

book to attempting to prove his theories by appeals to facts philological and geographical; but all that can be said for his arguments is that if every assumption is correct, the deductions which he makes may be true, but if almost any one of them breaks down, his whole fabric must collapse. For example, Prof. Keane says unhesitatingly,

"the original Punt was South Arabia (Arabia Felix, Yemen), whence the name was extended to Somaliland during the eighteenth dynasty, say, about 1700 B.C."

But this is impossible, for in the sixth dynasty Punt was in Africa, and was probably reached by way of the Nile; and as the inscription of Her-khuf, formerly at Aswân and now at Cairo, contains the oldest mention of Punt in such a way that its position can be traced, we see at once that, so far as this remote period is concerned, Prof. Keane has no satisfactory authority for his statement, "the original Punt was South Arabia." The Punt of the eighteenth dynasty was reached in exactly the same way as it was reached in the reign of Seânkhka Râ (eleventh dynasty), and all the Egyptological evidence available goes to show that the region visited by the Egyptians at both periods was in Africa.

Prof. Keane thinks little of the evidence which Dr. Peters has deduced from the "*ushabte* figure impressed in a mould" which he found in the middle of Africa during his last expedition, yet he accepts the description given of it to the effect that it has "in each hand a scourge instead of a hoe." If the figure is an *ushabti* figure, and was really made in ancient days in a region far to the south of Egypt "for a courtier of Thothmes III.," the objects in the hands must have been intended to represent the flail and the hoe of Osiris, otherwise the whole figure is meaningless. In any case, how can it have a curious significance (p. 35) because "it is armed with a scourge in each hand, and [was] picked up in a mining district"? Let us hope that this wonderful figure may be placed somewhere so that it may be inspected by those interested in the matter.

Prof. Keane relies too much upon the statements of the late Mr. Bent in the deductions which he makes about the ruins at Zimbabwe, and this is the case also in respect of the views of the Hon. A. Wilmot, who wrote a volume entitled "*Monomotapa*," and who adopted nearly all Mr. Bent's views. Mr. Bent was an intrepid traveller and an accomplished gentleman, but he knew no Semitic language and his training as an archæologist was rather classical than anything else; his opinion on all Phœnician matters was, therefore, that of an intelligent but untrained amateur.

Our want of space prevents the possibility of discussing many of Prof. Keane's philological dicta, and we must pass on to his

"important conclusions," which he trusts "may now be considered fairly well established, and may therefore legitimately take the place of the many theories and speculations hitherto current regarding the 'Gold of Ophir,' its source and forwarders" (p. 194).

These are:—Ophir, on the south coast of Arabia, *i.e.* Moscha, or Porters Nobilis, was the distributing market of the gold of Havilah, or Rhodesia. The mines of

Rhodesia were first worked by South Arabian Himyarites, who were followed in the time of Solomon by the Jews and Phœnicians, and these very much later by the Moslem Arabs and Christian Portuguese. Tarshish was the outlet for the precious metals, and was near the modern Sofala. The Himyarites and the Phœnicians reached Havilah through Madagascar, where they maintained commercial and social intercourse with the Malagasy natives. With them were associated the Jews, by whom the fleets of Hiram and Solomon were partly manned. There is, of course, something to be said for all these views, because each represents a possibility, but the facts required to prove them are wanting. Nevertheless, Prof. Keane's book is as valuable as it is interesting, because it has put the question on a scientific base, and we are glad to see that he has freed himself from the ordinary traditional trammels in dealing with it. Moreover, we must acquit him of all mercenary motives in trying to prove that the gold which Hiram and Solomon's fleets obtained from Ophir came from Rhodesia, for so far as we know, he has no pecuniary interest in the mining operations which have been carried on in that wonderful country during recent years. The "notes" which he gives will be very useful to other workers in the same field, and his index facilitates the profitable perusal of the present book.

EXPERIMENTAL WORK WITH GASES.

The Experimental Study of Gases. By Morris W. Travers, D.Sc. With preface by Prof. W. Ramsay, D.Sc., F.R.S. Pp. xii + 323. (London: Macmillan and Co., Ltd., 1901.) Price 10s. net.

IN 1857, Robert Bunsen published the first edition of his classical work "*Gasometrische Methoden*," and twenty years later a rewritten and enlarged edition of the same, which still ranks as a standard text-book on the subject. We think it is not too much to say that since that date no more important work has been published on the properties of gases in general than the one now before us. The progress made in our knowledge of the subject has probably been at least as rapid as in any other department of chemistry, and the discovery within the last half-dozen years of five new elementary gases, in the investigation of the properties of which Dr. Travers has taken a prominent part, would alone afford justification for this volume, did it contain nothing else of merit.

The volume consists of 320 pages, with numerous illustrations, most of which appear to be original and not merely reproductions from current text-books. The first portion of the book is taken up with a detailed description of the apparatus used, and the methods employed in the preparation of gases in a state of purity and their accurate measurement and analysis. Then follow chapters on the gases of the helium group, the determination of density and the relations of pressure, temperature and volume, the liquefaction of gases, and finally their properties and the constants relating to them. Careful perusal of the work leads us to the impression that in this case (as is by no means always the rule) the best chapters are those on the subjects with which the

author is peculiarly at home, namely the sections dealing with the gases of the helium group and with liquefaction. On the other hand, the chapter on the preparation of pure gases is somewhat disappointing, not so much on account of what is said as because of what is left unsaid.

In the introductory fifty pages we notice much valuable information, obviously the outcome of experience, regarding the construction of apparatus, such as Toepler and Sprengel pumps, and practical hints on such matters as the cleaning by means of zinc dust and hydrochloric acid of glass apparatus which has become dirty by long-continued use with mercury.

While referring to pumps, we may mention that the statement on p. 15 that a filter pump with a good head of water will reduce the pressure in a vessel to the vapour-pressure of water at the time is well inside the mark. In the writer's experience it is not uncommon to obtain by selection a filter pump which will reduce the pressure to much more nearly one millimetre than 15 to 20 mm., the latter being a degree of vacuum quite easily attainable with almost any good pump and moderate pressure.

For flexible connections to stand high pressures or vacua, the thin weldless steel tubes recommended by Dr. Travers should always be protected by an outer sheath consisting of a compo tube slipped over the steel and drawn tight on to it through several holes of a draw plate. This prevents the steel suffering, as it is very liable to do, from too sudden bends or from accidental crushing.

In attempting to preserve for long periods gases collected in a sample tube over mercury, great caution is needed in seeing that the surfaces of the tube are quite clean and free from grease, and that the mouth dips well under the mercury in the vessel in which it is placed. Otherwise slow inward diffusion of air may occur along the walls.

In the chapter on the preparation of pure gases we should have liked fuller descriptions of the methods, and more of them, the details in some cases being decidedly meagre and several of the methods recommended being only suitable for the preparation of very small quantities of gas.

The electrolytic preparation of hydrogen and oxygen from dilute sulphuric acid is a method which does not receive the author's commendation for ordinary use, but most of the disadvantages disappear, at least in the preparation of oxygen, if phosphoric acid is taken in the place of sulphuric.

No mention is made of the electrolysis of hydrochloric acid and the preparation of the intensely interesting mixture of chlorine and hydrogen sensitive to light, although this experiment is attended with peculiar difficulties.

On p. 74, reference is made to the "Paris kilogram," an ambiguous and unnecessary term if the now almost universally recognised international kilogram is meant (let us be thankful that there are not as many kilograms as ohms), and on p. 130 we find the statement,

"The results (weighings of gases) are reduced to the values which would have been obtained at sea-level in

latitude 45° . They may be reduced to the Paris standard by multiplying by 1.000316."

We fail to see why, after having reached lat. 45° and sea-level, some charm in the local value of gravity should induce us to come back and reweigh the gas at Paris. It may be mentioned here that the very divergent values quoted on p. 74 for the mass of a cubic decimetre of water at 4° ought to be replaced by more modern data, which agree in fixing $999.95 \pm .02$ grm. as a much more probable value.

We are glad to see that in the chapter on gas analysis Dr. Travers has weeded out from the many forms of apparatus and methods employed those only suitable for *technical* use, describing only those capable of scientific accuracy, with copious references to the most recent work on the subject. The usefulness of the chapter would, however, have been increased had a description been given of some form of complete apparatus for general gas analysis, such as that of Prof. MacLeod, or one of its later modifications.

We may sum up the chapter on the preparation and properties of the gases of the helium group by saying that it contains practically all that is known on the subject.

Temperature measurement by the gas thermometer is gone into at considerable length; and the convenient and accurate compensated constant-pressure thermometer of Prof. Callendar is illustrated and its working described in detail.

In the chapter on the liquefaction of gases, a full account is given of Dr. Travers' own experiments on the liquefaction of hydrogen, which is a reprint, with additions, of his recent paper in the *Phil. Mag.* This concludes with an account of the cost of these experiments, in which it is stated that, after an outlay of about 250*l.* on the complete plant, an expenditure of about 1*l.* each time covers the cost of making liquid hydrogen.

Anyone familiar with some of the palatial laboratories of many of the physical chemists abroad, visiting for the first time the dingy dwelling of the chemical department at University College, which the school of Ramsay has now made classic ground, could not fail to be surprised at being shown the hydrogen liquefier fitted up in a disused lavatory, and to hope that in the coming London University scheme physical chemistry may find a worthier home.

To return to the book, it appears to be accurately printed, and although we have verified many of the numbers and constants given, the errors we have detected are not numerous.

Among the slips may be pointed out, Kaysir for Kayser; Wülmer for Wüllner; Kirschhoff for Kirchhoff. Fig. 102, which is repeatedly referred to, appears to be missing.

We may conclude by stating how much a study of the book has emphasised in our own mind the importance of Prof. Ramsay's concluding sentence in the preface he has written directing attention to the lacunæ still remaining in many branches of our knowledge, and by heartily congratulating Dr. Travers on his labours, which have produced a book worthy of a place in the reference library of every student of modern chemistry. J. A. H.