

carbonic acid, some of them, such as calcium, magnesium, &c., will form carbonates when the temperature sinks below that of the dissociation of such compounds. The scoria thus formed will float upon the heavy metals below and protect them from cooling by resisting their radiation; but if in the course of contraction of this crust, some fissures are formed reaching to the melted metals below, the pressure of the floating solid will inject the fluid metal upwards into these fissures to a height corresponding to the floatation depth of the solid, and thus form metallic veins permeating the lower strata of the crust. I need scarcely add that this would rudely but fairly represent what we know of the earth.

But it may be objected that I only describe an imaginary experiment. This is true as regards the whole of the materials united in a single fusion. Nobody has yet produced so complete a model with platinum and gold in the centre, and all the other metals arranged in theoretical order, and with the oxidised, silicated, and carbonated crust outside; but with a limited number of elements this has been done, is being done daily, on a scale of sufficient magnitude amply to refute Sir William Thomson's description of a fused earth solidifying from the centre outwards.

This refutation is to be seen in our blast furnaces, refining furnaces, puddling furnaces, Bessemer ladles, steel melting pots, cupels, foundry crucibles; in fact, in almost every metallurgical operation down to the simple fusion of lead or solder in a plumber's ladle, with its familiar floating crust of dross or oxide.

As an example I will—on account of its simplicity—take the open hearth finery, and the refining of pig iron. Here a metallic mixture of iron, silicon, carbon, sulphur, &c., is simply fused and exposed to the superficial action of atmospheric air. What is the result?

Oxidation of the more oxidisable constituents takes place, and these oxides at once arrange themselves according to their specific gravities. The oxidised carbon forms atmospheric matter and rises above all as carbonic acid, then the oxidised silicon being lighter than the iron floats above that, and combines with any aluminium or calcium that may have been in the pig, and with some of the iron; thus forming a siliceous crust closely resembling the predominating material of the earth's crust. The cinder of the blast furnace, which in like manner floats on the top of the melted pig iron, resembles still more closely the prevailing rock-matter of the earth, on account of the larger proportion, and the varied compounds of earth-metals it contains.

When the oxidation in the finery is carried far enough, the melted material is tapped out into a rectangular basin or mould, usually about 10 feet long and about 3 feet wide, where it settles and cools. During this cooling the silica and silicates—*i.e.*, the rock-matter—separate from the metallic matter and solidify on the surface as a thin crust, which behaves in a very interesting and instructive manner. At first a mere skin is formed. This gradually thickens, and as it thickens and cools becomes corrugated into mountain chains and valleys much higher and deeper, in proportion to the whole mass, than the mountain chains and valleys of our planet. After this crust has thickened to a certain extent volcanic action commences. Rifts, dykes, and faults are formed by the shrinkage of the metal below and streams of lava are ejected. Here and there these lava streams accumulate around their vent and form isolated conical volcanic mountains with decided craters, from which the eruption continues for some time. These volcanoes are relatively far higher than Chimborazo. The magnitude of these actions varies with the quality of the pig-iron.

The open hearth finery is now but little used, but probably some are to be seen at work occasionally in the neighbourhood of Glasgow, and I am sure that Sir William Thomson will find a visit to one of them very interesting. Failing this he may easily make an experiment by tapping into a good-sized "cinder bogie," some melted pig-iron from a puddling furnace (taking it just before the iron "comes to nature"), and leaving the melted mixture to cool slowly and undisturbed.

For the volcanic phenomena alone he need simply watch what occurs when in the ordinary course of puddling the cinder is run into a large bogie and the bogie is left to cool standing upright. I need scarcely add that these phenomena strikingly illustrate and confirm Mr. Mallet's theory of earthquakes, volcanoes, and mountain formation.

In merely passing through an iron-making district one may see the results of what I have called the volcanic action, by simply observing the form of those oyster-shaped or cubical blocks of cinder that are heaped in the vicinity of every blast

furnace that has been at work for any time. Radial ridges or consolidated miniature lava streams are visible on the exposed face of nearly, if not quite all, of these. They were ejected or squeezed up from below while the mass was cooling, when the outer crust had consolidated but the inner portion still remained liquid. Many of these are large enough and sufficiently well marked, to be visible from a railway carriage passing a cinder heap near the road.

I intended to have made a few remarks upon another of Sir William Thomson's arguments for the earth's solidity, but the pressure of necessary business compels me to postpone them.

W. MATTHEW WILLIAMS

Belmont, Twickenham, October 17

### Are We Drying Up?

IN NATURE, vol. xiv. p. 527, there is an article condensed from one by Prof. Whitney, with the alarming title "Are We Drying Up?" with a number of facts to prove that we are—that in the temperate zone at least, the supply of water in the rivers and lakes is failing at a more rapid rate than the destruction of forests will account for.

Supposing this to be true, it can have only one of two causes: a decrease in the area of the ocean, from which the rivers are supplied through evaporation and rainfall; or a diminution in the supply of heat from the sun, which would of course diminish evaporation.

It is scarcely necessary to say that any perceptible decrease in the area of the ocean during historical time is theoretically most improbable, and that practically there is no evidence of it.

A diminution in the radiation of heat from the sun is not impossible: and it is also shown in the concluding paragraph of your article, that a diminution in the obliquity of the ecliptic, which I believe is now going on, must tend to diminish the supply of solar heat to the higher latitudes, and, consequently, to diminish evaporation and rainfall there.

But were it true the supply of heat to the temperate zone were sensibly diminishing from either of these two causes, the fall of temperature would be quite as noticeable as the diminution of rainfall; and we should have proof of this from historical evidence as to the distribution of cultivated and wild plants. But there is no general evidence of the kind. In Iceland and Siberia, it is true, there appears to be some evidence of the summers having become colder, but in the more temperate regions the range of cultivated plants seems to have remained unchanged, or at least not to have receded, from the earliest periods of which we have any record.

It appears, therefore, most likely that the diminution of rainfall, where it really exists, is a merely local phenomenon.

It seems to be forgotten, that while any local diminution of rainfall is certain to give proof of itself in unfilled water-courses, any corresponding increase of rainfall in another locality will not prove itself in any equally visible way.

There appears to be little doubt of the recent desiccation of the region round the Caspian and Aral Seas, but it admits of being explained by a local cause. The Caspian has, within the last few thousand years, been cut off by a geological change from the Black Sea or the Arctic Ocean, or from both; since then it has shrunk in consequence of the excess of evaporation over rainfall, and the more its area has diminished, the less is the rainfall of the surrounding regions.

Some of the facts quoted, showing that rivers are ceasing to be navigable, do not necessarily prove that the rainfall is less than formerly, but only that the flow of the rivers is less regular. It appears certain that the destruction of forests, and the introduction of agricultural drainage tend to this result, by throwing the water more rapidly off the land. But there is also a good deal of evidence to show that the destruction of forests, and of vegetation generally, tends to diminish rainfall. The most satisfactory instances, in every sense, are those of the converse kind, which show that rainfall may be increased by the judicious fostering of vegetation. I will mention a few of these which occur to me, without being able to remember my authorities.

In Lower Egypt, rain has become much commoner since the formation of extensive date-tree plantations; and the flow of water in the Kedron, in the neighbourhood of Jerusalem, has become more abundant and regular since the planting of groves of mulberry and other trees about its sources. In the arid volcanic Island of Ascension, where trees would not have lived, showers of rain have been attracted, by planting such herbaceous plants as are best able to endure the almost permanent drought. The

introduction of cultivation in the neighbourhood of the Great Salt Lake of North America has increased the rainfall, and caused the level of the lake to rise. JOSEPH JOHN MURPHY

#### *Antedon rosaceus* (*Comatula rosacea*)

THE communication from Major Fred. H. Lang in NATURE, vol. xiv. p. 527, as to the abundant capture of *Comatula rosacea* in Torbay by himself and Mr. Hunt with the dredge during last month, is a valuable contribution to the study of the question of the appearance and disappearance of certain marine animals in certain localities respecting which we know so little. It is specially interesting to the Birmingham Natural History and Microscopical Society, and as president of the Society and reporter during the marine excursion to Teignmouth in 1873, alluded to by Major Lang, I must say that I read it with very great surprise and pleasure. My knowledge of the locality has extended over a period of about thirteen years, and during that time I have on several occasions dredged the ground which he mentions, and never once succeeded in taking an adult specimen of the rosy feather star, much less the more interesting pedunculate form of it. I have not, however, dredged there since our marine excursion. Mr. Gosse, whose experience is very large, and who resides in the neighbourhood, to whom I showed our mounted specimens, had never before seen the animal in that form, and there is no mention made of the adult animal in any of his descriptive works except in "A Year at the Shore," where at p. 182 he states, "We sometimes but very rarely find on this coast a very lovely form of this class of animals. . . . *Comatula rosacea*, a fine specimen of which, taken by myself in a little cove near Torquay, I have delineated." This was written in 1864. In the year previously, I believe, Prof. Allman dredged the same locality, and communicated to the Royal Society of Edinburgh a paper "On a pre-brachial stage in the development of *Comatula*," founded on a single specimen which he took on the occasion. It is a most remarkable circumstance, therefore, that in the space of about three years the species should have become numerous to the extent alluded to by Major Lang, more than a hundred being taken in one haul of the dredge! The marine naturalist who year by year finds his favourite specimens disappearing on many parts of the coast, will derive some consolation from Major Lang's communication as a set-off to disappointments elsewhere. I notice that Major Lang uses—as I did in 1873—the nomenclature, *Comatula rosacea* of Lamarck. Will he forgive me informing him of what I was then ignorant—that Dr. Carpenter, reverting to the previous designation of Fréminville, has adopted *Antedon rosaceus*—and at the same time directing his attention to the two wonderful and exhaustive monographs on the animal in the *Philosophical Transactions*:—(1) "On the Embryogeny of *Antedon rosaceus*," by Sir Wyville Thomson, at page 513, for the year 1865, and (2) "Researches on the Structure, Physiology, and Development of *Antedon rosaceus*," by Dr. Carpenter, at page 671, for the year 1866? Birmingham, October 20 W. R. HUGHES

#### Caterpillars

IF the experiment related below has never been made before, it appears to me deserving of notice in reference to instinct and evolution. The successful result of the experiment in a single case last year led me to repeat it on a somewhat larger scale this autumn. On September 25 I placed a number of the caterpillars of *Pieris brassicae* in boxes, and fed them with cabbage till they began to spin up. As soon as they had attached themselves by the tail and spun the suspensory girdle, and therefore before the exclusion of the chrysalis, I cut the girdle and caused them to hang vertically by the tail in the manner of the *Suspensi*. More than half of the caterpillars had been ichneumonized, and some accidents to the others finally reduced the number in which the experiment was fairly tried to eight. Of these, three came out successfully, the chrysalids maintaining their hold of the caterpillar-skin until they had succeeded in fastening themselves by their anal hooks to the silk to which the caterpillars were attached. The other five, as might have been expected of all, fell to the ground for want of the suspensory girdle. Counting the case last year, here then are no less than four out of nine caterpillars of the *Succincti*, when artificially placed in the conditions of the *Suspensi*, adapting themselves to circumstances so greatly changed, and whether by plasticity of instinct or reversion to ancestral habit accomplishing a very difficult operation no less successfully. J. A. OSBORNE

Milford, Letterkenny, October 14

#### Electro-Capillary Phenomena

THE electro-capillary machine of Lippmann and his capillary electrometer, besides the capillary electrocope of Werner Siemens and the electro-chemical relay of Wheatstone are all illustrations of a phenomenon resulting from application of an electric current. I am not aware that the converse phenomenon is so generally known, namely, that the motion of the mercury in the tube produces an electric current. If we substitute a galvanometer for the battery in a Lippmann capillary machine and move the lever by hand, the galvanometer needle is deflected. Similarly, if in any of the electro-capillary electrometers a galvanometer is substituted for the battery and the bubble caused to move by mechanical action, electrical currents are produced which deflect the galvanometer needle.

The following small instrument may serve to show this action for lecture purposes:—*a a* is a glass tube of any convenient bore, say 15 to 20 millimetres, by 300 mm. length; *b* is a cork fitting tightly into the middle of the tube, and perforated in two places where are inserted—at *c* a tube of  $\frac{1}{8}$  mm. bore, slightly longer than the cork is thick, and at *d* a longer tube, extending half way into both compartments. The ends of the tube *a a* are stopped by the corks *c c*, through which pass the platinum wires *f g*. Sufficient mercury to quarter fill each compartment is introduced into the tube *a a*, with a small quantity of diluted sulphuric acid. The apparatus being now sealed up, the wires *f* and *g* are connected to the terminals of a somewhat delicate galvanometer.

By inverting the tube, as is done with an hour or egg-glass, a current flows through the galvanometer so long as any mercury runs through the tube *c* (the tube *d* is an air-tube simply). Reverting the tube gives a current in an opposite direction, the platinum wire from that compartment from which the mercury flows always being the zincode of the electrical system. The current decreases with the mercury in the upper chamber as it falls, being a maximum with greatest head of mercury, and falling to nothing when all the mercury has dropped through. By any arrangement maintaining a constant head of mercury a constant current may be maintained.

Such an apparatus is especially useful in an electrical laboratory where weak currents are required for the adjustment of delicate galvanometers, or where the heating effect of currents of greater intensity and quantity are required to be avoided. The apparatus can be made in glass and hermetically sealed. A tube like the above placed on a stand which will allow it to revolve in a vertical plane, and fitted with a commutator, can be made to give a constant current in one direction, and is always ready to hand.

With a filter funnel the tube of which is drawn out to a fine point placed above a vessel containing mercury and acidulated water (wires being led from the funnel and lower vessel to the galvanometer) some interesting results are to be noticed which serve to throw considerable light on the action in electro-capillary apparatus. It will be found that when the mercury breaks away from the funnel at too great height the mercurial column becomes discontinuous, the circuit is interrupted, and of course no current passes through the galvanometer; and when the funnel is brought so close to the lower vessel as to give only a continuous column, the current is on short circuit and the galvanometer needle undeflected. There is a point, consequently, between these two positions giving a maximum current in the outer circuit, and this is easily found experimentally.

P. HIGGS

#### THE CAPercaILZIE IN NORTHUMBERLAND

A SHORT time back an account appeared in a Newcastle paper of the occurrence of the Capercaillie at Lilburn, in the north of Northumberland. Of course it was also stated that the bird had been shot. The account was "descriptive," and the writer evidently thought he was noting a fact worth telling, for he had