LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Transpiration into a Space Saturated with Water.

FOR some time past[1] I have been endeavouring to decide whether the energy used in raising the water of the transpiration current is derived solely and directly from the inflow of heat at the evaporating surfaces of the leaf-cells, or whether stored energy (*i.e.* vital force) is in any way responsible for work done.

It has been observed that plants transpire into a space saturated with moisture. But I am not aware that it has been pointed out that this transpiration will continue even when no light falls on the leaves. Without this precaution we cannot assume that the space is really saturated at the surface of the leaves; for they will convert some of the light into heat, and so lower the state of saturation at their surfaces.

In my experiments small leafy branches were cut and set in a watery solution of eosin under a glass receiver. Beside the vessel containing the eosin, and under the receiver, a beaker filled with boiling water was placed. The receiver became immediately filled with water vapour, and, as the space was continually falling in temperature, owing to the cooling of the beaker, it remained always in a state of saturation. These arrangements were made in a feeble light, and then the receiver branch and all were set in total darkness. It is to be mentioned that a wet board cut off the direct radiation of the beaker from the branch. After an hour it was found that the eosin had risen into the leaves of the branch. In order to ensure that this rising was not due to reduced air pressure, previously obtaining in the water conduits of the branch, experiments were made in which any reduced pressure was equalised by setting the branch for one hour standing in water under the receiver, before setting it in eosin. The same result was obtained in these cases.

The raising of the eosin in this experiment seems probably due to a pumping action in the cells of the leaf, depending upon vital processes taking place there. This surmise is confirmed by the fact that the elevation of the eosin does not take place in a saturated atmosphere if the leaves have been killed. This may be proved either by leaves killed by immersion in water at about 90° C., or by exposure to chloroform vapour.

If the pumping action be a "vital" process we would expect it to be dependent upon a supply of oxygen, like growth and grotropic curvatures, &c. We, in fact, find this to be the case. Thus a branch wholly surrounded by water will draw up eosin from a vessel below, if exposed to light. The raising of the eosin will be but little if the light be cut off from the submerged branch. The action of light supplies the leaves with oxygen set free by assimilation; in the dark, however, the leaves can only obtain the small amount of oxygen dissolved in the water, and perhaps a little, too, derived by intramolecular respiration. With this limited supply the elevation of the eosin is inconspicuous.

The oxidising processes taking place in the leaf-cells must bring about some minute rise in temperature. This will, of course, favour evaporation. But I think this effect would be far too small to account for the whole phenomenon of transpiration into saturated spaces, as I have here described it.

That a very considerable amount of the pumping action is located in the leaves, may be shown by employing large leaves set upright in the eosin. It will be found that in a dark saturated space the veins of such large leaves severed from the stem will quickly become injected with the colouring fluid.

HENRY H. DIXON.

Trinity College, Dublin, December 14.

The Zeeman Effect Photographed.

IN the number of NATURE issued on September 2, 1897, a short account is given (p. 420) of the recent work which has been done in the study of "the radiation of light in the magnetic field," and it is there remarked that it would be very desirable if the effects described by Prof. Zeeman were reproduced by photography. This, indeed, appeared to be all the more necessary in consequence of the doubts expressed and entertained as to whether the effect was a simple broadening of the spectral lines, or the production of doublets and triplets, or a combination of both effects. I accordingly availed myself of the opportunity afforded me, through the courtesy of the Royal University, of using for this purpose the splendid Rowland's concave grating mounted in the Physical Laboratory at Earlsfort Terrace, Dublin.

After the usual amount of preliminary difficulties and failures, I have finally succeeded in actually photographing all the appearances described by Prof. Zeeman, and I herewith enclose three small negatives which show the general character of the phenomena, and verify Zeeman's observations.

I do not now propose to enter into any particulars as to measurements, &c., so I shall merely describe the photographs.

The line represented is the violet line of cadmium which lies nearest to the blue, its wave-length being 4678. Plate A is taken with the slit viewing the spark *across* the lines of force of the magnetic field. The electro-magnet being excited, we have the triplet marked 1. The current was then turned off, and 2 was taken, which shows the line in its normal condition. A nicol was then inserted between the lens and the slit, and 3, 4, 5 were taken. Of these 4 shows the line when the magnet is not excited, while 3 and 5 were taken with the magnet excited. The position of the nicol in 5 was at right angles to that in 3, and as in 5 the side lines of the triplet have disappeared, it is proved that they are plane polarised. A faint middle line is shown in 3, but in my other photographs this line of the triplet is very weak, showing that it is mainly plane polarised in a plane at right angles to that of the side lines of the triplet. This is shown more distinctly in plate B, where 6 and 8 were taken with the excited field and the nicol interposed, the position of the nicol in 8 being at right angles to that in 6. The line marked 7 was taken with the magnet unexcited.

The third plate, C, was taken with the slit viewing the spark *along* the lines of force in the usual way through an axial aperture in one of the pole-pieces. In this plate the line marked 9 was taken with the magnet unexcited, whereas 10 was taken with the field excited. The latter is a distinct doublet, and a photograph which I took to-day with a quarter wave-plate and a nicol interposed, shows that the lines of the doublet are circularly polarised in opposite senses.

I wish to thank Dr. W. E. Adeney, the curator of the University laboratories, by whom the grating was mounted, for all the trouble he took to facilitate my work, and also Prof. Barrett, of the Royal College of Science, who kindly lent me his electro-magnet.

THOMAS PRESTON.

P.S.—You will observe that all the effects described above are clearly visible on the plates (which I have forwarded) by aid of any ordinary magnifying glass. They lend themselves admirably to lantern projection, and when thrown on a screen the effects may be shown to a large audience. It is to be clearly understood, however, that the description above applies to this particular line (it is also true for other particular lines); but it is not implied that the same effect precisely is produced in every other line, either of the same or of different substances.

I am making further observations on this latter point, and hope to publish my results shortly.

T. PRESTON.

November 19.

[The negatives referred to by Mr. Preston show clearly the effects described, but they do not lend themselves to satisfactory reproduction, even when enlarged.—ED. NATURE.]

The Small Tortoiseshell Butterfly in December.

I SEE in more than one daily paper of this morning's date a paragraph announcing the appearance of a small tortoiseshell butterfly in Highgate Police Court yesterday as something unusual.

This butterfly is more or less common wherever nettles grow freely, and there is a succession of broods throughout the fine season, the last of which hibernates and reappears early in spring (in mild winters in the southern counties as early as February, or perhaps occasionally even in January). It is easily disturbed in its winter quarters, so there is really nothing surprising about its appearance now. The small tortoiseshell is usually one of the latest butterflies to retire from notice in autumn, and one of the first to reappear in spring.

Chiswick, December 21.

W. F. KIRBY.

[1] *Cf.* Report of a Discussion on the Ascent of Water in Trees, *Ann. of Bot.*, December 1896.

© 1897 Nature Publishing Group