Letters to the Editor.

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Early Rhodesian Gold.

I HAVE not the intention of entering into the correspondence which I hope to see develop further out of Prof. J. W. Gregory's letters in NATURE of Nov. 9 and Jan. 11. If, however, that correspondence is to be profitable to science and clear thinking, may I ask that precise information be given on certain points which have been once more resurrected? For example:

(a) *Roman Coin from Umtali*.—Who found it? Who has seen it? What were its associations when found? I made inquiries, of course, in Rhodesia, but even the late Mr. R. N. Hall had, it seems, given up faith in it. The history of other coins of antiquity purporting to be South African finds is, when investigated, no more satisfactory. See Prof. Dart's article, NATURE, Mar. 21, 1925, and Mr. Schofield's devastating retort, Mar. 27, 1926.

(b) *Soapstone Birds on Beams*.—What parallels sufficiently close to pass morphological muster are provided by ancient Egypt and Assyria? Who has published them? For one would wish, when these birds come to London in the spring for temporary exhibition at the British Museum, to place their counterparts beside them for comparison. This I shall also hope to see done with the 'Rosette' Cylinder.

(c) *Ptolemaic Beads*.—Who 'referred' them to this source? I am, of course, acquainted with Bent's reference. He says ("Ruined Cities of Mashonaland", p. 204), "beads of doubtful provenance, though one of them may be considered as Egyptian of the Ptolemaic period". They were found "in the vicinity of the Temple" . . . very near the surface. What were their associations? Celadon, Arab glass, and Persian ware. Deposits, like ladies, have the fortune to be dated by their youngest feature.

(d) *Proto-Arabic Inscription*.—Where was it found and where published? Bent published ("Ruined Cities of Mashonaland", p. 199) an 'inscription' on a soapstone bowl, and supposed letters on a rock in Bechuanaland. These were elaborated by Keane, with the result recorded in the *Geographical Journal*, April 1906, p. 346. I have looked at all the bowls in museums but could not identify Bent's inscription. The soapstone bowl fragments we found are a mass of scratches.

Further, why is that nice eighteenth dynasty Ushabti figure from Ndanga always left out of the argument? Its value as 'evidence' is not less remarkable than that of the other relics mentioned.

Two more questions. (1) When mining authorities of eminence differ in their estimate of the gold production by £60,000,000 (maximum £75,000,000, minimum £15,000,000), what is the archaeologist to do? I can only suggest that he should read Theal's "Records" carefully, and examine the relics from 'ancient workings' at Bulawayo and Salisbury. (2) When a coin of Antoninus Pius is found in a mine shaft at Umtali and is considered to date that mine, why should not four Bantu skeletons found in ancient mines be taken equally as evidence?

So far as space has hitherto allowed, I have put the plain facts of excavation on the table; these facts are now being dealt with fully in book form, which I hope may be available by the summer. It is fair,

therefore, that I, too, should be given facts, so that I may take them into full consideration. Theory I have had offered to me, and generalisations without number. But facts can only be met by facts. Who will supply them?

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Colours of Inorganic Salts.

No satisfactory explanation of the colours of inorganic salts in the vapour state, in solution, or in crystalline form has yet been put forward, excepting certain suggestions by Fajans ("Handbuch der Physik", Bd. 24, p. 564), that the colours are due to the deformation of the cation produced by surrounding anions and molecular complexes. The ideas of Fajans were rather vague, but the time has now come to put forward a more precise hypothesis. It is well known that salts like NaCl, CaCl₂, AlCl₃, in which the electrons of the cation form closed shells (p^6), are colourless or white. Herzfeld found from a study of dispersion of NaCl that there are three ultra-violet absorption bands, one at $\lambda 340$ which was ascribed to Na⁺, another at about $\lambda 1500$, which was ascribed to Cl⁻ ion. This last one has been experimentally obtained by Pfund (*Phys. Rev.*, vol. 32) by the *Reststrahlen* method. The wave-length $\lambda 340$ ascribed to Na⁺ agrees remarkably well with the resonance line of Na⁺ identified by K. Majumdar (*Ind. Jour. Phys.*, 1927) and Bowen, though definite assignment of values of the absorption wave-length from dispersion data in this region is subject to certain uncertainties.

Colours are almost entirely shown by the compounds of the transitional group of elements (the first group consisting of elements from scandium to copper). Let us fix our attention on the first group alone, as the same arguments will apply to other groups. The colours are somewhat modified by the anion, or the state of aggregation (solution or crystal), but intrinsically it is due to the cation. Taking a compound like CrCl₃, we can say that it consists of a Cr⁺⁺⁺-ion, surrounded by three Cl⁻ ions. The absorption of light in the visible region is due entirely to the outer electrons of the Cr⁺⁺⁺-ion. Let us see how this absorption takes place.

The outermost shell of the Cr⁺⁺⁺-ion (and generally of all ions of transitional elements) consists of a number of electrons in the d -shell. In Cr⁺⁺⁺, the number is 3. The multiplicity of the most stable combination state is obtained by adding up the multiplicity vector $r = \frac{1}{2}$ for all the electrons, and the next metastable states are obtained by reversing the vector r for one of the electrons. In d^3 , the states are respectively 4X and 2Y , where X and Y are further to be formulated. This is obtained by considering the l -coupling according to Pauli's principle, and in the case of Cr⁺⁺⁺, $X = F$ and P in 4X , and $Y = H, G, D$ in 2Y . The average difference in energy between the terms obtained in this way, that is, by having the rotating quantum number all in one direction, and then reversing only one, is about $C_{av} = 20,000$, the value increasing with the number of net charges in the nucleus, as shown by the spectroscopic data of Russell, Gibbs and White, Lang, Shenstone, etc. (see various papers in the *Physical Review*).

It is therefore evident that the absorption of light in the visible region is due to some of the d -electrons changing their r -vector from $\frac{1}{2}$ to $-\frac{1}{2}$. This type of transition is possible only in transitional groups, and though usually forbidden they become very prominent in all molecular formations. We cannot, of course, expect that the values of energy difference which we