wrote at least five hundred books, some large and some small. About fifty of these are known to exist, and I have no doubt that many others could be found by diligent search. A study of the extant manuscripts shows that Jābir was very catholic in his learning—he was at once philosopher, physician, mystic, and chemist. It so happens that Berthelot came upon some of the more mystical of Jābir's works, and was therefore led to a wrong conclusion as to his attainments in chemistry.

To come now to the definite points in Berthelot's argument. It will be convenient to give these so far as possible in his own words ("La Chimie au moyen âge," tome i.).

1. La première et la plus essentielle, c'est que le texte arabe renferme certaines des doctrines précises sur la constitution des métaux, que nous trouvons dans les textes latins réputés traduits de l'arabe et attribués [à Geber]; tandis qu'une autre partie de ces doctrines manque complètement dans les traités arabes et paraît dès lors appartenir à une période plus moderne. Ainsi la doctrine des qualités occultes, opposée aux qualités apparentes, est formellement exposée dans les textes arabes de Djāber [Jābir]. . . . Au contraire, aucune allusion n'est faite dans les textes arabes précédents à la théorie de la génération des métaux par le soufre et le mercure.

2. On ne rencontre . . . dans les œuvres arabes de Djāber, de recette précise pour la préparation des métaux, ou des sels, ou de quelque autre substance.

3. Dans ces traités arabes, le langage est vague et allégorique.

4. Aucune doctrine ou fait précis n'est énoncé, aucun personnage n'est cité.

5. (No direct quotation of Geber is made by Albertus Magnus or Vincent de Beauvais, the presumption being that the Latin works of Geber were therefore not known to these two alchemists.)

6. La *Summa* ne contient . . . aucune des formules musulmanes . . . dont [Jābir] est prodigue.

7. (The *Summa* contains an account of the arguments of those who denied the possibility of transmutation. Of this "on n'en trouve aucune trace dans les opuscles arabes de Djāber.")

8. (The style of the *Summa* recalls that of the Schoolmen.)

9. L'auteur (of the Latin works) dit que, d'après lui, il existe, en réalité, trois principes naturels des métaux: le soufre, l'arsenic qui lui est congénère,

¹ Private communication to the author.

et le mercure. Ce sont là, en réalité, des théories nouvelles, postérieures à celles d'Avicenne.

10. (All the *Summa*) "est d'une fermeté de pensée et d'expression, inconnue aux auteurs antérieurs, notamment au Djâbir arabe."

11. There is no mention in the Arabic work of nitric acid, *aqua regia*, or silver nitrate, all of which are described in the Latin works.

It will be observed that all these arguments are negative ones, and rest upon the difference between the Latin works and the Arabic opuscles of Jābir known to Berthelot. Up to the present I have not found any Arabic works which can be considered as the originals of the Latin treatises, but that there is much to be said against Berthelot's conclusions will be apparent from the following remarks, which I have numbered to correspond with the preceding quotations.

1. Jābir enunciates the sulphur-mercury theory of metals in the first book of his "One Hundred and Twelve Books" (quoted by Al-Jildakī in vol. i. of the "Nihāyat at-Ṭalab"). He says very definitely that "the seven fusible bodies are composed of mercury and sulphur." Compare this with chap. ii. of the "Investigation of Perfection": "All metallic bodies are compounded of argentive and sulphur." This is expanded in the "Book of Properties," section 12 (B.M. manuscript), where Jābir advances the theory that all minerals, whether metallic or not, are composed of mercury, sulphur, gold, and sal-ammoniac.

2. Jābir can be quite definite when he likes; the three preparations given below are taken from the "Book of Properties."

(a) Section 36. "Take a pound of litharge, powder it well and heat it gently with four pounds of wine vinegar until the latter is reduced to half its original volume. Then take a pound of good *qalī* (crude sodium carbonate) and heat it with four pounds of fresh water until the volume of the latter is halved. Filter the two solutions until they are quite clear and then gradually add the solution of *qalī* to that of the litharge. A white substance is formed which settles to the bottom. Pour off the supernatant water and leave the residue to dry. It will become a salt as white as snow." (b) Section 38. "Take a pound of litharge and a quarter of a pound of soda, and powder each well. Then mix them together and make them up into a paste with oil and heat in a desensory. (The metal) will descend pure and white." (c) Section 36. "To convert mercury into a red solid. Take a round glass vessel and pour a convenient quantity of mercury into it. Then take a Syrian earthenware vessel and in it put a little powdered yellow sulphur. Place the glass vessel on the sulphur and pack it round with more sulphur up to the brim. Place the apparatus in the furnace for a night, over a gentle fire . . . after having closed the mouth of the earthenware pot. Now take it out and you will find that the mercury has been converted into a hard red stone of the colour of blood. . . . It is the substance which men of science call cinnabar."

3. That many of Jābir's books are couched in allegorical language no one will deny, but in others there is scarcely any trace of allegory (e.g., the "Book of Properties") and Jābir is quite capable of sustaining a closely reasoned argument. Lack of space prevents me from illustrating this point as fully as I could wish, but I may perhaps refer to the "Book of Balances," where he says, "It must be taken as an absolutely

rigorous principle that any proposition which is not supported by proofs is nothing more than an assertion which may be true or may be false. It is only when a man brings proofs of his assertion that we say, your proposition is true." Similarly, he is at pains in the "Book of Properties" to make it clear that he is describing his personal experiences; "we have described only that which we ourselves have seen, and not that which was told us or what we heard or read." Jābir is very precise, again, in his "Book of Definitions."

4. Berthelot's fourth argument is sufficiently answered by the evidence I have brought forward in 1, 2, and 3. In his "Book of the Divine Science," Jābir refers to Pythagoras and Plato, and defines chemistry as "that branch of natural science which investigates the method of formation of the fusible bodies" (i.e. the metals). His views on the structure of cinnabar, given in the same book, are so precise, and refute Berthelot's charge of vagueness so well, that I cannot refrain from quoting them here.

"When mercury and sulphur combine to form one single substance it has been thought that they have essentially changed and that an entirely new substance is formed. The fact is otherwise, however. Both the mercury and the sulphur retain their own natures—all that has happened is that their parts have become attenuated and in close approximation to one another, so that to the eye the product appears uniform. But if one could find an apparatus to separate the particles of one sort from those of the other, it would be apparent that each of them has remained in its own permanent natural form and has not been transmuted or changed. We say, indeed, that such transmutation is not possible for natural philosophers."

5. If Albertus Magnus and Vincent de Beauvais knew no Arabic, and if the *Summa*, etc., (supposing that they were originally Arabic) had not yet been translated into Latin, the absence of mention would be explained. In any case, the argument *a silentio* is always unsatisfactory.

6. It is here that Berthelot's ignorance of Arabic has led him astray. As a matter of fact, the *Summa* is full of Arabic phrases and turns of thought, and so are the other Latin works. It is obvious that a full discussion of this point would require far more space than is available here, and I hope to treat of it elsewhere. I will, however, quote one or two passages of Russell's English translation of Geber which are of unmistakable Arabic origin. "Our Art is reserved in the Divine Will of God and is given to, or withheld from, whom he will, who is Glorious, Sublime, and full of all Justice and Goodness." ". . . transmute with firm transmutation" (a well-known construction in Arabic). "This Divine Art, which is both necessary and known." "Now let the high God of Nature, blessed and glorious, be praised, who hath revealed to us the Series of all Medicines." "We have dispersed the special things pertinent to this Praxis, in diverse Volumes" (often said by Jābir). "Gold Obrizon" (*dhahab ibrīz*). "One part tingeth infinite parts of Mercury into most high Sol, more noble than any natural Gold." "Festination is from the Devil's part."

7. So far, I have not found in Jābir any mention of the arguments against the possibility of transmutation.

to which Berthelot refers, but Jābir is never tired of pointing out the errors of other chemists and insisting upon the superiority of his own theories and methods. He even curses them in the manner of the Latin works.

8. The style of the Latin works does indeed resemble that of the Schoolmen, but so does that of many of the Arabic works of Jābir. I would refer especially to the first twelve sections of the "Book of Properties," and to the "Book of Definitions."

9. Arsenic as one of the principles of metallic bodies is referred to by Jābir in Book I. of the "Hundred and Twelve Books" (quoted by Al-Jildakī in vol. ii. of the "Nihāyat al-Ṭalab"). "Arsenic" here refers of course to the arsenic sulphides, realgar and orpiment. It will be noticed that the Latin Geber does not insist upon the necessity of arsenic; in this he is in agreement with Jābir. Both agree in regarding the prime constituents of metals to be sulphur and mercury.

10. I have explained Berthelot's insistence on the difference in style between the Latin works and the

Arabic treatises as due to the fact that Berthelot was unlucky in his choice of the latter.

11. I cannot say whether the Arabic Jābir definitely mentions nitric acid, *aqua regia*, and silver nitrate. It is unfortunate that the pages referring to solutive waters are missing from the British Museum MS. of the "Book of Properties," especially as I believe this MS. to be unique. Al-Jildakī mentions a "solutive water" (*ma' al-hilāl*) which was used to dissolve out silver from a gold-silver alloy; I presume this must have been nitric acid. Al-Jildakī, however, lived after the date of the earliest MSS. of Geber's works.

I ought to say that I have hitherto examined by no means all of the available material, and that in the present article I have only very roughly sketched out the case for the identity of Geber and Jābir. I hope to deal with the subject much more fully in the future, but the question of the identity of Geber is so important for the history of chemistry that it seemed desirable to publish a preliminary account of some of my conclusions.

The Alleged Discovery of the Virus of Epidemic Influenza.

THE recent report in the daily press that the cause of influenza had been discovered by Drs. P. K. Olitsky and F. L. Gates, of the Rockefeller Institute, N.Y., might lead the layman to believe that the problem was solved. There is no published evidence to show that this is correct. The facts are briefly these. Influenza is the greatest pandemic disease known and may be traced to the most remote periods of which we have historic data. One of its great outbursts (1889-1890) coincided with the bacteriological epoch in science, and by means of the technique devised by Robert Koch, one of his assistants, R. Pfeiffer, distinguished by the accuracy of all his work, isolated (1892) a small rod-shaped microbe since universally called *Bacillus influenzae*. This microbe, not easy to cultivate, was missed by all the investigators before Pfeiffer, but his work was subsequently regarded as correct.

In succeeding years influenza as an epidemic disappeared and little was heard of Pfeiffer's bacillus in bacteriological literature. In 1918, under the title of Spanish influenza, the disease again appeared, and sweeping over the inhabited world like a prairie fire, caused immense morbidity and mortality everywhere. The microscopes of bacteriologists were riveted on the disease processes of the plague. The results of tried investigators varied, but with prolonged experience and suitable methods the bacillus of Pfeiffer was found almost everywhere in cases of the disease. Dissident voices were, however, raised here and there, partly owing to inability to find the bacillus, partly owing to the fact that when found it was difficult to prove its causal relation to influenza, as animals are by no means so susceptible to the disease as man.

It was believed and stated, in fact, that Pfeiffer's bacillus was not and could not be the cause of influenza, which was to be sought in some hitherto unknown or unrecognised agent. Among those who held this view must be mentioned Gibson Bowman and Connor, who, attached to the B.E.F. in France, published statements (1919) to the effect that influenzal secretions which had

been forced through bacterial-proof filters, gave rise in monkeys, rabbits, mice, and guineapigs to a disease closely resembling that of human influenza. They claimed to have transmitted the disease from animal to animal in series. They believed that the virus was a "filter passer." Independently, Bradford, Bashford, and Wilson made similar claims, which they afterwards withdrew. Following the same lines, Maitland, Cowan, and Detweiler of Toronto recorded entirely negative results and directed attention to grave errors which might arise in interpreting results believed to be positive. What were described as typical effects by the supporters of the filter-passing-virus theory were shown by the Canadians to occur in animals that had never been inoculated at all but which had been intentionally killed. This fact has since been abundantly confirmed by Branham (1922) and shown by her to occur when death is brought about by a blow on the neck. It is along the same route that the Rockefeller investigators have proceeded, from whose work it is now claimed that the etiology of influenza is settled, and it is claimed that the virus is a body called by them *Bacillus pneumosintes* (σίντρινς, injurer or devastator—from its supposed deleterious effect on the lungs).

In the last two years Olitsky and Gates have published a long series of papers in the *Journal of Experimental Medicine*, giving the results of their inquiries. Their claims are based on the following statements. (1) Influenzal throat secretions diluted and filtered through Berkefeld filters produce symptoms which cannot be produced by similar filtrates from normal persons. The symptoms—in rabbits—are fever, conjunctivitis, and a diminution in the number of leucocytes in the blood, a symptom which is very characteristic of the influenza disease in man. None of the animals died of the experimental disease, but on being killed, the lungs were found mottled and hæmorrhagic. (2) The lesions in the lungs are said to be transmissible in series. (3) Although none of the experimental animals died, they are stated to have been rendered