

only can testing become a real benefit to the administration."

Again he says, "We know quantitatively the electrical state of the lines at all hours of the day, and seasons of the year; we are able to localise faults of all kinds very accurately and repair them with despatch; we test all our telegraphic material, and by it have greatly improved its essential qualities; we are not groping in the dark any more—we *measure and know*."

It never must be forgotten that testing is in reality a physical experiment, and these physical experiments are being conducted every day throughout the whole of our English telegraph system. Our cable electricians under the guidance of Sir William Thomson have carried this system of physical experiment to a high standard of perfection, and our Indian friends would do well to profit by their teaching.

Mr. Schwendler's explanation of the theory of the bridge is not clear, nor does his use of Kirchhoff's corollaries to Ohm's law much help the student. Indeed it is very doubtful whether his proof that the sensibility of the bridge method is greatest when the branch and the resistance are equal is true. At any rate in our practice we find that the more delicate the galvanometer of the bridge the more sensitive and the more accurate is our test.

The most valuable portion of Mr. Schwendler's book is his abstract of Ohm's classical paper, a translation of which is to be found in Taylor's "Scientific Memoirs," and also in his account of Kirchhoff's corollaries to this law.

The practice generally of line testing and testing for faults contains nothing new, but his chapter on natural currents, showing the effect of polarisation of earth plates and the presence of earth currents, is interesting.

He says, also "*Defective insulation at a few points in a line is a fruitful source of currents. At all such points polarisation is produced by the working currents, in a manner precisely similar to that of the earth plates, by the same cause already alluded to, and to a degree dependent on the resistance and the position of the faults. These currents will be strongest in rainy weather, when the line is in contact with trees, when the insulators are covered with dew—in fine, under those circumstances which diminish the resistance of faults and promote electrolytic action.*"

"The stronger the working currents used, and the fewer the defective points, the stronger will be the polarisation currents."

"If these currents become very strong their direction may be reversed by sending for a short time a strong current with zinc to line; and, in such a case, this invariably indicates a single fault in the line or cable." This is a defect which we do not experience in England.

We find that (p. 66) "on all the lines in India positive signalling currents (copper to line) are used in order to have the greatest possible insulation of each line under all circumstances. Now, when measuring the insulation of a line with a positive test current, it is evident that the value obtained must give the insulation much too high, *i.e.*, higher than the line actually has when signals pass through it; because the signalling currents can only have a comparatively small oxidising effect on the line, since only a very small part can escape to earth in the different points of the

line, while a positive testing current, the further end of the line being insulated, must all escape to earth at the defective points of the line. Again, when measuring the insulation of a line with a negative testing current, we get a value which gives the insulation of the line much too low, because negative signalling currents are never used. In the absence of any known law, which would give us how much too high the insulation of the line is obtained with a positive testing current, and how much too low with a negative testing current, we can do nothing better than to take the arithmetic mean of the measured values as representing the insulation the line probably has when signals are passing through it. Of this mean it may, however, be said that it must be always somewhat too low, for the very reason that negative signalling currents are never used, and therefore the arithmetic mean again of the *first mean* and the *positive measured value* would represent a value most probably approximating to the one which the line actually has when signals pass, and which alone is of practical interest and consequence to be known."

The latter part of the book is devoted to fault testing, *i.e.*, to the localisation of the positions of faults.

The book itself is a very valuable addition to the literature of the subject, but we doubt whether it will be of any practical use to our English electricians.

OUR BOOK SHELF

Sketches of Wild Sport and Natural History of the Highlands. By Charles St. John. Illustrated Edition. (London: Murray, 1878.)

MANY of our readers must be familiar with the inimitable "Sketches" of St. John, which has long ago achieved the position of a classic for both the sportsman and the naturalist. We do not know of any descriptions of sport to equal those that abound in these pages, in truthfulness, vigour, and genial humour. To the naturalist who loves to know the habits of an animal in its native haunts, the book must be a treasure; and now that Harrison Weir, Whymper, Corbould, Collins, and Elwes have adorned it with their art, the book should become a greater favourite than ever. No artist equals Whymper in his faithfulness to life in drawing animals. Every picture in the book—and there are about eighty of them—is a masterpiece in its way, and an impressive lesson in natural history. We need only say that the engraver is Mr. J. W. Whymper to convince our readers that the artists' charming work has been faithfully and skilfully rendered. No one can read a chapter of the book without being both refreshed and instructed.

LETTERS TO THE EDITOR

- [The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]
- [The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Paradoxical Philosophy

It is strange to see a writer on philosophy like Mr. S. H. Hodgson, as well as physicists so exceptionally able as Prof. Clifford, and now Prof. Clerk-Maxwell, falling into the same errors of observation as more ordinary mortals. Neither the authors of the "Unseen Universe," nor any of the members of the Paradoxical Society, have, so far as I am aware, expressed the