The Planting of Timber Trees.

IN Traill's sketch of the life of Shaftesbury (the first Earl), the following passage occurs in a letter from the Earl to the steward of his estates in Dorsetshire :—

"The best planting of timber trees is with nuts, acorns, seeds, and footsets, and not with young trees removed . . . In setting of chesnuts, acorns, and seeds [it is desirable] to steep them twenty-four hours in milk, which gives them a great advantage. . . . If siccamores [are planted] near my gardens, they will spoil all my fruit with the flies they breed. Therefore pray pluck up all the siccamores that are in the dry meadow behind my kitchen-garden, and in the room of every one of them plant a chesnut, a walnut, or a honey-broke oak."

Can any of your readers inform me whether the soaking of seeds in milk is now, or ever has been, extensively practised, also what is meant by a "honey-broke oak"?

ALFRED W. BENNETT.

Rhynchodemus Terrestris in England.

THE credit of the first discovery of this land-planarian in England lies not with Sir John Lubbock, as Dr. Scharff stated, but with the late Rev. L. Jenyns (Blomefield), who, in his "Observations in Natural History," 1846 (p. 315), makes some interesting remarks on the "Ground Fluke" (*Fasciola terrestris*) and its occurrence in the woods at Bottisham Hall, a locality searched with success by Mr. Harmer.

Rhynchodemus terrestris is widely distributed in England, and I have found it in Derbyshire, North Lancashire, and Westmoreland, under moist conditions and on a limestone substratum.

Any additions to the limited number of land-planarians in Europe are of considerable interest, and mention may therefore be made of Prof. v. Graff's description (*Bull. Soc. Zool. France*, xviii. 1893, pp. 122–3), of *Rhynchodemus pyrenaicus*, n. sp., from St. Jean de Luz, which is not alluded to by Dr. Scharff.

F. W. GAMBLE.

Owens College, Manchester, October 26.

Tan-Spots over Dogs' Eyes.

THE shepherds in some of the east counties of Scotland used to call their black-and-tan collies four-eyed dogs, which agrees so far with Mr. Peal's observations. These collies, twenty years ago, were much in demand. Now they are hardly allowed prizes at shows, and are becoming scarce; black and white, pure white, and, more commonly, brown dogs being greater favourites.

J. SHAW.

A CRITICISM OF THE ASTRONOMICAL THEORY OF THE ICE AGE.

IN a communication to the British Association at Oxford, I gave an outline of a method of obtaining a limit to the direct effect on terrestrial temperature of the diminished winter sun-heat during epochs of great eccentricity, the conclusion being that that effect had been enormously exaggerated, and that the astronomical theory of the Ice Age was really but a vague hypothesis, having no sound physical foundation.

It will be remembered that Dr. Croll's theory is shortly this: In the long northern winters in the time of great eccentricity, far less sun-heat is received than at present; the *direct* effect of this decrease in sun-heat is a *proportionate* decrease in terrestrial temperatures, or, more properly, a proportionate decrease in the excess of terrestrial temperature over the temperature to which the earth would fall in the absence of all sun-heat. So far Croll and Sir Robert Ball, the later expounder of the theory, agree. But now they part company. Croll affirms that the lowering of temperature thus calculated would be quite insufficient, and that it is the *indirect* effect of this fall of temperature (chiefly the effect in disturbing oceanic circulation) which gives rise to the additional lowering of temperature necessary for the production of an Ice Age. Ball, on the other hand, affirms that the direct lowering of temperature due to diminished sun-heat is amply sufficient to cause an Ice Age. I use the word *affirms* advisedly, because neither writer assigns any reason. Apparently Croll's reason was that he thought he could see additional causes, which if they existed must have contributed to the effect, and also that previous writers had said that the direct effect of the change in sun heat would not be sufficient; while Ball seems to have considered that he had strengthened Croll's argument so much that the new form of the theory was as strong without the ocean currents, as Croll's was with ocean currents. It does not seem to have occurred to either writer to ask what change in temperature would be necessary in order to produce an Ice Age, so that they might see if the cause they assigned would be sufficient; yet one would have thought this was the first step towards formulating a theory.

The point in reference to which the two authors employ numerical calculation is in obtaining the fall of terrestrial temperature due to a reduction of sun-heat. The problem is, of course, very complicated, and one would expect that the most approved principles of physics would be employed. Not at all. The physics is founded on an incidental remark of the astronomer Herschel in his "Outlines of Astronomy" (edition of 1869), where he assumes that the radiation of a body in space is *proportional* to its absolute temperature. Yet it has for many years been known to physicists that the radiation increases faster than the temperature, and in 1880 or 1881 what is now known as Stefan's law was published, namely, that the radiation increases as the fourth power of the absolute temperature. This would make an enormous reduction in the calculated fall of temperature due to a diminished supply of heat—*it would reduce it to one-fourth* of the amount obtained on the erroneous assumption employed by Croll and Ball alike. For if temperature be solely due to sun-heat, the heat radiated, say $A\theta^4$, where θ is the absolute temperature, must be equal to that received, say S, or

$$A\theta^4 = S,$$

hence

$$\frac{d\theta}{dS} = \frac{1}{4}\frac{\theta}{S},$$

whereas the law of direct proportionality assumed by Herschel, and adopted by Croll and Ball, gives

$$\frac{d\theta}{dS} = \frac{\theta}{S},$$

a result four times as great as that obtained above—

Turning now to Croll's form of the argument, we find one very remarkable inconsistency, which I think is no bad illustration of the special pleading which characterises that ingenious writer. When, in the first place, he desires to show how great may be the midwinter fall in temperature due to diminished sun heat, he thus employs the argument I have criticised above :—

Let T_p be the present excess of midwinter temperature at the latitude of the British Isles above the temperature of space, *i.e.* above the temperature to which the earth would fall if all sun-heat were to cease, and S_p the quantity of sun-heat at present received on that latitude on Midwinter Day, and let T_g and S_g be the corresponding quantities for the supposed glacial winter. Then, on Herschel's hypothesis, T_g is to T_p as S_g is to S_p. Having in that way got an enormous fall of temperature, Dr. Croll goes on to say that a vast proportion of our midwinter temperature in these isles is due, not to sun-heat received by us, but to heat carried to us by ocean currents. These ocean currents, he argues, will be diverted in the supposed glacial period, and thus there will be a *further* great fall in temperature. The argument for this double diminution of temperature is, of course, utterly invalid. If a great proportion of our winter-heat be not due to sun-heat, then a considerable

loss of sun-heat would not affect our winter temperature very much, and the first argument is wrong; if it be all due to sun-heat, then the first argument is right, and the second wrong.

Nor do we find much greater accuracy in Sir R. Ball's exposition of the theory. He is, indeed, much fairer than Croll in taking the winter temperature as proportional to the *average* daily supply of winter sun-heat, instead of the Midwinter Day sun-heat, for it is evident that the adjustment of temperature to sun-heat could not take place instantaneously. But in another particular he seems greatly to *understate* the case for the theory. His method of calculating the average daily sun-heat is to take the winter heat over the *whole northern hemisphere*, and divide it by the number of days in winter, and similarly for the daily summer sun-heat. He applies the average thus obtained to calculate variations in temperature in the latitude of the British Islands. But when we remember that the theory of the Ice Age is the theory of the temperature of the latitudes from about 45° N. to lat. 70° N., or, if you like, to the pole, it appears quite misleading to use numbers obtained from the sun-heat received by the *whole hemisphere*. For the proportion which the total winter sun-heat we receive in these Isles bears to the total summer-heat is expressed, not by Ball's numbers 37 and 63, but by the very different numbers 25 and 75. The great disparity between these numbers, contrasted with the temperate character of our climate, enables us to see how futile it is to appeal to our imagination, as Ball does, to conceive what vast differences of climate must be produced by differences in the daily receipt of sun-heat.

"If," he says, "a double supply of heat [63 measures] be poured in like a torrent during the short season [the 166 days of the short summer] while the single supply [37 measures] is constrained to do duty over the long season [the 199 days of the long winter], then an intolerable climate is the result. The total quantity of heat received on the hemisphere in the course of a year is no doubt the same in each case, but its unsuitable distribution bespeaks a climate of appalling severity—an Ice Age, in fact."

How untrustworthy this style of argument is, will appear when it is pointed out that in order to get a latitude in which as large a proportion as 37 per cent. of the annual sun-heat is received in the coldest 199 days, we have to go as far south as Madrid, Naples, Constantinople, New York, or Pekin! Yet we are asked to believe that this distribution, approximately two measures in 166 days, and one in 199 days, will produce "a climate of appalling severity—an Ice Age, in fact." ("Cause of an Ice Age," p. 135.)

There is another form in which the numerical method is applied by Ball, the result of which, so far from supporting the astronomical theory, would, if true, appear to me to be conclusive against it. The present mean annual range of temperature in Great Britain is about 20° F., and this, according to Ball, is caused by the disparity in the daily receipt of winter and summer sun-heat, acting against the mitigating causes. In the epoch of great eccentricity the disparity will be much greater, and instead of the range of 20° F. we shall have a range of 28° F. ("Cause of an Ice Age," p. 131.) Ball then goes on to say that such proportionate changes "are quite large enough to imply profound differences in the climatic condition. It is to be observed that, generally speaking, the coldest places are those of the greatest mean annual range. We are therefore entitled to infer that the effect of such a change in the eccentricity as we have supposed, would be to increase the range, lower the temperature of the hemisphere, and thus induce the glacial period."

One would not consider such a statement out of place in a popular series if it embodied the result of an inquiry too complicated to be explained except in technical language; but that is not the case here, nor can the conclusion be admitted as in the slightest degree probable. In fact, so far from our being entitled to infer that such an increase in the mean annual range would induce a glacial period, it appears to me that the mere fact that in all continental climates north of Lat. 40°, the present range is greater than 28° F., entitles us to infer that such a range would have no power whatever to induce an Ice Age.

The problem of ascertaining the effect of different astronomical conditions upon terrestrial temperatures is too complicated for accurate solution. How far the temperature at any place depends on the sun-heat falling on the outer layers of the atmosphere at the place (which is all that we can find by calculation), and how far on the transference of heat by ocean or air currents, must always remain to some degree uncertain, but that the latter exert a preponderating influence seems evident for two reasons—first, that while the sun-heat in each season remains the same from year to year, the seasons themselves vary enormously (we have cold summers and hot summers, warm winters and cold winters, all with unchanged conditions of sun-heat); and second, the difference between summer and winter temperatures is, in northern latitudes, but slight when compared with the difference between the quantities of winter and summer sun-heat received. Hence it appeared to me that no modification of Croll's method of calculating differences of temperature due to differences of sun-heat could be relied on, for our knowledge of the transference of heat from one region to another is too slight to enable us to allow for its effect in our equations. But there is another method which seems very reliable, especially when applied to the British Isles, or any region where warm ocean currents flow from the south. Not, indeed, that the method enables us to calculate the lowering, if any, of temperature in the epoch of great eccentricity, but it appears to enable us to fix, with some degree of certainty, *a limit to the direct effect of the diminished winter sun-heat*.

The method depends on comparing those regions which now receive given allowances of summer and winter sun-heat with the regions which, in the epoch of great eccentricity, received the same allowances. If, following Croll, we suppose the temperature on Midwinter Day to depend on the sun-heat received on that day, we find that latitudes 90°, 80°, 70°, 61°, 52°, and 43° now receive the same sun-heat on Midwinter Day as latitudes 90°, 80°, 70°, 60°, 50°, and 40° received on the Midwinter Day of the most extreme eccentricity. In other words, instead of Dr. Croll's fall of 45° F. (I omit his decimal point), the midwinter temperature of London would, in the supposed glacial epoch, be lowered to that of Manchester at present, for Manchester is about 2° north of London. If, following Ball, we take the average daily heat in winter as the basis of comparison, we should find that latitudes 90°, 81°, 71°·3, 61°·7, 52°·4, and 43°·3 receive in the present winter the same daily average of sun-heat as latitudes 90°, 80°, 70°, 60°, 50°, and 40° received in the long winters of greatest eccentricity. Or, finally, if we adopt the hypothesis, too favourable to the astronomical theory, that the widwinter temperature depends on the daily average through the 199 coldest days of the year, we find that latitudes 84°·5, 74°, 63°·5, 54°, and 44°·2 ought now, so far as direct sun-heat is concerned, to have the same midwinter temperature as 80°, 70°, 60°, 50°, and 40° had in the supposed glacial epoch; and when it is observed that the summers in these latitudes were then considerably hotter than the summers in the former latitudes, 84°·5, 74°, 63°·5, 54°, and 44°·2 now are, the utter inadequacy of the astronomical theory to explain the vast differences in temperature must surely be admitted by any reasonable mind.

But when we take account of the ocean currents, it

seems probable that instead of being lowered the winter temperature in the British Isles would be raised in the long winter of the supposed glacial epoch. For the Gulf Stream flows at about four miles per day between the Azores and Norway—that is, about ten degrees of the earth's surface in six months, so that we may fairly suppose the midwinter heating of these countries to be dependent on the summer heating at about Lat. 40°–45°. Now during the 166 days of the short summer in the epoch of great eccentricity, these latitudes received a greater daily average of heat than any latitude, even the equator, now receives in an equal time. Hence it is likely that the midwinter receipt of ocean heat in that epoch was much greater than at present. This seems to harmonise with the present condition of Mars. So far, indeed, as the evidence from the condition of Mars is admissible, it seems to be quite inconsistent with Croll's view.

A paper dealing more fully with the mathematical portion of the subject will shortly appear in the *Philosophical Magazine*, and a more exhaustive criticism of Croll's and Ball's works will be found in the January number of the *Geological Magazine* for 1895.

It is satisfactory to know that although the astronomical theory of the Ice Age has been steadily gaining an assured position among the semi-scientific public—one sees it referred to as the most generally accepted explanation in such diverse works as Nansen's "Journey across Greenland," and Laing's "Human Origins"—the rising school of geologists are strongly opposed to it, as contradicting the geological evidence.

EDWARD P. CULVERWELL.

NOTES.

THE President and Council of the Royal Society have this year awarded the medals as follows:—The Copley Medal to Dr. Edward Frankland, for his eminent services to theoretical and applied chemistry; the Rumford Medal to Prof. James Dewar, for his researches on the properties of matter at extremely low temperatures; the Davy Medal to Prof. Cleve, of Upsala, for his researches on the chemistry of the rare earths; and the Darwin Medal to Prof. Huxley, for his researches in comparative anatomy, and especially for his intimate association with Mr. Darwin in relation to the Origin of Species. The Royal Medals have been awarded to Prof. J. J. Thomson in recognition of his contributions to mathematical and experimental physics, especially to electrical theory; and to Prof. Victor Horsley for his important investigations relating to the physiology of the nervous system and of the thyroid gland, and to their applications to the treatment of disease. We learn as we go to press that the Queen has signified her approval of these awards.

THE following is a list of those who have been recommended by the President and Council of the Royal Society, for election into the Council for the year 1894–5, at the anniversary meeting on November 30:—President: Lord Kelvin. Treasurer: Sir John Evans, K.C.B. Secretaries: Prof. Michael Foster, Lord Rayleigh. Foreign Secretary: Sir Joseph Lister, Bart. Other members of the Council: Dr. Andrew Ainslie Common, William Crookes, Francis Darwin, Dr. Andrew Russell Forsyth, Sir Douglas Galton, K.C.B., Prof. Alexander Henry Green, Sir John Kirk, K.C.B., Prof. Horace Lamb, Prof. Edwin Ray Lankester, Prof. Alexander Macalister, Prof. John Henry Poynting, Prof. Arthur William Rücker, Osbert Salvin, Prof. J. S. Burdon Sanderson, Dr. Thomas Edward Thorpe, William Henry White, C.B.

WE regret to note the death of Prof. M. Duchartre, the eminent French botanist. He was in his eighty-fourth year.

THE Société nationale d'Horticulture de France is organising an international exhibition of horticultural products and industries, to be held in May 1895.

THE death is announced of Dr. Francesco Gasco, Professor of Comparative Anatomy and Embryology in the University of Rome.

SIR D. A. LANGE, who was appointed in 1858 the constructor of the Suez Canal, has just died, and was for some years director in England of that work. He was a Fellow of the Royal Geographical Society, the Society of Antiquaries, and of other learned societies, and the author of several important books connected with the Suez Canal.

A BLUE-BOOK has been issued containing Commissioner H. H. Johnston's report of the first three years' administration of the eastern portion of British Central Africa. The report deals with the physical geography of the country, its meteorology, agricultural conditions and resources, minerals, and fauna, with the characteristics of the native races, and is altogether of considerable scientific value.

AFTER the great earthquake shocks in Greece, last spring, a committee was appointed to make an examination of the Parthenon, in order to ascertain what damage the temple had sustained. The committee reported that the building had been seriously injured, and that there was great risk in allowing it to remain in its present dangerous condition. They recommended, therefore, that immediate steps be taken to strengthen it. Reuter's correspondent at Athens now reports that the Archæological Society, at a meeting called to consider the question, have voted an unlimited credit for the purpose of effecting the necessary repairs.

MR. H. C. RUSSELL, has sent us an account of the travels of three bottle-papers used for determining ocean currents. One was thrown into the sea near the Crozet Islands in March 1893, and was found in September 1894 between Cape Banks and Cape Northumberland. The mean daily rate of this appears to have been nearly eight miles. Two other papers travelled over much the same course on the south coast of Australia, at mean rates of six and nine miles a day. The interesting point is that three current papers should pass over more or less the same track, and agree so well as to the rate of the current. The paper that made only six miles a day was hampered with a heavy frame of wood, which had been put round it as a protection when it should reach the coast.

THE arrangements for the new session of the Society of Arts are now announced. The session commences on November 21 with an address from the Chairman of the Council, Major-General Sir John Donnelly. The first regular paper will be by Mr. Hiram Maxim, on his "Experiments in Aeronautics," and this will be followed the succeeding week by one by M. Hermite, on "The Electrical Treatment of Sewage." Two other papers—one by Mr. Thomas Ward on "Salt," and one by Gen. Michael on "Forestry"—will be read before Christmas. A number of papers for meetings after Christmas are also announced. Six courses of Cantor Lectures are promised, of which the first is by Prof. Vivian Lewes on "Explosives." There will be, as usual, a course of Juvenile Lectures after Christmas; the lecture this year is by Prof. C. V. Boys, F.R.S., his subject being "Waves and Ripples."

M. A. DELEBECQUE, of Thonon, sends us a small pamphlet on the lakes of Dauphiné. These lakes are very numerous, many of them being mere tarns or lagoons, and some, although figuring as sheets of water on the large-scale maps, are frequently dry. He gives an account of his soundings in the lakes of Bourget, Aiguebelette, Paladru, and the smaller lakes of the