Letters to the Editor.

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Nickel in Ancient Bronzes.

THE issue of NATURE for January 19, 1924, page 100, contained a synopsis of a paper by Prof. John Sebelien of Aas, Norway, upon certain analyses made by him of Egyptian and Mesopotamian bronzes. A remarkable feature of these bronzes examined seems to be the regular occurrence of nickel as an impurity, whereas ores examined from an old mine in Kurdistan revealed no nickel.

In the synopsis referred to, Prof. Sebelien does not tell us whether nickel was present in the slag from the copper mines of Sinai or not. In any case, it is not to be expected that all the copper utilised in ancient Egypt and Mesopotamia came from the countries immediately surrounding them. The demand for tin and copper to make bronze was so great in olden times that even the remote coasts of Spain and Cornwall were exploited by ancient traffickers from the east.

Too frequently the possibilities of Southern Africa as a more convenient source of these desirable commodities in ancient times are overlooked. It is therefore of some interest in this connexion to cite the analysis of a piece of ancient bronze discovered in the Transvaal which was reported upon by Mr. T. G. Trevor, Inspector of Mines for the Union Government at Pretoria, in the Journal of the Chemical, Metallurgical and Mining Society of South Africa for January 1912, as follows:

"Mr. Schoch, the Manager of the Rooiberg mine, has kindly supplied the following analysis of a piece of bronze obtained from a small slag heap on the farm Blaaubank near the Rooiberg mine: copper about 80%, iron and alumina about 5%, tin about 7%, nickel about 3%. The piece is about $\frac{1}{4}$ to $\frac{1}{2}$ lb. in weight, and is unformed, appearing to be more like the overflow of a crucible than anything else. . . .

"Concerning the bronze, there is no known ore in the Transvaal that by simple smelting would yield such an alloy as this, nor is there any copper mine known in the immediate Rooiberg district. As the composition is that of an excellent bronze it is impossible to doubt that the alloy was intentionally made of a definite composition and was not an accidental production. It is perhaps unnecessary to remark that there is no evidence of any native race south of Benin and the Gold Coast being acquainted with either tin or bronze."

In a discussion of this analysis Prof. G. H. Stanley, now professor of mining and metallurgy in the University of the Witwatersrand, said: "The bronze is a most peculiar product. . . . The presence of nickel is noteworthy; I do not remember another case in which it has been found in prehistoric bronzes, though arsenic was used for hardening purposes."

To the writings of Trevor, Woodburn, Baumann, and others in the same Journal we are indebted for the knowledge that, at a time which probably synchronised with the exploitation of the gold-mines of Rhodesia, there existed a widespread industry also in tin, copper, gold, hæmatite, and micaceous iron throughout the whole of the Northern Transvaal so far south as the latitude of Pretoria.

It is not generally recognised that a veritable ring of ancient copper mines has been discovered surrounding the Rhodesian gold-bearing centre. McDowell has pointed out that, in the fringe of the

Kalahari desert in the west, old copper workings are encountered intermittently for some miles near the Tebedzi River, and it is on the largest of these that the modern Malakoye mine has developed. "All of these workings are on copper; this one has a length of some 800 feet and has been found to have a depth in places of 130 feet; certainly not less than 1000 tons of copper must have been taken out of it by those early miners."

On the south, in the Transvaal, "there are at least five or six large groups of ancient workings" in the Messina district, and Trevor states that "it is quite impossible to estimate the amount of copper the ancient workings at Messina Mine must have produced, but it certainly could not have been less than several thousand tons, and if the other workings in the locality yielded proportionately, then the total output from the ancient workings in the vicinity must have mounted well into the tens of thousands of tons." In addition to these extensive workings at Messina there are in the Transvaal the ancient copper mines of the Palabora area which "cover many acres," and "in the aggregate, as in the individual workings, they are far larger than those at Messina."

To the north it is well known that the sites of the Katanga, the Star of the Congo, and the M'kubwa copper fields were all exploited by an ancient people as was the tin of the Broken Hill area, while to the east, in Portuguese East Africa, the copper areas in Macanga territory and near Pandamacua on the Zambesi were equally filched of their wealth. So famous was the latter site that the modern natives still call it by a name which signifies, according to Maugham, "fill yourself with copper."

It was for this copper that the tin of localities such as Broken Hill and Rooiberg supplied the means of producing bronze. Some 2000 to 3000 tons of tin were abstracted from the Rooiberg-Weynek-Leeuwpoot area to the north-west of Pretoria. Estimating this tonnage in terms of bronze, Baumann (1919) arrived at the modest figure of 30,000 tons of bronze produced and exported from this area alone at a remote epoch. This quantity of bronze of the magnitude of 60,000,000 lb., which is the estimated product of one area only, certainly never found a home market in this country.

The value of the gold taken from Rhodesia's gold mines in early times has been variously estimated as between 75,000,000*l.* and 200,000,000*l.* When it is remembered that, after 400 years of European occupation and with all the advantages of modern transport and mining equipment, it has taken fifty years to extract 900,000,000*l.* worth of minerals and precious stones from the earth in South Africa (Prof. E. H. L. Schwarz, *South African Geographical Journal*, vol. vi., 1923), the scale of the operations necessary to remove so huge an amount of gold and other minerals in ancient times may be the more readily appreciated.

Of the gold as well as of the tin, copper, and associated industries, it is at least true that they were not consumed commercially in Southern Africa. These facts therefore aid the imagination in assessing the amount of traffic which has plied along the East African coast prior to the coming of the European. Meantime, it does not seem impossible that the reasons for the occurrence of nickel in ancient bronzes of Egypt and Mesopotamia are to be sought from further afield than the Western arm of the Asiatic continent.

This metallurgical method in prehistory utilised by Prof. Sebelien provides a new and valuable instrument the further exploitation of which may well reward us with data of precision in regard to the commercial movements of ancient civilisations.

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