of the problem of Four Tautozonal Poles. The indices of two poles C, D may be expressed as functions of those of the two other A (*abc*), B (*def*) in the form (*pa*+*qd*, *pb*+*qe*, *pc*+*qf*), (*ma*+*nd*, *mb*+*ne*, *mc*+*nf*) where *p*, *q*, *m*, *n* are small positive or negative integers. Since $npcotAD=(np-mq)cotAB+mqcotAC$, a table of natural cotangents enables a numerical example to be solved rapidly. Usually $p=q=1$, and the equation reduces to $ncotAD=(n-m)cotAB+mcotAC$. L. J. Spencer: Crystals of Iron Phosphide (Rhabdite) from a Blast-furnace. The small, acicular, tin-white, and strongly magnetic crystals were found sparingly in cavities in a large mass of metal at the bottom of a blast-furnace near Middlesbrough. They are tetragonal (sphenoidal-hemihedral) with the axial ratio, $a:c=1:0{\cdot}3469$. Dr. G. T. Prior: The Meteoric Stone of Cronstad Orange Free State.

At the above meeting the following officers and members of Council were elected: President, W. Barlow, F.R.S.; Vice-Presidents, Professor H. L. Bowman and A. Hutchinson; Treasurer, Sir William P. Beale, Bart., K.C., M.P.; General Secretary, Dr. G. T. Prior, F.R.S.; Foreign Secretary, Professor W. W. Watts, F.R.S.; Editor of the Journal, L. J. Spencer; Ordinary Members of Council, Dr. J. J. Harris Teall, F.R.S., F. N. Ashcroft, Professor H. Hilton, Arthur Russell, W. Campbell Smith, Dr. J. W. Evans, Dr. F. H. Hatch, J. A. Howe, T. V. Barker, G. Barrow, Dr. C. G. Cullis, and F. P. Mennell.

CORRESPONDENCE.

"ON CERTAIN CHANNELS."

Sir,—A section of Professor Bonney's recent essay *On certain Channels attributed to overflow streams from ice-dammed lakes*[1] is devoted to an extremely courteous criticism, but final rejection, of my interpretation of glacial phenomena in the Black Combe area.[2] Since he advances an alternative hypothesis to account for the above-mentioned channels, I am sure he will pardon me if I, in my turn, offer a few critical remarks.

I must first protest against Professor Bonney's assumption (*vide* title of his paper) that I ascribe practically all these channels to overflow waters from ice-dammed lakes. In many cases, as I clearly state, they were merely carriers of the normal marginal drainage of an ice-sheet. Nor do I invent ice-dams "almost by the dozen". As regards overflows from lakes, one dam—the Irish Sea Ice—is quite sufficient.

In my description the drainage channels are discussed and interpreted in the light of observations, recorded on 6 in. field maps, and fall into place as an important chapter in the glacial history of the area. Professor Bonney states that he accepts most of my facts, but differs from my conclusions; yet, having made this admission, and agreeing that land-ice "occupied all this district during some part of the Ice Age", he appears to ignore the evidence

[1] Published by Bowes & Bowes, Cambridge, 1915.
[2] Q.J.G.S., vol. lxviii, 1912.

relating to the composition, character, and location of the glacial drifts, as well as that furnished by erratics, ice-moulded surfaces, and striæ.

Having thus divorced these anomalous channels from their surroundings, he has constructed a theory to explain their origin (as it seems to me) based chiefly upon their shape and rate of fall.

If land-ice "occupied all this district during some part of the Ice Age", and there was no Irish Sea Ice, I venture to ask why (as its markings show) the ice from Eskdale first turned south, along the seaward slope of Black Combe, and then swung to the east and north-east into the mouth of the Duddon estuary; and why the Whicham Valley Ice, moving first in a south-westerly direction, was also directed towards the south-east and east near the mouth of that valley? Why did it not ride out to sea? What was the impelling force that turned it aside?

Professor Bonney doubts whether marginal streams could cut channels in granite in a short time. He may read of recent examples described by Von Engeln,[1] to whose article I have already made reference.

My critic admits that the systems of parallel trenches on the west coast, as contrasted with the preglacial drainage, are abnormal in direction, and finds some difficulty in explaining this anomaly, but confesses himself happier when dealing with the channels east of Black Combe, where "the trenches take a more normal course". The explanation is simple: in the first case the trenches were marginal to the Irish Sea Ice, and are therefore transverse to the normal drainage, whereas in the second case they were marginal to the local Lake District glaciers which occupied the present drainage lines at a late stage of the glaciation. If, as Professor Bonney maintains, the dry channels on the west coast are preglacial, how does he explain the presence of thick glacial drift upon the ground between them, and upon the higher inland slopes, but not within them?

Perhaps the weakest part of this new hypothesis is an attempt to explain the 'in-and-out' channels by marine erosion of the seaward wall. A preglacial submergence cannot be invoked, because one of the long 'in-and-out' channels (Monk Foss) is cut entirely in glacial drift; nor can we admit a postglacial submergence, for that would have entirely destroyed the typically hummocky character of the drift on the plain between Millom and the mouth of the Esk. Moreover, even were 'in-and-out' channels at this spot due to marine erosion, we cannot explain in this manner the 'in-and-out' channels of other districts far from the sea.

Finally, one might pertinently ask how pre-Triassic valleys could have maintained such sharp well-defined contours to this day. As a field-geologist I have frequently noticed the "half effaced features of an earlier topography", but in few instances have I seen anything more blatantly modern in appearance than these marginal or overflow-channels in the Black Combe district, or, indeed, in North Wales, where they are cut in fairly soft shales.

[1] "Phenomena associated with Glacial Drainage and Wastage": Zeit. Gletscherkunde, vol. vi, pp. 126–31, 1911.

This conception of old drainage systems running parallel to the contours of the mainland, in Cumberland, Haddingtonshire, S.E. Ireland, Denbighshire, Flintshire, etc., when coupled with the warping movements necessary to explain the steep fall of the channels, sets the mind, no less than the land, awhirl.

BERNARD SMITH.

THE GEOLOGICAL AGE OF THE CARRARA MARBLES.

SIR,—Permit me to comment briefly on Dr. Du Riche Preller's paper on the Carrara Marble District.[1] It contains a quantity of interesting information, topographic and economic, but does little, in my opinion, to settle the question as to the age of those rocks or strengthen the position of the Italian geologists. I had their map with me in the autumn of 1889, and in regard to faults (which Dr. Preller considers to be almost negligible) wrote thus in my diary: "In order to accept the geological succession they have indicated, we must explain the proximity of ordinary dark mechanically disturbed limestone (just like some of that at Spezzia) with lighter varieties to perfectly typical Carrara marble." I was aware that the statuary marble is intercalated with marbles of inferior quality, but instead of finding any sign that the metamorphism was a result of pressure, maintain that, as shown by the microscope, that marble has escaped (as I stated) from the crushing which has affected its associates. As to 'metamorphism' and its effect on sedimentary rocks, I have been doing my best to study the whole question since about 1875, have spent much time and money in examining alleged passages from crystalline schists to comparatively unaltered sediments or intercalations of the two, with the invariable result that the evidence was never conclusive and very commonly worthless; in fact, I have not been able to discover any case (I have not restricted myself to the Alps) where a truly crystalline limestone, such as that of Carrara, is in stratigraphical sequence with a sedimentary rock to which a date can be assigned on the evidence of fossils, except in the case of contact metamorphism, which, so far as I am aware, is not exhibited in the Apuan Alps. Dr. Preller's paper contains no evidence that he has made use of the microscope in studying these Carrara rocks, and as I know the vague use of the term 'schist' by many Continental and some British geologists I am unable to discuss his sections (Figs. I–IV) beyond saying that only one of them seems to demand an explanation, and this I think my past experience would enable me to supply.

T. G. BONNEY.

RENÉ ZEILLER—MASTER PALÆOBOTANIST.

SIR,—In the current number of *Nature* there is a short tribute by Professor Seward to Professor Zeiller, whose death this week in Paris we all deplore. I should like to add a word in token of the deep and lasting affection and reverence the great Palæobotanist inspired in his younger colleagues in many countries.

[1] GEOL. MAG., December, 1915, pp. 554–65.