



Note on the conductivity of tourmaline crystals

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intermixture of species, notwithstanding the irregular repetition of the zones, the non-occurrence of these colony species in intermediate beds, and other reasons. The stratigraphy and palæontology of several of these colonies was discussed in detail, showing it to be more probable that their apparent intercalation with later faunas is due to repetition by faulting.

3. "On the Pre-Cambrian Rocks of the North-western and Central Highlands of Scotland" By Henry Hicks, Esq., M.D., F.G.S.

The author, after examination, considers the rocks of the following districts to be wholly or in part Pre-Cambrian:—

(1) *Glen Finnan, Loch Shiel to Caledonian Canal*.—In the former district the rocks are gneiss, often massive. In Glen Firmilee is a series which the author regards as newer and Pebidian. At Farofarn are quartz rocks which the author identifies with those beneath the limestone in Glen Laggan, near Loch Marce, and probably of Silurian age. At Bannavie is a granite which the author considers to be Pre-Cambrian.

(2) *Fort William and Glen Nevis*.—In this district chloritic schists and gneiss occur, which the author regards as Pebidian.

(3) *Ballachulish, Glen Coe, and Black Mount*.—Chloritic schists and quartzites occur here, followed near Loch Leven unconformably by Silurian rocks. On the east of the Ardsheal peninsula there is granite which the author believes to be Pre-Cambrian. Going eastward from Ballachulish we have slates, probably of Silurian age. In Glen-coe are granite-banded felsite, gneiss, breccia, resembling as a whole the rocks of the Welsh Arvonian group. Between the Black Mount and Loch Sullich are traces of a great Pre-Cambrian axis, bringing up the gneissic series; this is traceable also towards Glen Spean and Loch Laggan to the N.E.

(4) *Tyndrum to Callander*.—South and east of the former are gneisses and silvery mica-schists. Crystalline limestones and serpentines are associated near Loch Tay, resembling those in the Pebidian series of North Wales.

The author states that the Silurian (and Cambrian) rocks flank the Pre-Cambrian in lines from N.E. to S.W., and overlap Ben Ledi on the south side. Thus here, as elsewhere, subsequent denudation has removed enormous masses of the more recent rocks, only here and there leaving patches of these in folds along depressions in the old Pre-Cambrian floor.

XI. Intelligence and Miscellaneous Articles.

NOTE ON THE CONDUCTIVITY OF TOURMALINE CRYSTALS.

BY GEORGE FRANCIS FITZGERALD, M.A., F.T.C.D.

IN the Philosophical Magazine for July 1879, Professor Sylvanus Thompson and Dr. Oliver Lodge give the results of some very interesting experiments upon the unilateral conductivity of tour-

maline crystals for heat and electricity. Dr. Lodge had shown that an explanation of pyroelectricity might be given if such crystals possessed a unilateral conductivity for electricity. A body is said to possess unilateral conductivity for any thing if it conducts better in one direction than in the opposite one—as, for example, a tube with a series of funnels in it all turned the same way for fluids, and apparently, in the case of Geissler's tubes, for electricity also. The result of their experiments was that tourmaline crystals do possess a unilateral conductivity for heat *as long as their temperature is variable*, and similarly for electricity *as long as the temperature varies*. The first of these facts is an important and valuable increase of our knowledge; but the latter, as they point out, is of course only due to the already known electromotive force which constitutes their pyroelectric properties. They seem to have been dissatisfied with these results; for they had hoped to discover unilateral electric conductivity independently of changes of temperature. They do not seem to have noticed that what analogy should have led them to look for was unilateral conductivity *during changes of intensity of the current*. It is to be hoped that, as they possess a very fine specimen of tourmaline, they will continue their investigations into this point. In the meanwhile it may be worth noticing a mechanical illustration of how this might be connected with pyroelectricity. Suppose a wire carrying a current, surrounded by a number of magnets, and that a majority of them pointed in one direction round the wire, and that each was kept in its place by a spring. On passing a current through the wire, all the magnets that did not point round it in a particular direction would tend to set themselves in this direction; and during changes of intensity of the current, work would be done against or by the springs. If the current passed in such a direction that the majority of the magnets were set so as to remain unchanged, there would be less work done by changes of intensity than if the current were in the opposite direction; and this would give rise to an apparent unilateral conductivity. I say “apparent,” because the weakening of the current is due to an inverse electromotive force, and not to a true increase of the resistance. The same effect would be produced by supposing a majority of the magnets turned in the same direction along the magnet, and kept in position by two springs, one on each side, but one stronger than the other, when of course a current would have to do more work in turning them to one side than to the other, so that in this case also there would be apparent unilateral conductivity during variations of the current.

Now, suppose that the proportion of polarized magnets or their strength depended on the temperature of the system. It is then evident that during changes of temperature there would be changes in the numbers or strengths of the polarized magnets: either would produce an electromotive force in the wire during the change. Hence the phenomena of pyroelectricity would be manifested by such a system. I put these forward merely as illustrations, not

supposing that the structure of tourmaline is necessarily at all like either of them; but there are generally great analogies between different systems exhibiting the same phenomena, and an illustration gives us a concrete stepping-stone to found our conceptions on during the difficult transit to the abstract.

The passage of a current through an iron wire is accompanied by the production of a series of magnetic elements round it; and the effect of this has been noticed as causing an apparent change of resistance during changes of the current; but as there is no want of symmetry in the wire, there is no apparent unilateral conductivity.—*Scientific Proceedings of the Royal Dublin Society*, Jan. 19th, 1880.

ON A SIMPLE METHOD OF IDENTIFYING A SUBMERGED TELEGRAPH-CABLE WITHOUT CUTTING IT. BY W. P. JOHNSTONE, ESQ.

To the Editors of the Philosophical Magazine and Journal,

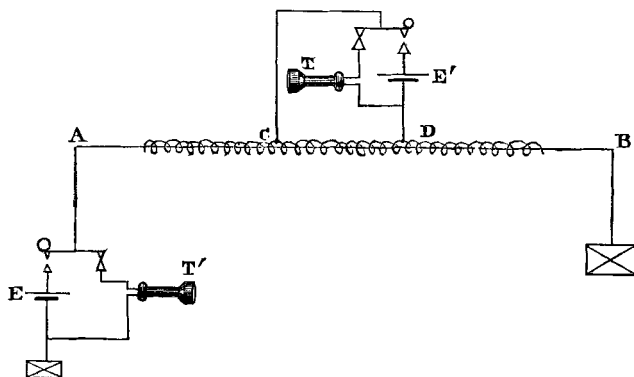
GENTLEMEN, Electrician's Office, Alipore, Calcutta,
3rd May, 1880.

In continuation of my letter dated 27th April, 1880, I send you now a Postscript, which kindly publish with the Paper*, and oblige

Yours faithfully,

LOUIS SCHWENDLER.

P.S.—The following diagram represents a simple method for communication between the repairing-boat and the shore.



The telephone T on the boat is worked as before explained; and the telephone T' on the shore is worked by the currents induced in the copper conductor by the currents sent into the guards from the

* We were unable to comply with our Correspondent's request, the Postscript having reached us after the issue of the June Number.—Eds.