same time the number of persons remaining in the crowd will represent the quantity of heat in, and so the temperature of, the interior. Then it will be obvious that as the crowd disperses the number of persons at any one time between the lines may continue about the same (although the individuals will be changed), whilst those in the central crowd become fewer and fewer. This illustrates how the temperature of the crust may continue nearly uniform in spite of the continued loss of heat from, and cooling of, the interior.

I believe that I have long ago proved that the mere cooling of a solid earth would not give the amount of contraction needed to account for the observed inequalities of the surface, and I surmise that a diminution of the earth's volume has been caused by the escape of steam and gases from volcanic vents during past ages. This view has, however, attracted more attention in America than at home.

O. FISHER

Harlow, Cambridge, December 13

Magnetic Storm, May 14, 1878

I AM inclined to think that Mr. Mance's observations (vol. xix. p. 148) upon the earth currents observed at Kurrachee must be incorrectly reported. To agree with the observations in China, Stonyhurst, Greenwich, and Haverfordwest, they should have commenced at 4 A.M. on May 15, and terminated at 5 P.M. on the same day (Kurrachee time).

It is a pity that electricians do not record these currents in absolute units. To say that the current was equal to fourteen Daniell cells means nothing unless the resistances present are also given. If an earth current is observed upon a cable it is easy to reproduce this current upon the same galvanometer with a known resistance and a known electromotive force, and then to express its value in webers or milliwebers. Thus if at Kurrachee 50° were noted on a galvanometer, and one Daniell cell reproduced this deflection through a total resistance of 125 ohms, then the current would be equal to $\frac{1}{125}$, or '008 weber

or 8 milliwebers, a magnitude which every electrician would understand. Moreover, if the length, resistance, and general direction of the cable or wire were given, as well as the direction of the current itself, the difference of potential of the earth at the two ends would be known. This if the cable were 246 miles long, and lay due east and west, and its resistance were 50 per mile, then in the above case

$$\frac{E}{1230} = '008$$

$$E = 9'84 \text{ volts,}$$

which is the difference of potential of the two ends.

If simultaneous observations were made in this way at numerous stations on the earth's surface, we should be able to plot out the distribution of potential on the globe, and arrive at some better knowledge of the cause of earth-currents than we have at present.

W. H. FREECE

December 20

The Derivation of Life from the North

ATTENTION has been called by the President of the Royal Society to the labours of Mr. Dyer, as pointing in the case of plants to the conclusion that their various forms have been developed and dispersed from the north. I presume it is recognised that similar conclusions have been arrived at by Mr. A. R. Wallace in the case of animals. Mr. Wallace points to the palaearctic region as the great centre of their development or creation. On reading "The Geographical Distribution of Animals" when it first appeared, I was so much struck with the evidence adduced, that I was tempted to write and ask him if his work might not be said to occupy the following position in the history of unravelling what was formerly the mystery of geographical distribution. Mr. Darwin and others, including Mr. Wallace himself, had found a causal nexus in the case of islands, had shown that the faunas of islands had been derived from that of the nearest mainland, and in a character and degree varying concomitantly with the degree of their present disconnection therewith. They had thus completed the necessity for "centres of creation." Did not "The Geographical Distribution of Animals" afford the requisite evidence for carrying this commencement to its logical conclusion: for showing that in their turn the great continents themselves, or, more precisely, those

which are outlying to the central mass (which is in the north, around the Pole), have a similar dependence, and have borrowed their own faunas from that northern mass, in a character and degree proportional to the dates and degree of their connection or separation from it, the islands might then be said to be the satellites, and the great zoological regions the planets of this system, all having borrowed their life directly or indirectly from a single "centre of creation."

To render this still clearer to my own mind I had a map of the world designed on a polar projection, the northern hemisphere being projected to somewhat beyond the southern tropic. By this means the manner in which the land surface of the globe is built around the pole is clearly seen, and the extremities of America, Africa, and Australia, extending into the great oceans of the world, are embraced, or nearly so. When the subdivisional regions (zoologically) of each of these great projections, and of the whole, are marked in colours, a succession of zoological strata, to speak rather inaccurately, appears. By carrying an ideal section from the supposed centre of creation in the north through either of these three great extremities, and from thence to the nearer, and afterwards the more remote, dependencies of those extremities (remote not in point of actual distance, as in degree of connection), we pass in each case through zoological strata of different types, until we arrive at those where no land-mammals are to be found at all. And this succession in space, as evidenced by geography, corresponds in a rough way with the succession in time, as revealed by geology. 1. As we recede in distance we meet with increased dissimilarity. 2. This dissimilarity partakes of a recession in type. 3. Some of these geographical districts seem to have their counterparts in geological periods. The Ethiopian region, as Mr. Wallace shows, presents us with the exiled miocene fauna of Europe in the most striking manner. Eocene forms may be seen in its dependency of Madagascar, or in the West Indies. Highly isolated Australia with its marsupials, &c., appears as if it were still in the secondary age. Oceanic islands, such as New Zealand, with a more beautiful climate, and more extensive surface than Great Britain, give us no land mammals at all. In others the reptiles "possess the land."

Mr. Wallace's plan is an excellent illustration of the comparative method, and shows how a careful classification leads to the solution of historical questions connected with the causes of that classification. Those causes are in this case comprised in the inference that a succession of waves of life has been propagated from the north, not all of which have had an equal extension, nor all encountered similar modifying circumstances.

If these inferences are not correct, perhaps Mr. Wallace would kindly set me right.

J. W. BARRY

1, Duncombe Place, York

Glaciation of the Italian Lakes

HAVING spent some time lately on the border-land between Switzerland and Italy, it has occurred to me that a note on some glacial features of that region may prove of interest to the readers of NATURE.

The Lake of Lugano is a rock-basin. I believe it to have been scooped out by the glaciers which have formerly descended from the Alps. Of this there is abundant proof. The crystalline rocks in their lower reaches possess the easily recognisable outlines of *roches moutonnées*, but the stratified mesozoic rocks have lost these characters. Above Lugano and Agno these features are very well marked, and in these localities striation is tolerably frequent, the direction of the striae being southerly. Along both sides of the southern extension of Mount St. Salvatore to Moreate, striae can be seen in a few places near the lake-level, and the same is the case on both the Pianello and Generoso shores. At the southern extremities of the lake are abundant moraine-mounds. Erratics are also present, most being gneissose or granitic, but a few have fallen upon the moving ice from nearer localities, as they are of dolomite. The moraine masses are cut through by the northerly flowing streams, but, after passing the parting between the waters flowing towards Lake Lugano and those running into Lake Como, there is the appearance of great destruction of the moraines. Unfortunately I had a mere cursory glance down the Val della Tresa, through which the drainage of the lake flows to Lago Maggiore. It has often been remarked that in this South Alpine lake district, the *debris* left by the glaciers is exceedingly small when contrasted with similar regions north of that moun-

tain chain. To every observer, indeed, this must be obvious. Two reasons have been adduced in explanation—1. That the glaciers have been smaller from the cold of the glacial period not having extended over Italy, as indicated by the absence of the reindeer and other sub-arctic species from the drift; 2. That denudation has been enormous. In spite of the southern exposure it hardly appears probable that there could have been sufficient difference in the size of the northern and southern glaciers to cause this contrast, as long as the glacial period lasted, for the vapour-laden winds from the sea must have deposited much of their moisture on the southern slopes as snow. But, as the ice-age passed away, the southern aspect of the Alps would doubtless be freed from its influence sooner than the northern, and hence, while snow and ice reigned in the latter area, the regions south of the mountains underwent denudation, probably, for a vast period. I would therefore suggest that the comparatively small amount of glacial *débris* on the southern side of the Alps may arise from that region having been exposed for a much longer time to sub-aërial waste, and in particular to the floods caused by the more rapid melting of the snows on the southern slopes of the mountains.

GEO. A. GIBSON

10, Old Square, Birmingham, December 16

Electric Lighting

In the *Proceedings* of the Philosophical Society of Manchester Mr. Wilde has described a new electric lamp, in which the carbons are placed parallel to each other, as in a Jablochhoff candle, but without any insulating material. It may not be apparent to all why the arc always locates itself at the extremity of the pair of carbons, and this, as Mr. Wilde observes, whether the lamp be erect or inverted. The explanation is that the current in each carbon repels the electric arc exactly as the current in the mercury-troughs repels the connecting cross-wire in a well-known experiment of Ampère. In Wilde's candle we have two fixed conductors, the carbons, and a movable conductor, the arc. Since the current in the arc and the current in either carbon are one from the other towards the point of junction of that carbon with the arc, the arc must be repelled by the carbon. One cannot but be surprised that Ampère's experiment did not suggest the discovery made by Mr. Wilde, that the insulating material might with advantage be omitted in Jablochhoff's candle.

J. HOPKINSON

4, Westminster Chambers, December 12

The Reproduction of the Eel

THE time of spawning and the differences between the sexes of the common eel has been hitherto unknown. Last year for the first time in this country eels (*Anguilla bostoniensis*) containing eggs were found, December 31, by Mr. Edwards, at New Bedford, Mass., as stated by Mr. Putnam in the *Proceedings* of the Boston Society of Natural History. From observations on eels brought me at Providence, R.I. it appears that eels spawn here in salt or brackish water from October to the end of November, as I have found several eels containing eggs which seemed nearly ripe, the ovary being full and large. To-day on examining the testis of a male eel 17 inches long, the mother-cells and sperm-cells were found, the latter numerous and lively, from $\frac{1}{1000}$ to $\frac{1}{2000}$ inch in diameter. The eggs were white, just large enough to be distinguished by the naked eye, measuring a little less than $\frac{1}{2}$ mm. in diameter. The females are larger than the males, with the belly white, while the males are easily distinguishable by the dark bellies and a narrow silvery or golden median stripe.

A. S. PACKARD, Jun.

Laboratory of Brown University, U.S., November 27

AERATED BREAD

SOME remarks upon aerated bread which were made by Dr. B. W. Richardson at the recent general meeting of the company working Dr. Daughlish's patents require examination. Now it is noteworthy how imperfect our knowledge of the chemistry of the mill-products from the cereal grains still remains. Without such knowledge we are not in a position to dogmatise as to the exact nutritive values of different kinds of bread. As I pointed out in a previous article on "Real Brown

Bread,"¹ the statement that whole wheaten meal, bran, pollard, &c., contain more nitrogen, and therefore more flesh-formers than fine flour, rests upon no certain basis of analytical fact. And if it were proved that all the nitrogen of the most nitrogenous of mill-products does really exist in what are called albuminoids or flesh-formers, we cannot ignore the presence of much indigestible fibrous material in bran and pollard, material which is not only non-nutritive itself, but which locks up in an inaccessible form much of the real nutrient substances associated with it. Thus a sample of wheaten bran, or rather, fine pollard, may refuse to give up to the boiling dilute acid and alkali used in fibre-determinations more than six-sevenths of its nitrogenous matter; and it can hardly be expected that the secretions of the alimentary canal will prove successful in withdrawing a larger proportion. Indeed, the analysis of the residues of such foods after having been submitted to the digestive process, has confirmed this expectation in the case of the human subject. Moreover, while a not inconsiderable part of the albuminoid matters of the outer coverings of the grain thus escapes digestion from its mechanical condition, there is good reason to believe that a further portion remains unabsorbed, by reason of the rather hurried passage of the branny particles through the digestive tract. And the same causes which operate to prevent a part of such flesh-formers as exist in the bran from being utilised, affect also and in a similar way the useful mineral substances which abound in the coarser mill-products, as well as the oil or fat which they contain.

Now let us see what are the distinctive advantages claimed for Dr. Daughlish's bread-making process by Dr. Richardson. It yields a bread which is said to be "perfectly clean, perfectly wholesome, and completely nutritious." As to the perfect cleanliness of this mechanical process for making bread there can be no question; it is immeasurably superior to the barbarous and old, but, as Dr. Richardson remarked, *not* "time-honoured system of kneading dough by the hands and feet of the workman." And we may agree, with almost equal confidence, in the statement that aerated bread is perfectly wholesome. The stream of pure water charged with carbonic acid gas vesiculates the dough, which has required neither alum, nor blue vitriol, nor lime-water, to check the irregular fermentation, and neutralise the sourness of mouldy or otherwise damaged or inferior flour. But, on the other hand, the adoption of the aerating process does not of itself necessarily exclude *all* adulterations of the bread: materials to whiten the loaf and to cause the retention of a larger percentage of water may still be used. As to the small loss of nutrient materials involved in the ordinary fermentation of dough, it hardly merits consideration. Perhaps Dr. Richardson alluded to it because it gave him an opportunity of having a fling at his old enemy, alcohol, of which it has been found that a newly-baked loaf, made by means of yeast, contains about 0.25 per cent. So that a man who eats twenty quartern loaves has therein consumed an amount of alcohol which is commonly contained in one bottle of port! But if there be no really serious loss of starch by conversion, first into sugar, and then into carbonic acid gas and alcohol, there can be no doubt that a number of altered products are present in a fermented loaf, and that these are less abundant and less variable in nature in aerated bread. But the presence in fermented bread of larger quantities of sugar, gum, and soluble starch than are found in aerated bread is not usually a disadvantage so far as the digestibility of the loaf is concerned. It is rather to the production of lactic acid and of nitrogenous ferments by the use of yeast or leaven that we should attribute the uncertain value of ordinary bread. The quality of the yeast, too, must not be left out of consideration, as some of our home and of our imported supplies are by no means of a satisfactory character.

¹ See NATURE, vol. xviii, p. 229.