

ithic, but never in beds yielding neolithic implements. As we travel northwards, say to Hesse, these *Cyrena*-bearing gravels are seen to underlie boulder-clay newer than the upper one of East Anglia; and in cave deposits still further north, beds yielding the same pleistocene mammals appear in similar situations, notably in the Victoria Cave at Settle. Now bearing in mind that in East Anglia, &c., where these beds are best developed, there has been no subsequent glaciation to sweep them bodily away, or show their age relatively to the glacial epoch, it seems to be a legitimate deduction that they are of inter-glacial age, when we find that to the north, wherever fragments have escaped destruction, they are overlaid by glacial beds. This is the conclusion to which Mr. Tiddeman arrived from a study of the Victoria Cave deposits and an intimate acquaintance with the glacial phenomena of the district, and my own work in the Fenland and East Anglia led me to a similar result. Mr. J. Geikie has, however, done more than any one to develop this idea, and was the first to propound it. He claims, then, that no palæolithic implement is of post-glacial date; and when we reflect upon the vast changes which have occurred since palæolithic times in the physical configuration of the country, in the mammalian fauna—changes which are even impressed upon the stable molluscs—the theory appears more than probable, and the difficulties which surround the post-glacial hypothesis steadily increase.

Palæolithic implements, however, are not all of one age (it would be strange indeed if they were), though it is very difficult to discriminate their relative antiquity. I have been much struck with the aged aspect of certain of the ruder tools as compared with some of the better finished ones and with the stones in the gravel in which they occur, and this gave me hopes of tracing such tools to an older deposit, a desire which has been abundantly fulfilled, and remarkably confirms my friend Mr. J. Geikie's bold surmise.

Here and there along some of the minor valley sides around Brandon are preserved patches of brick-earth, which are valuable as affording the only workable clay in the district. Whenever these beds are well exposed they are seen to underlie the chalky boulder-clay. Of this there cannot be the slightest doubt, for the glacial bed is typically developed and not in the slightest degree re-constructed. In these beds I have been so fortunate as to find palæolithic implements in two places; and in one of them quantities of broken bones and a few fresh-water shells. The implements are of the oval type, boldly chipped, but without any of the finer work which distinguishes the better made palæolithic implements. Although it would be rash to lay too great a stress upon the characters of these implements, it is, nevertheless, worthy of remark that they do belong to the crudest type. Equally rough specimens are found in the gravels above the boulder-clay and even among neolithic finds, still these very antique implements certainly do seem to belong to an earlier stage of civilisation if we regard them as examples of the best workmanship of their makers.

The interest attaching to these specimens lies in their exceeding antiquity—an antiquity greater than can be ascribed with certainty to any others. I have shown this boulder-clay to belong to the earlier part of the ice age, and beneath it these tools were found. I am not yet certain whether they belong to the so-called "middle glacial" series of Mr. Searles Wood, jun., to a somewhat newer date, or to a preceding period, for the beds lie directly upon the chalk. This much, however, is certain, that they conclusively prove man to have been a denizen of our land before the culmination of the glacial epoch.

Another point is deserving of notice. The tools are decidedly of palæolithic aspect—the difference between them and those which overlie the boulder-clay is slight in comparison with the differences between the latter and neolithic implements. Who shall say how long East Anglia was swathed in ice? Yet that interval was not long enough for man to advance greatly in his manufactures, and it appears to me we have here another argument in favour of the glacial age of all palæolithic tools and against the theory which relegates them to after the close of the ice age. It seems to bring the brick-earth tools and the gravel implements closer together, and withdraw them still further from the newer stone age.

As soon as the bones are examined and the survey of the brick-earths completed, I hope to write more fully upon this question, and here only indite a few preliminary notes in the hope that they may prove interesting to brother geologists.

SYDNEY B. J. SKERTCHLY

The Inverse Rotation of the Radiometer an Effect of Electricity

IN my communication published in *NATURE*, vol. xiv. p. 288, I endeavoured to show that the direct rotation of the radiometer was an effect of electricity. Before attempting to explain the inverse rotation it will be necessary to expound briefly some new facts which my electroscopic researches have led me to establish.

In order to ascertain the electric state of their inner surface, I exposed to solar radiation glass receivers such as are used for the air-pump. By means of the proof plane and electroscope I found that this surface was electrified negatively, and even to a greater degree than the exterior. This excess of energy I attribute to the numerous reflexions from the interior. If, however, we hold one of these electrified receivers near the Bohnenberger electroscope, taking care that it does not come in contact with it, the electroscope at once indicates the presence of *positive* electricity. As both the outer and inner surfaces are negatively electrified, this phenomenon must be attributed to the electricity developed in the interior of the glass itself by its molecular polarisation and feeble conductivity. The following experiment confirms this explanation. If we remove from the exterior by means of the proof-plane a portion of the negative electricity and then approach, as before, the globe to the electroscope, a remarkable increase of positive electricity is at once shown. The same results are observed in the radiometer.

I next examined the electric state of the exterior of the radiometer globe when placed in partial obscurity and moistened with ether. There are no signs whatever of electricity as long as the inverse rotation continues, but as soon as the direct rotation commences—on account of the obscure radiations given forth by the surrounding bodies—positive electricity manifests itself and rapidly increases. While in this state I exposed the radiometer to solar radiation, and I found that this positive electricity remains quite a long time, and that, notwithstanding the positive charge on the exterior, the direct rotation continues with its usual rapidity.

The fact last-mentioned enabled me to determine, by experiment, the electric state of the inner surface of the radiometer globe. Only two suppositions can be made in regard to it: either the electric state of the inner surface is dependent by means of molecular polarisation upon the electric state of the exterior, or it is independent. In the first supposition the interior face is electrified positively when the exterior is electrified negatively, and *vice versa*. The second supposition may be divided into three hypotheses, for we can admit that the interior is constantly, under the same circumstances, either neutral, or negative, or positive. Hence we have in all four hypotheses, *a priori*, viz. :—

1. Inner surface is dependent upon electric state of exterior.
2. Inner surface is independent and neutral.
3. Inner surface is independent and negative.
4. Inner surface is independent and positive.

Now of these four hypotheses the fourth alone is verified by experiment. This I have established as follows :—

In one series of experiments I charged the exterior of the radiometer with positive electricity by exposing it to solar radiation.

In a second series I charged the same surface with positive electricity by exposing it to solar radiation after moistening it with ether.

Each experiment comprised two operations. I touched a certain number of times the exterior of the glass globe with the proof-plane and I carefully observed the electroscopic signs of the Bohnenberger electroscope when brought in contact with the proof-plane; then I approached to the electrometer the glass globe which had been partially discharged by the preceding experiment, and I again observed the signs given by the electroscope. In the case that one of the first two hypotheses expresses the real state of the inner surface of the radiometer under the influence of radiation, on approaching the glass globe we should have, in both series of experiments, electroscopic signs of equal intensity for equal electric charges of the exterior surface, manifested by the equality of those of the proof plane. Now this does not take place. In my experiments on the approach of the globe the electroscopic signs in the second series surpass in intensity those observed in the first series. These results agree perfectly with the fourth hypothesis, but are in open discord with the third. Any one can easily see this, with a little attention, by considering the layers of electricity produced in the interior of the glass walls by molecular polarisation. The fourth

hypothesis is, then, the true one, and the inner surface is electrified positively.

The explanation of both the direct and inverse rotation follows naturally from these facts and those communicated in my former note. For since the inner surface, when exposed to luminous or calorific radiations, is electrified positively, the direct rotation is a necessary consequence of the attractions and repulsions which this positive electricity exerts upon the free electricity of the vanes. This rotation continues when the radiometer is surrounded by light, because a perfectly homogeneous layer of electricity upon the inner surface is almost impossible.

The inverse rotation occurs in two circumstances—

1. When the instrument, having been exposed to radiation which produces a direct rotation is allowed to cool slowly.
2. When the radiometer at the ordinary temperature is cooled suddenly, for instance, by moistening it with ether.

In the first case, the electricity which the globe acquires when exposed to radiation disappearing very slowly, as experiments show, an inversion of the movement can be produced by an inversion in the signs of the electricity of the vanes. In fact, in accordance with the principle of reciprocity, the emission of the radiations gives rise in the vanes to a development of electricity equivalent and contrary to that which absorption has produced there. By this development of electricity the vanes would return to their neutral state if the electricity produced by absorption had not passed in part from the vanes into the rarefied gas of the globe. Now this passage took place with a greater energy as the rotary movement of the vanes had renewed more frequently the mass of air in contact with them. Hence the electric effect of the emission will be to change the signs and to diminish the charge of free electricity of the vanes.

In the second case, where the cooling is produced by moistening the exterior, the globe remains in its neutral state. For, as I have above remarked, during the whole time of the inverse rotation, the cooled surface of the globe gives no signs of electricity. It appears that the cooling itself is not capable of producing electricity, but that the passage of a radiation through the surface is absolutely required. In these conditions the vanes become charged with negative electricity upon the dark, and positive upon the bright side, by reason of the emission, at the same time that the radiations given forth by the vanes and absorbed by the inner surface of the glass globe electrify the latter positively.

Thus the electric theory of the radiometer explains quite well the principal phenomena which have been observed up to the present time. I hope to make, hereafter, a study of all the particular movements which different observers have noted in the accounts of their experiments. I will only say now that the most remarkable of them, viz., the rotation of the radiometer globe, when an obstacle is put to the rotation of the vanes, as discovered by Schuster, is in entire conformity with the above theory, while it constitutes a very serious objection to the hypothesis of mechanical impulse by radiation.

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A Rudimentary Tail

A DAY or two ago a curious and interesting abnormality came under my notice, which, I think, deserves mention. I was examining the back of a girl, aged about eight, when I saw over the lower part of the sacrum, in the middle line of the back, a small hole, that, on the first glance, seemed like the opening of an old sinus. I was told, however, that it had been present since birth, and I then looked at it more carefully. It had a direction downwards and somewhat forwards, and consisted of a reflection of the skin entering a more or less circular depression, about $\frac{1}{4}$ inch in diameter, and about $\frac{1}{2}$ inch deep. Not quite $\frac{1}{4}$ inch below its lower border could be felt the pointed extremity of the coccyx, which, instead of having its usual form, curved backwards and rather upwards. On stretching the skin downwards, that portion of it entering the depression or hole was raised, coming out like the top part of the finger of a glove which had been pressed down into the lower part, and a small prominence, about the height of the diameter of a pea, stood up from the surface; and this little sheath was found to cover and exactly fit the sharp end of the coccyx. The resemblance this bore to a rudimentary tail was sufficiently striking.

Jersey

ANDREW DUNLOP

The Æolian Formation on the Lancashire Coast

IN the absence of large works on the subject, has your recent Waterloo correspondent seen the Survey memoir of the district around Southport in which the phenomena of wind driftage are treated in a brief yet quantitative manner? The efficient way in which pebbles and shells—as of *Macra stultorum* (with which the shore is so plentifully covered)—especially when the convex side of a valve is presented vertically towards the direction of the storm winds, protect a small area to leeward, forming a miniature crag-and-tail arrangement, would seem to suggest that a solid screen offering an unbroken surface to the action of the wind, and at some distance from the region threatened, would be far more useful than the present expedients of growing marram grass, &c., to consolidate the dunes, or of planting lines of bare stakes. Practical men would easily devise a cheaply constructed barrier of old ship-timber faced with ling or other accessible material, or perhaps use the sand-hills themselves when armoured with tabular blocks of stone made on the spot by some such process as employed in the construction of the sea-walls of the Suez Canal. Land sold for building plots on exposed points ought surely to have some adequate defence against the devouring sand.

WILLIAM GEE

Manchester, Sept. 15

OUR ASTRONOMICAL COLUMN

THE TOTAL SOLAR ECLIPSE OF 1885, SEPT. 8-9.—The following elements, though approximate only, will suffice to give a pretty fair indication of the circumstances under which the totality of this eclipse will take place:—

Conjunction in R.A., 1885, Sept. 8, at 9h. 18m. 58s. G.M.T.

R.A.	...	...	...	...	167° 25' 39"
Moon's hourly motion in R.A.	...	...	...	...	34 36
Sun's	...	...	...	...	2 15
Moon's declination	...	...	...	...	4 30 44 N.
Sun's	...	...	...	...	5 23 40 N.
Moon's hourly motion in declination	...	...	...	...	10 58 S.
Sun's	...	...	...	...	0 57 S.
Moon's horizontal parallax	...	...	...	...	59 43
Sun's	...	...	...	...	0 9
Moon's true semi-diameter	...	...	...	...	16 16
Sun's	...	...	...	...	15 54

Hence the central and total eclipse begins upon the earth in long. 156° 54' E., lat. 40° 54' S., and ends in long. 75° 33' W., lat. 74° 38' S., and the sun is centrally eclipsed at apparent noon in long. 138° 39' W., lat. 57° 40' S.

The following are also points upon the central line:—

Long.		Lat.		Long.		Lat.
173° 26' E.	...	40° 28' S.		177° 58' W.	...	41° 23' S.
175° 3' E.	...	40° 34'		171° 59' W.	...	42° 39' S.
177° 33' E.	...	40° 46'				

The semi-diameter of the shadow in these longitudes is about 55'. It would therefore appear that observations are not likely to be made to any useful purpose, except in the southern part of the northern island of New Zealand, and here the sun will have no great elevation above the horizon. If we calculate from the above elements directly for Wellington, assuming the longitude of this place 171h. 39m. 20s. E., and its latitude 41° 17', we find—

		h.	m.	s.	
Partial eclipse begins	Sept. 9 at	6	18	0	A.M.
Total	" begins	"	7	42	22 "
Total	" ends	"	7	43	0 "
Partial	" ends	"	8	58	0 "

Mean times
at
Wellington.

And therefore the duration of totality 38 seconds only, with the sun at an altitude of 15°.

Calculating similarly for one of the points upon the central line, some fifty miles north of Wellington, or long. 175° 3' E., lat. 40° 34', the totality is found to commence at 7h. 41m. 31s. A.M., local mean time, and to continue 1m. 54s., with the sun at an altitude of 16°.

At Wellington the sun rises at 6h. 21m.