LETTERS TO THE EDITOR

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Properties of Selenium

In a letter headed "Anomalous behaviour of Selenium," which appeared in NATURE (vol. xii., p. 187), Mr. Gordon states that "it has lately been observed that the electrical resistance of selenium is greater in light than in the dark." I am anxious to learn where an account of this remarkable observation is to be found.

Mr. Gordon afterwards announces the discovery that a bar of granular selenium belonging to the Cavendish Laboratory exhibits a decrease of resistance under the influence of light. This phenomenon was well-known outside the Cavendish Laboratory more than two years ago. Mr. Gordon also states that the very high resistance of a certain medal of selenium did not sensibly alter under the influence of light; and concludes that "the physical form of the metal" seems to have some influence on its electrical properties. From his description of the medal it would appear that it is made of vitreous selenium. I am therefore surprised that its resistance was so low. A conducting form of selenium having the appearance of black-lead is certainly a novelty.

It is perhaps not generally known that the electrical properties of selenium are very variable. In a paper by Mr. Henry Draper and myself which appeared in the "Proceedings of the Royal Irish Academy" (vol. i. ser. ii. (Sci.) p. 529), we have shown that there is a granular variety of the element which is, at ordinary temperatures, apparently as good a non-conductor as the vitreous variety. Unlike the latter, however, it cannot be rendered electrical by friction. Another granular modification of the element was found to conduct electricity comparatively well in darkness, and scarcely any better under the influence of light; while there is an intermediate state of the element which appears to possess a molecular structure so susceptible of change, that light is capable of converting it temporarily into the form which conducts comparatively well. Some bars which we prepared of this sensitive variety exhibited an increased conductivity of 100 per cent. under the influence of sun-light. In appearance there is not the slightest difference between this and the non-conducting granular variety, both exhibiting a gray granular fracture resembling that of the metal cobalt. In the course of our experiments Mr. Draper and I prepared a large number of bars and plates of various shapes and sizes, but we have not observed any unusual connection between the shape of the bars or plates and their resistance. There is a great difficulty in making observations with reference to this point, as we are as yet unable to produce two or more bars of the sensitive variety possessing the same electrical properties. Thin plates are generally more sensitive to light than cylindrical bars, but we have occasionally prepared bars as sensitive in proportion as a plate measuring 75 × 15 mm., and only 0·5 mm. in thickness.

I have not as yet been able to learn the contents of Prof. Adams's recent paper on this subject, but Mr. Gordon says that he has shown that the phenomenon is a purely optical one. I may state that Mr. Draper and I have long since shown that, so far as the effect of heat on electrical resistance is concerned, some forms of granular selenium conform to the metallic type. This was demonstrated by placing a plate of selenium inside a spiral of platinum, at a distance of about 4 mm. from the wire. The usual decrease of resistance took place when the plate was exposed to light; but on heating the surrounding platinum wire by passing a current of electricity through it, the resistance of the selenium increased considerably. The effect of light is therefore partially counterbalanced by the effect of the heat which usually accompanies it. This partly explains the increase of resistance that is known to follow prolonged exposure to light. A portion of this increase being doubtless due to the slight elevation of temperature that must result from the passage of the current through the selenium. The opposite action of light and heat is very remarkable, especially as the longest light undulations are those that cause the greatest decrease of resistance. It is remarkable, also, that a thin film of non-conducting vitreous selenium transmits these red rays, while an equally thin film of granular selenium is perfectly opaque to them.

RICHARD J. MOSS

Mr. Darwin and Prof. Dana on the Influence of Volcanic Action in preventing the growth of Corals

In his critique on the new edition of Mr. Darwin's work on Coral Reefs (NATURE, vol. x., pp. 408-410), Prof. Dana adduces four examples of islands in which he thinks comparatively recent volcanic action has prevented the formation of extensive coral reefs. One of these is Savaii, the largest island of Samoa.

Some time ago I read Prof. Dana's "Corals and Coral Islands," while on a tour on Savaii, and on the margin of page 302 I noted this very point now brought forward by the author in his paper in NATURE, intending, at some future time, to show that his view respecting this island is based upon imperfect knowledge, and is altogether incorrect.

I do not intend to enter here into all the details respecting Prof. Dana's incorrect statements, but will confine myself to the one point on which his views and those of Mr. Darwin are at variance. In his work (p. 302) Prof. Dana says: "Savaii abounds in extinct craters and lava streams, and much resembles Hawaii in character; it bears proof in every part of being the last seat of the volcanic fires of the Samoan Group. *Its reefs are consequently few and small.*" In NATURE (vol. x. p. 409), he says: "Savaii has coral reefs on its *western* (eastern) and northern shores, while elsewhere without them. *I failed to find evidence in the case of either of these volcanic regions that they are situated within areas of elevation* rather than subsidence. *Only ten miles* west (this should be *east*) of Savaii lies the large island of Upolu, having very extensive reefs—on some parts of the north side three-fourths of a mile wide; and it has not seemed safe to conclude that while Upolu thus bears evidence of no movement or of but little subsidence, Savaii was one of elevation; or *that the north and west* (*east*) *sides of Savaii have differed in change of level from the rest of the island.*"

In the above passage Prof. Dana has reversed the relative positions of Savaii and Upolu. Savaii is *west* of Upolu, and its reefs are on the *eastern end next to Upolu*, and extend for some distance on its north-eastern side. Its south, west, and north-west sides are free from coral reefs *except in bays*, where they are very narrow.

Now what Prof. Dana did not consider it "safe to conclude," viz., that part of Savaii had "differed in change of level from the rest of the island," is nevertheless a *fact*. And more than that, those parts of the island which present unmistakable evidence of upheaval *are destitute of a coral reef on their shores*, except the narrow fringes above mentioned.

The elevated portions of the island commence at the south-eastern point, in a line with three small islands which stand in the straits between Upolu and Savaii, and which doubtless indicate the line of fissure. I have traced the upheaval for many miles along the southern coast. In some places there are *old water-worn cliffs* from twenty to thirty feet above the cliffs which at present form the coast line, and which are themselves from twenty to thirty feet above high-water mark. These old cliffs are usually within two or three hundred yards of the present coast line, but are sometimes more distant. I have not at present traced this upheaval around the entire western end of Savaii, but I have observed the point at which it commences on the northern side, as well as at the south-eastern extremity.

How this fact tells on the point on which Prof. Dana's view differs from Mr. Darwin's, I may leave to those who are familiar with the subject to decide. My own conviction is, that instead of furnishing proof of the correctness of Prof. Dana's view, Savaii supplies a remarkable example of the correctness of that of Mr. Darwin, that, *ceteris paribus*, the extent of coral reefs is chiefly determined by the depth of water on the coast.

I have visited and examined a good many intertropical islands of the Pacific belonging to the three orders: 1. Volcanic islands with fringing coral reefs, such as Samoa, the New Hebrides, &c. 2. Atolls, such as the Low Archipelago, Ellice, Gilbert Islands, &c. 3. Upraised coral islands, such as Niuē or Savage Island, part of the Friendly, the Loyalty Islands, &c. I have studied their structure with Mr. Darwin's "Coral Reefs" as my text-book; and the further I have gone the more firmly have I been convinced of the correctness of his theory.

Prof. Dana is, without doubt, correct in his opinion that submarine or littoral volcanic action would destroy living corals which came within its influence; and it might for a time, even after the volcano became quiescent, prevent the spread of corals within the area affected by it. But the fact that in some of the areas where extensive reefs are not found, narrow coral fringes exist in bays (as at Savaii), where the slope of the shore is less