## Chemistry in 'Iraq and Persia in the Tenth Century A.D.

AN important communication with the above title appears in the *Memoirs of the Asiatic Society of Bengal*, vol. 8, No. 6, pp. 317-418 (1927), the authors being Principal H. E. Stapleton, of Presidency College, Calcutta, the late R. F. Azo, and M. H. Husain, professor of Arabic at Presidency College. The principal object of the paper, which is provided with numerous references and notes of great value, and is illustrated, is confined to supporting the thesis that "in 900 A.D. such a degree of exact knowledge of chemical substances and apparatus was displayed that historians may henceforward be justified in antedating the birth of scientific chemistry by—in all probability—at least 900 years; and, secondly, to indicating briefly the influences, both personal and racial, that appear to have controlled the development of chemistry in the period of investigation."

There is nothing in the paper which would incline any one acquainted with the works of the Greek-writing practitioners of the 'Divine Art' at Alexandria, some 500 years before the period dealt with in the present memoir, to assent to the first part of the thesis, and it is much to be regretted that the enthusiasm of some writers on chemistry in Islam should often lead them to overstep the bounds of reality.

The subject matter of the memoir falls naturally into two parts. The first contains an account of the chemical information contained in two treatises written by Muhammad bin Zakarīyā ar-Rāzī, who is generally known (and will in what follows be called) by the name of Rhases (although this is really his address), and an encyclopædia of sciences written about A.D. 980 by Abū 'Abdallāh Muḥammad bin Aḥmad bin Yūsuf al-Kātib al-Khwārazmī, the Arabic text of which was published by Van Vloten in 1895; an English translation of the part of the latter dealing with alchemy is given.

Rhases was born in A.D. 866 at Ray, and was, like many other Arabic writing men of learning, a Persian. Rhases' treatises on alchemy are said by our present authors to be "scientific works in the modern sense of the word," and free from that "veil of mysticism with which even Jābir had continued to conceal from public view the mass of chemical facts that had gradually accumulated in the Near East up to the middle of the eighth century A.D." It may be useful to notice at this point that the writings of Jābir ibn Hayyan do, in fact, contain a good deal of childish mysticism, and that the claims put forward for his 'rationalism' are exaggerated.

One of the sources of Rhases' information, according to our present authors, was the "Book of the Seventy," a Latin translation of which in the Paris MS. Latin 7156 was mentioned by Hoefer in 1842 ("Histoire de la chimie," vol. 1, p. 409, 1842: "Liber de Septuaginta translatus a magistro Renaldo Cremonensi de lapide animali"—a treatise which, says Hoefer, "pourrait beaucoup intéresser les amateurs de la science hermétique. Il a été, selon toute apparence, traduit de l'arabe"). It was published by Berthelot in 1906, after he had suggested in 1893 that it was the work of the same title attributed to Jābir ibn Hayyan in the "Kitab al Fihrist" of al Nadim. This has been confirmed, since the present memoir was written, by Julius Ruska, who has discovered the Arabic original. "The substances, apparatus, and processes mentioned by ar-Rāzī are, almost without exception, found in the 'Book of the Seventy.'" The authors proceed to demonstrate in detail the indebtedness of Rhases to Jābir ibn Hayyan.

The second part of the memoir deals with the interpretation of the word Khārsīnī, which is mentioned as one of the metals in the treatise published by Van Vloten. It is there said to be "a rare metal, almost unprocurable." It is associated with the planet Mercury, and this leads the authors to a discussion of the planetary idols of the Sābians of Harran, which are described in a treatise of Al-Dimishqī (*d.* A.D. 1327) translated by Chwolson, and also in full by Mehren ("Manuel de la cosmographie du moyen âge," Copenhagen, 1874), in which the idol of Mercury "is made of an alloy of all the metals as well as of Khārsīnī, and in the hollow of which much quicksilver is poured" (Mehren translates Khārsīnī as "Chinese porcelain," as does Chwolson). The literal meaning of Khārsīnī is, according to the authors, "the Barb, or [poisonous] arrow-head of China"; it takes the place of glass in Jābir's list of the metals, and after an exhaustive examination of the other sources of information (in which they refer to "a further possible source of Arabic alchemy, viz., the Chinese School of Alchemy which was flourishing at least as early as B.C. 200, and of which the chief exponent, Ko-Hung, wrote his treatise on Taoist Philosophy and Alchemy, called the *Pao p'o tsz'* in A.D. 330"), they conclude that "the original Khārsīnī of ar-Rāzī represented the metal now known to us as zinc." They also refer to "the Chaldæan element in ar-Rāzī's chemistry, as indicated by the inclusion of Khārsīnī in the list of metals," and suppose that "the ancient civilisation of Mesopotamia had still survived in his time at Ḥarrān" (a part of which comprised the Sābian planetary religion mentioned above), and that Chinese information was also available to him there. "Greek and Chinese alchemy must have had some common source of origin: and as the Chinese could hardly have drawn directly on Greek (or Egyptian) sources for this knowledge, China must either have discovered the facts for herself, and passed them on to some intermediary, like Babylonia, or acquired the knowledge from the same (or some other) intermediary. . . . In addition to the Greek knowledge of chemistry, which reached him through Jābir, ar-Rāzī also drew—in all probability through the Temple-priests of Ḥarrān in northern Mesopotamia—on the considerable body of knowledge at the disposal of the ancient Babylonian and Egyptian priests."

It is suggested that such information as that translated in R. C. Thompson's "Chemistry of the Ancient Assyrians" may have been transmitted directly, together with unspecified elements from other civilisations. This suggestion is clearly worth following up, since the usual opinion that chemistry is largely of Egyptian origin was put forward at a time when practically no information existed as to the technical knowledge of that people. Exaggerated claims for "a Babylonian origin of alchemy," such as those of Eisler, are still without confirmation, but the possible contributions from Mesopotamia grow more probable with fuller knowledge. In this connexion there is an interesting suggestion of Ruska ("Tabula smaragdina," p. 22) that the καιρικαὶ βαφαί of the Greek alchemical MSS. refers to the colorations of metals in the interior of the earth, which were formerly engendered by the action of the planetary spirits, but in the period when these actions had ceased, could be effected by the 'divine art' of chemistry. This, in turn, seems to be related to the old Babylonian belief in "spirits of mineral treasures" living under the earth, and related to the fire god.

The Chinese element assumed by our authors is

awaiting investigation, and it may be that Rhases' account of Kharṣīni refers to mercury as a compound such as corrosive sublimate, which would correspond better with the Sābian account and with the poisonous properties of the material. I-Tsing (A.D. 671–695) seems to know corrosive sublimate, the production of which in China may have been early.

It has been possible only to mention one or two of the numerous interesting matters dealt with in the memoir, and the authors have performed a most useful and valuable service in its publication. Students of this difficult period in the history of chemistry will await with keen interest the further memoirs which Principal Stapleton promises. J. R. P.

## The Empire Mining and Metallurgical Congress.

THE first Empire Mining and Metallurgical Congress was held in 1924 at Wembley, on the occasion of the British Empire Exhibition, and the second will open at Montreal on Aug. 22. These conferences are for the discussion of scientific, technical, and economic problems connected with the mineral industry, and they have in view the development of the mineral resources within the Empire. They are arranged by an Empire Council consisting of delegates from five constituent institutions domiciled in Great Britain and five domiciled oversea.

The convening body for this second Conference is the Canadian Institute of Mining and Metallurgy. Invitations have been widely accepted from Great Britain, South Africa, Australia, and elsewhere within the Empire, while in addition many members of one or other of the institutions resident in the United States will attend. Probably, therefore, including ladies, there will be some 750 participants.

The venue of the conference in Canada is a particularly happy one, not only because this year is the diamond jubilee of the Dominion's Confederation, but also because the mineral industry in Canada has risen so rapidly to a position of great importance that it may be regarded as being on the threshold of further important developments.

The congress will begin by a session at Montreal on Aug. 22, and it will end by return to the same capital city on Sept. 28. Intermediate sessions will be held at Toronto and Winnipeg in succession, the major portion of the conference then proceeding westward to Vancouver to visit Edmonton on the return, at both of which places there will be further sessions, while the remaining participants will turn eastward from Winnipeg to hold a session at Sydney in Nova Scotia. There will be, accordingly, full opportunity to visit all of Canada's important mineral fields from the Atlantic to the Pacific.

With the greatest sympathy, interest, and assistance from the Dominion and Provincial Governments, as well as from the Canadian mineral industry itself, the presentation of Canada's mineral resources to the visitors will undoubtedly be as complete as the best possible auspices can ensure.

The wider question of the Empire's mineral resources will be the feature of the discussions at the opening session at Montreal, when papers dealing with it will be presented, particularly from the Institution of Mining and Metallurgy, London. So important, indeed, does that Institution consider the question to be that it has forwarded to the Conference the following resolution: "Resolved: That the Council of the Institution of Mining and Metallurgy being of opinion that the questions raised in the Paper submitted to the Institution by Sir Thomas Holland on a 'Proposed Review of the Mineral Resources of the Empire' are of vital importance to the British Empire as a whole, and to the Dominions, Dependencies, and Colonies, as units, think it desirable that they should receive serious consideration and discussion by competent authorities within the Empire."

Apart from this outstanding question, the Conference has been presented with an abundance of valuable papers from the other institutions and from prominent individuals, on the closer problems of the industry, scientific, technical, and economic, wherefrom all participants, whether from the homeland or from overseas, are assured of a lively and sustained interest in the proceedings. That interest, the delightful tour, and not least the friendliness promised both in Canada and on the way there, constitute a sum of entertainment which explains the large number who have seen their way clear to attend.

It is understood that the next of these Conferences will take place in South Africa in 1930.

## Mycorrhiza.

DR. M. C. RAYNER concludes her series of papers on mycorrhiza in the May issue of the *New Phytologist*. The final chapter is devoted to a consideration of the significance of these structures, and the nutrition of mycorrhiza plants. The author holds a brief for the view that the relationship between fungus and host plant is a reciprocal one beneficial to both symbionts, and implies an exchange of food material with a credit balance on the side of the vascular plant.

Evidence is adduced from experimental work on the relationship in forest trees, orchids, and heaths. In the case of conifers, the fungi concerned show marked stimulation in contact with the roots, due no doubt to the small quantity of exudates, particularly phosphatids, present. The infected root, on the other hand, seems to absorb inorganic salts as well as, or in raw humus soils, better than, the uninfected roots. It is pointed out that the struggle for existence often centres about competition for suitable compounds of nitrogen, and the mycorrhiza habit enables the plant to draw efficiently on sources of nitrogen in the soil otherwise unavailable for its use.

On the other hand, there is no evidence that any of the known root fungi of trees can assimilate free nitrogen. While conifers can utilise ammonium compounds, more complex organic nitrogenous compounds are more readily utilised by the root fungi, and on acid humus soils, where such compounds constitute the chief source of nitrogen, plants with mycorrhiza are well equipped in competition with other forms. Orchid mycorrhizal fungi differ from those of conifers in retaining the power of autonomous existence. Seedling development is, however, conditional on infection. In the case of chlorophyllous forms, whether or not the mature plant can thrive in the absence of infection is an open question, but with non-chlorophyllous species, complete dependence on fungal symbionts is a condition of existence, as the food material of the plant must come from the humus in the soil.

The structural features of heath mycorrhiza