Animal Intelligence

MR. HARRISON, like most of those who deal with animal communications, assumes that sounds or words must form the basis. This rests upon the assumption that speech is a primary system of communication for mankind, instead of being secondary. Many babies will begin with sign communication, and show a preference for it after they are well able to articulate words. The dog will follow human gestures as well as sounds and words. It is indeed worthy of consideration how far signs play a part in communication between animals. Instead of supposing a complicated system of words, as Mr. Harrison does, it is easy to conceive that, with the apparatus he describes, many signs may be made. Expressions of alarm, joy, direction, can be as well made with antennæ as with hands.

32, St. George's Square, October 6 HYDE CLARKE

Shifting of the Earth's Axis

PERMIT me to say that it was from the diagrams in the paper by Mr. Christie which he quotes (NATURE, October 2, p. 536) that I drew the conclusions of decrease of latitude. In the fuller statement to which I referred, I had expressly said that it was from the Polaris observations that a decrease of latitude might be deduced. The question turns on whether the truest result is obtained by trusting entirely to Polaris, or by including other stars which are at greater N.P.D. and have more variation in the refraction: as the former is less dependent on the most uncertain element of reduction—refraction—I inclined to rely on it entirely. It would be remarkable if the great oceanic circulation should have a mean axis of motion so nearly coincident with that of the earth as not to produce 1/100th of a second change in the Pole during half a century; the presumption would seem against such a fixity. W. M. FLINDERS PETRIE

Bromley, Kent

To Find the Cube of any Number by Construction

CAPT. H. BROCARD (of Montpellier), writing to me on the subject of my note in last week's NATURE (p. 539), communicates the following two simple constructions:—

1. On two rectangular axes Ox, Oy, take A on Ox and B on Oy, such that $\angle OAB = \alpha$, through B draw $BC \perp^r$ to AB, meeting OX in C, and draw $CD \perp^r BC$, meeting OY in D: join AD. Then $\tan OAD = \tan^3 \alpha$.

2. Take $BOD = \alpha$, from A on OD erect $\perp^r$ to meet OB in B: draw $BD \perp^r$ to OB, and let fall $AC \perp^r$ to BD. Then if we take $OA' =$ unity (A' is the projection of A on OB), $BC = \tan \alpha$, $A'B = \tan^2 \alpha$, $CD = \tan^3 \alpha$.

It may be of interest to note with reference to the figure indicated in my construction, that M. Brocard finds that if $FK \perp^r FD$ meets CB in K, and $KL \perp^r FK$ meets FO ($\perp^r BC$) in L, then LD passes through H.

October 6 R. TUCKER

THE ASCENT OF WATER IN PLANTS

THE fact that water is taken up by plants and passes off as vapour at the leaves is one of the best known data of vegetable physiology. The current of water passing up the stem of the transpiring plant is known, moreover, to be copious and rapid, and to pass through certain parts of the wood only. Apart from other questions, it has long been sought to explain by what forces this current can be maintained in the plant, and the difficulties which have arisen and been surmounted have been many; certain of these difficulties, however, are still outstanding.

It was an immense stride forwards when the fact was demonstrated that the water absorbed by the roots passes up the stem in the younger wood; and when it was recognised that in the Conifers this consists of definite elongated cells, not openly communicating, and is not complicated by the presence of vessels, &c., the problem promised to be much simpler.

As is now well known, the earlier hypotheses which were made to explain the ascent of water in transpiration have been long put aside, as new facts were observed which could not be satisfactorily explained by them the old theory of capillarity succumbs evidently to the facts; and Quincke's hypothesis, though less easily despatched, must also be relegated to the list of past errors.

Two theories, or rather hypotheses, have attracted so much attention lately, that we may fairly regard them as the two rival views for the explanation of the ascent of the transpiration current. The one, especially advocated in its earlier shape by Boehm, seeks to explain the ascent as due essentially to the pressure of the atmosphere acting on a system of air-bubbles and water which can be shown to exist in the plant: this hypothesis, but shortly stated here, is obviously in contradiction to several important facts, *e.g.* the height of tall trees, and the difficulty of explaining how the atmospheric pressure could act on the closed system of the plant.

The second, and very different hypothesis, is the one recently proposed by Sachs. Assuming that the molecules of water imbibed by the wood cell-walls are held between the complex molecules of these walls in a peculiar condition—very much, in fact, as salt molecules are held between the molecules of water in the sea—then the difficulties in connection with tall trees disappear; for by the peculiar properties of the wood cell-walls it matters not whether a given molecule of water is a yard or a hundred yards high. This hypothesis undoubtedly explains numerous facts, and, if choice lay between it and the theory of atmospheric pressure only, no doubt could exist as to which we should accept; nevertheless, there are objections to it apart from the assumption of such very peculiar properties of lignified walls.

Before saying anything as to the possible modifications of the former theory, it will be well to see how it arose in the first instance.

Jamin, in the *Comptes Rendus* for 1860, published an investigation on some capillary phenomena, and particularly on the behaviour of capillary tubes containing air-bubbles in addition to water.

Suppose an open capillary tube of glass filled with alternating drops of water and bubbles of air. If pressure is exerted at the one open end of such a tube, of considerable length, it is observed that the pressure is not transmitted simply through the system, but that each successive one of the alternating columns of water causes a lessening of the effect. Of course each column of water, between two air-bubbles, has two concave ends, and the changes produced in these can be observed. Without here going into the explanation of this phenomenon of the apparent disappearance of the pressure, it suffices for our purpose that an open column consisting of air-bubbles alternating with drops of water may be placed upright and the water not flow out. Jamin showed that with long tubes, the water-columns of which were sufficiently broken by air-bubbles, even a pressure of three atmospheres applied to one end failed to move the lower parts of the column. Such a column of alternating drops of water and air bubbles is called a "*chapelet de Jamin*."

It is known that porous bodies, such as gypsum, absorb water with great force: such bodies when saturated with water are very impervious to air, a fact which may be illustrated by means of the wet linen in any wash-tub. Jamin even proposed an explanation of the ascent of water in accordance with these facts, regarding the wood simply as a porous body.

It is not necessary to go into details as to the various modifications of the theories which in any way depended upon ordinary capillary phenomena; enough that the objection that, even if the plant had capillary tubes sufficiently fine to support the water columns required by a tall tree, the water could not flow through them so rapidly as the requirements of respiration demand seemed fatal to any of these theories, and made Sachs's assumption of the extraordinary properties of wood cell-walls appear the more necessary. Moreover, the Conifers have no such capillary tubes in the secondary wood.