

one another. The fainter series are attributed to interference. In bright rainbows there are three, if not four, series of colours, at least in the upper part of the arch, where the colours are always the most distinct, probably owing to the rain-drops being smaller high up, and therefore more perfectly globular. It may not be generally known that a rainbow may be seen much more perfectly in a single drop of dew, by placing the eye close to it, than in rain, and then no less than ten or twelve series of colours may be seen; and in the irregular dew-drops (as also in hoarfrost) a great and very beautiful variety of bows and spectra can be seen.

T. W. BACKHOUSE

Sunderland, Sept 23

I SHOULD like to say a few words regarding Mr. Swettenham's letter (*NATURE*, vol. x. p. 398). The mathematical theory of the rainbow has been worked out pretty completely. We must not look for it, however, in text-books, which generally give a very unsatisfactory account of the rainbow, but in the original memoirs, which sometimes are very difficult to find.

The appearance of coloured bands inside the primary rainbow is not at all of very rare occurrence; since my attention has been drawn to them by a casual observation, I have seen them repeatedly. Only a few weeks ago I saw distinctly three concentric bows, with all the colours inside the primary bow. These bows have been called supernumerary rainbows. The complete mathematical theory has been given by the Astronomer Royal in the *Philosophical Magazine*, and the theory has been verified by Mr. Miller. The cause of these coloured rings is the interference of two rays of light entering the rain-drop at different angles of incidence, but having the same deviation, and therefore leaving the rain-drop parallel to each other. It is clear that two such rays must exist for all deviations from the maximum to the deviation of ray of light having an angle of incidence of 90°.

In text-books no mention is ever made of these supernumerary rainbows, and this is the more to be regretted as the interference mentioned above is, I think, one of the principal causes of its formation.

Were the explanation given in text-books complete, we should not have in the rainbow such pure colours as we actually see, but the yellow would contain a great deal of red, and the green would be contaminated by a great quantity of red and yellow. As it is, however, the red, which would have the same deviation as the green and yellow rays, is destroyed, or nearly so, by interference, which, therefore, is the cause that the colours of the rainbow are nearly pure. What is called the violet of the rainbow is generally the violet mixed with the red of the next supernumerary rainbow. This is not the only instance that text-books contain incomplete accounts of phenomena which have been satisfactorily explained.

ARTHUR SCHUSTER

Sunnyside, Upper Avenue Road

#### Mist Bows

ON Sept. 14 I was driving from the Lizard just after sunrise with Mr. Lugg of Manaccan. A thick mist covered the fields and moorland. The tops of the farm buildings and corn stacks and the church towers were visible above the sea of mist which, matted on the ground, gave the entire country the appearance of being covered with snow. About 6.30 A.M. the sun was bright on our right hand, and on the left we saw a halo of prismatic colours forming a distinct circle of rainbow at a little distance from and encircling the shadows of our heads, and only broken where the shadows of our bodies interposed. This appearance lasted for ten minutes, and our shadows with their attendant bow showed brightly against the mist background as we passed hedges and fields, and kept pace with us like "the mist raised from the plashy earth" by the hare in Wordsworth's poem,

"That, glittering in the sun,  
Runs with her all the way wherever she doth run."

We afterwards opened a valley terminating in an extensive moor, when the mist appeared as a sea of prismatic colour extending to the horizon. About 7 A.M. we saw a perfect bow free from any prismatic colour, both ends of which terminated in the field immediately to our left.

My companion, who is constantly driving about this district in early morning, says he never before saw similar phenomena.

Lizard Signal Station, Sept. 16

HOWARD FOX

#### Carnivorous Plants—how to be obtained

IT is not unlikely that there may be a great demand for plants of the genus *Drosera*, and as I am in a neighbourhood where

the supply of the *D. rotundifolia* and *D. intermedia* is inexhaustible, I shall be glad to send, through the post, plants of the same to any who are desirous of investigating their carnivorous habits; but to meet the necessary expenses of collecting and postage, six penny stamps must be enclosed in the application for each dozen plants. The applications of dealers in plants will not be attended to.

The *D. intermedia* is far more abundant than the *D. rotundifolia*, and will answer the purpose of investigators quite as well. A few words about the method of growth of these may not be out of place. Pure peat well soaked with water suits either kind, but while the *D. intermedia* flourishes with its roots beneath the surface of the water, *D. rotundifolia* grows best when it is from 3 in. to 4 in. above the surface; now and then it happens that it is found with its roots in the water, and then the hairs on the stalks of the leaves, which constitute one of the distinguishing features between these species, are much diminished, both in number and length.

The Liverpool naturalists will find a large supply of the *D. rotundifolia* on Oxtan Common, and there they are most abundant in the corner nearest to Noctorum Farm. Thurstaston Hill is another locality in the same neighbourhood where this plant grows.

The *Pinguicula lusitanica* is not uncommon in the bogs of the New Forest, but I cannot promise specimens of this plant with the same certainty as I can those of the *Drosera*. Applications for plants had better have the word *Drosera* written on the envelope, to prevent the delay which would arise from such letters being forwarded to me when away from the New Forest.

Bisterne Close, Burley, Hants

G. H. HOPKINS

[Both species are moderately abundant, though small, in a peat-bog near Burnham Beeches, Bucks, about four miles from Slough.—ED.]

#### Automatism of Animals

PROF. HUXLEY'S most interesting address published in *NATURE*, vol. x. p. 362, seems to me to involve some difficulty, which I take the liberty to state, though well aware that I am stepping on slippery ground. I allude to this passage:—"Suppose I had a frog placed in my hand, and that I could make it, by turning my hand, perform this balancing movement. If the frog were a philosopher he might reason thus: 'I feel myself uncomfortable and slipping, and feeling myself uncomfortable I put my legs out to save myself. Knowing that I shall tumble if I do not put them further, I put them further still, and my volition brings about all these beautiful adjustments which result in my sitting safely.' But if the frog so reasoned he would be entirely mistaken, for the frog does the thing just as well when he has no reason, no sensation, no possibility of thought of any kind."

Now, does it unavoidably follow from the latter fact that this philosophising frog would be *entirely* mistaken? What I should venture to object is simply this:—Experiment shows, indeed, that very delicate combinations of muscular actions (as in swimming) are brought about by impressions upon the sensory nerves, even when, after ablation of the brain, there can be no longer any consciousness. But have not those combinations originally arisen during undisturbed consciousness, and therefore, perhaps, under the influence of consciousness, inscrutable as the relation of consciousness to corporeal phenomena is acknowledged to be? And even if the experiments alluded to should succeed with animal individuals which, before vivisection, never had executed the movements in question (and I was once assured by a distinguished physiologist that similar experiments do really succeed with rabbits deprived of part of brain soon after birth), yet those adjustments may be rather considered with regard to the great principle of inheritance, as it has been applied to instincts by Mr. Darwin and Mr. Spencer, and alluded to in Prof. Tyndall's address. Though now performed by animals without possibility of sensation and thought, those movements were adjusted to each other, and to impressions on sensory nerves in these animals' ancestors while in possession of consciousness.

Surely such questions will ever remain doubtful; yet I think it not unbecoming to state a view of them which seems to me to be in accordance with the present direction of biological theories.

I. D. WETTERHAN

Frankfort-on-the-Maine, Sept. 20