

as

$$\frac{du}{dn} = \frac{du}{dv} \cdot \frac{dv}{dn} = c \frac{dv}{dn}$$

$$\frac{dv}{dn} = g = \frac{u_1 - u_0}{c_0} F(x, y, z, t) \quad \dots (7)$$

where g is the temperature gradient inwards from the surface, and c_0 is the value of c at the surface.

If c and k are constant everywhere, say c_0 and k_0 , let us call the surface gradient g_0 ; then as $u = c_0 v + C$

$$\frac{g}{g_0} = \frac{1}{c_0} \frac{u_1 - u_0}{v_1 - v_0}$$

for the same place at the same time after cooling began.

As an example, let

$$k = k_0(av + 1),$$

and

$$c = c_0(av + 1),$$

and measure v on the Centigrade scale, c_0 and k_0 are the actual capacities and conductivities at 0°C. ,

$$u = c_0(\frac{1}{2}av^2 + v + C),$$

so that

$$\frac{g}{g_0} = \frac{\frac{1}{2}av_1^2 + v_1}{v_1} = \frac{1}{2}av_1 + 1.$$

Thus if c and k increase s per cent. per 100 degrees Centigrade, and if $v_1 = 4000$, as

$$a = 10^{-4}s, \quad \frac{g}{g_0} = \frac{s}{5} + 1.$$

In the cooling of Lord Kelvin's infinite mass with a plane face the time which elapses until a particular surface gradient is reached is inversely proportional to the square of the gradient. If the time taken on the assumption of constant c and k be called t_0 , and if the time taken on the assumption that c and k increase s per cent. for 100 degrees is t , then

$$t/t_0 = \left(\frac{s}{5} + 1\right)^2$$

Suppose

$$s = 50,$$

then

$$t/t_0 = 121.$$

So that Lord Kelvin's age of the Earth would be multiplied by 121.

It must be understood that my conclusions (NATURE, January 3, p. 224) are really independent of whether R. Weber's results are correct or not. Lord Kelvin has to prove the impossibility of the rocks inside the earth being better conductors (including convective conduction in case of liquid rock in crevices) than the surface rocks. If, however, Weber's results, as quoted by me, are trustworthy, the above solution is what I take Lord Kelvin to refer to in the first paragraph of his published letter. In considering all such measurements as those of R. Weber, it must be remembered that the rocks at twenty miles deep are not merely at a high temperature, but also under great pressure.

January 30.

JOHN PERRY.

Oceanic Temperatures at Different Depths.

THE question of the persistence or otherwise of the temperature of different strata of water beneath the surface of the oceans, is one upon which so few observations have been made, that it will probably be interesting to students of oceanic phenomena to publish in NATURE the results obtained at one spot in the Atlantic, at periods extending over as much as twenty-one years.

At a position about 200 miles west-south-west from Cape Palmas, in Africa, where the depth of water is about 2500 fathoms, and where on the surface the Guinea current is running to the eastward, the *Challenger* in 1873 and 1876, the *Buccaneer* in 1886, and the *Waterwitch* in 1894, have all obtained serial temperatures; the first three to a depth of 200 fathoms, the last to 150 fathoms.

The result is given in the following table, and illustrated by the diagram.

Comparison of Ocean Temperatures obtained at Different Times in or near the same position, viz. $5^\circ 48' \text{ N.}, 14^\circ 20' \text{ W.}$

Depth in fathoms.	Challenger temperatures, 19/8/73.	Challenger temperatures, 10/4/76.	Buccaneer temperatures, 5/1/86.	Waterwitch temperatures, 22/9/94.
Surface	79.2	83.5	85.5	80.0
10	—	83.2	82.5	78.0
20	—	70.0	79.6	—
25	72.6	—	69.0	75.2
30	—	62.6	65.9	69.2
40	—	60.0	60.8	62.8
50	62.5	59.2	58.8	60.2
60	—	58.5	—	—
70	—	57.8	—	—
75	58.8	—	—	58.8
80	—	57.1	—	—
90	—	56.5	—	—
100	56.2	55.9	56.1	57.0
110	—	55.2	—	—
120	—	54.6	—	—
125	54.1	—	—	—
130	—	54.0	—	—
140	—	53.3	—	—
150	52.2	52.7	—	52.5
160	—	52.1	—	—
170	—	51.4	—	—
180	—	50.8	—	—
190	—	50.1	—	—
200	48.3	49.5	49.0	—

Exact Positions and Observation Spots.

Challenger, 19/8/73	...	Lat. $5^\circ 48' \text{ N.}$...	Long. $14^\circ 20' \text{ W.}$
Challenger, 10/4/76	...	5 28		14 38
Buccaneer, 5/1/86	...	5 48		14 20
Waterwitch, 22/9/94	...	5 48		14 22

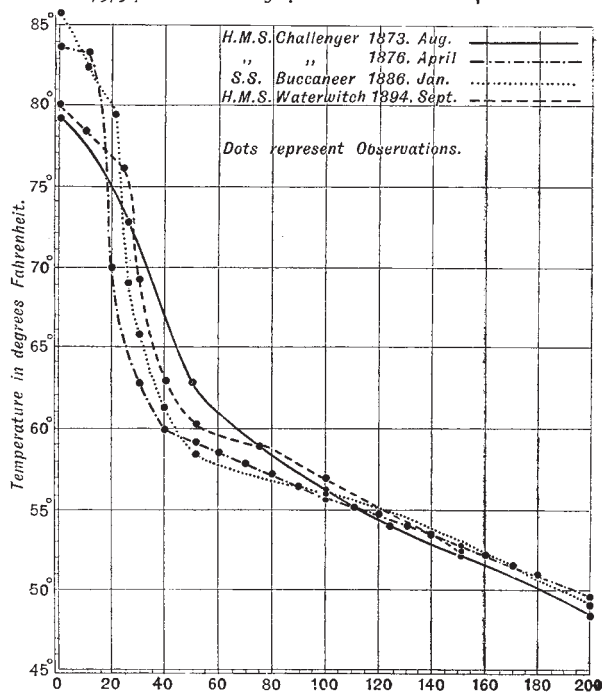


Diagram showing temperature at different depths obtained at various epochs in Lat. $5^\circ 48' \text{ N.},$ Long. $14^\circ 20' \text{ W.}$

It will be observed that the temperatures at the surface vary by 6.3° F. ; at a depth of 20 fathoms, by 9.6° ; at 40 fathoms,

by about 6°; at 50 fathoms, by 3°·7; while at 100 fathoms, three of the results are within 0°·3 of one another, the fourth being 1°·1 above the lowest. From 100 to 200 fathoms, the temperatures, diminishing in the same ratio, differ by about the same amount.

It is difficult to say exactly what value can be placed on each individual observation. Many small errors may creep in; errors of reading, errors from movement of the indices, errors from insufficient time being given for the instrument to take up the true temperature, &c.

These should not, however, reach a degree in any instance, and it is pretty plain that below 100 fathoms the temperature at this spot remains fairly equable. This confirms the general view held by those who have studied the results obtained from observations at different depths, in different parts of the ocean.

While from one point of view it is unfortunate that the observations have been taken in different months, on the other hand, the variation in the surface temperature at different seasons of the year is given full value in the comparison.

January 26.

W. J. L. WHARTON.

"The Bird-Winged Butterflies of the East."

PERMIT me to add a few notes supplementary to the very interesting and able article, by my friend Mr. Kirby, entitled "The Bird-Winged Butterflies of the East," which appeared in your issue of January 10, p. 254.

(1) If the male of either of the two species of my genus *Ætheoptera* is examined in the proper light and position, a long pupæ form stigma, composed of raised scent-producing scales, will be very readily seen, of a more slender character, but in nearly the same relative position on the hind margin of the anterior wing, as in the males of the genus *Ornithoptera*, or, as Mr. Kirby prefers to call it, *Troides*. As I have pointed out in part viii. of my "Icones Ornithopterorum," this stigmatic sexual brand, being a densely black mark surrounded by the general velvet black of the wing, is very likely to be overlooked by a casual observer in some positions, while it is really very prominent in others; and I have called special attention to the lovely arrangements by which the latter result is attained; and a reference to the plates containing the figures of these species will suffice to show how very obtrusive the mark is, and how much more beautiful the insect becomes by the magical play of opalescent tints on the black which encloses the stigma, as the insect is moved into different positions against or opposite the light. To simply look at the insect as it stands in a cabinet drawer, is to miss all this glory and its *raison d'être*. As in all the species of *Ornithoptera*, the female possesses no such organ.

(2) *Æ. (?) Tithonus* (De Haan), as quoted by Mr. Kirby, is (as he evidently suspect) not a member of the genus *Ætheoptera* at all, but belongs to the first genus of the true *Ornithoptera*, viz. *Schoenbergia* (sub genus of Fagenstecher, and genus of Rippon); and I have no doubt that the female butterfly supposed to be its mate, is rightly assigned to it, as it is singularly like the female of *Sch. Paradisea* of Staudinger, and also co-generic with the large form described by M. Ch. Oberthür under the name *O. Goliath*. Neither in *Sch. Paradisea* or *Sch. Tithonus* is the male furnished with a pupæ-form sexual mark as in *Ornithoptera* and *Ætheoptera*, nor with an abdominal marginal pouch or fold concealing the *androconia*, as in the males of *Pompeoptera*, or as Mr. Kirby calls them, *Ornithoptera* and *Trogonoptera*.

(3) I am compelled to regard the *Ornithoptera* as being naturally divided into three sub groups of unequal extent (so far as our present material indicates): (1) The African or *Acraeoid* *Ornithoptera*, containing one genus (*Drurya*), and two species, *D. Antimachus* (Drury), and *D. Zalmoxis* of Hewitson; (2) the Oriental or true *Ornithoptera*, with the five genera *Schoenbergia*, *Ornithoptera*, *Ætheoptera*, *Trogonoptera*, and *Pompeoptera*; (3) the South and Central American *Ornithopterina*, containing the numerous black and red, and black and green, and olive black *Papilios*, which are usually allowed to follow the true *Ornithoptera* in our systematic catalogues. The males of many of these possess an abdominal marginal fold concealing the *androconia*, an organ not found, as far as I am aware, on the abdominal margin of any other section of the *Papilionidæ*—though the sexual stigma can be found on the anterior wings of several males, as in *P. Ulysses* for example, though differing in form and position.

(4) My reasons for not adopting Hubner's name *Troides* in place of *Ornithoptera* for the *Priamus* group will be found by referring to "Icones Ornithopterorum." At the same time, I

quite understand, and to some extent sympathise, with the severe and uncompromising application of the law of priority in nomenclature for which Mr. Kirby and several other naturalists contend.

(5) The wonderful iridescence of the yellow hind wings of *Pompeoptera Magellanus*, ♂, may be seen equally displayed on the under surface also.

Finally, I may safely say that the males of *Ætheoptera* and *Schoenbergia* are probably the most perfectly beautiful of the butterflies of the world.

ROBERT H. F. RIPPON.

Upper Norwood, S.E., January 19.

Thirst-endurance in some Vertebrates.

WHEN an example of great ability to endure thirst is desired, the camel is usually suggested. Hibernating animals also are put forward in instance of existence without water for long periods. The camel carries a supply with it, so that what is most wonderful in its case is the tank. Torpid animals need little or no moisture beyond that in their systems, and, besides, they benefit from dampness around them. Better examples abound on the arid plains near the Rocky Mountains and the Sierras, in the innumerable active, noisy little rodents, miles away from streams or pools, and out of possible reach of water by burrowing. Any one who observes these creatures in their haunts in midsummer, will be pretty sure to inquire, like one of my companions, "What do those little wretches get to drink, anyhow?" The only reply appears to be, "They drink water when they get it, and do without at other times." For weeks and months, when the vegetation is shrivelled and parched, and the sands are at their hottest, these squirrels and their neighbours, with thickening blood, wait for the rain, that the currents in their veins may be thinned and quickened. But one need not go so far for a much better instance than the camel. The common mouse endures thirst quite as well as its allies in the desert. This has been proved repeatedly by mice kept here as a reserve supply of food for a lot of reptiles. Reducing the allowance of water prevented the foul odour by which mice are generally attended; this led to keeping some of them entirely without water, to note the effect. Last winter, a few were kept in a warm room more than three months before being fed to the snakes. On the first of last October, several were put aside to have no drink; at the time of writing, three months and a half later, they are eating heartily of the driest of maize and grass seeds, on which alone they have been fed, and they act as if able to endure the experiment a month or two longer.

S. GARMAN.

Cambridge, Mass., U.S.A., January 17.

Electroscopes in Lecture.

THE electroscope which Prof. Lodge proposes to use to indicate positive and negative potentials by different movements of the leaves (see p. 320), has the disadvantage that (assuming the case to be charged negatively), if too large a negative charge be given to the gold leaves they will diverge, and the inference will be that the potential is zero or positive, neither of which is the truth. For the purpose Prof. Lodge has in view, a Bohnenberger's electroscope would indicate more clearly positive, negative, or zero potential. Instead of the two dry piles, the inner and outer coatings of a charged insulated Leyden jar connected to two knobs, one on each side of the single gold leaf, might be substituted.

J. REGINALD ASHWORTH.

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Snake Cannibalism.

THE notice in NATURE, January 31, p. 321, on the above-mentioned subject, calls to my mind the following passage in Rénan's "Averroës," Paris, 1867, p. 310. He refers to the pre-Raphaëlle pictures representing allegorically the "Seven Liberal Arts," and adds: "Dans une fresque récemment découverte à Puy . . . La Logique tient en main un lézard ou un scorpion. Dans un tableau d'Angelico elle tient deux serpents qui se dévorent." I have not succeeded in finding any further statement about this picture in the books on Art within my reach, nevertheless this may prove an interesting addition to the growing literature on cannibal snakes.

C. R. OSTEN SACKEN.

Heidelberg, February 3.