

which it has imposed upon itself. However much we may marvel, we must allow that this is a fact of experience, and as inductive science is founded on all the facts that can be obtained, the spontaneous movement of living protoplasm can no more be omitted than the absence of initiative in non-living matter. So that, although we cannot explain how mind influences protoplasm, we must acknowledge that it does do so. Variations may depend upon the amount of stimulus received by the mother cell, and they may be developed automatically by selection, but neither selection nor stimulus can originate new processes or new structures. It is impossible to suppose that the external physical agencies, when they act upon protoplasm, antagonise their actions by forming chemical or physical combinations, for this is so different from what happens with dead matter. Dead protoplasm can no longer resist the attacks of other organisms, and it is only by undergoing the process of assimilation that it can be revived. If there is any truth in Mr. Herbert Spencer's definition of our conception of life as the continuous adjustment of internal to external relations, it follows that living protoplasm must be free to adjust itself. But whether these adjustments were intelligent and purposive or whether they were due to haphazard gropings after change is a separate problem which still requires solution. All that we can say at present is that while dead matter is subject altogether to fixed laws, living protoplasm is, to a certain extent, free to act. To it has been given the power of adaptation or antagonism to the physical laws which the rest of nature obeys implicitly. Ever since living matter appeared on the earth a constant war has been waged between dead and living matter, and mind has won, the result being biological evolution. Chemical affinity has been taken advantage of by mind to protect itself from enemies. Physical energy has been used to break down chemical affinity, and then mind has been able to lay up a store of potential energy. But it has overcome the physicochemical laws only by obeying them, and this has given rise to the illusion that it is not free but subject to fixed law, like dead matter. This, however, cannot be the case. At first mind was free to act, but constant repetition of the same experiences made it an apparent slave to the physical forces, although when attention was occasionally called into action by new external irritants it again reasserted itself. But this was followed by relapse. The cooperation and concentration of nervous matter, however, still went on until, in the brain-cortex, attention developed into consciousness, and in the large cerebrum of man, mind has once more passed into its original free state. It is this form of volition that we call free-will.

Such I believe to be the full scope of Prof. Hering's theory. I must confess that I have gone beyond his address, and I do not know that he would agree to all that I have said. But it is evident that we must either assume a freely acting mind as the mainspring of organic development, or we must try to explain it on a purely mechanical basis, a task which appears to me to be quite hopeless.

F. W. HUTTON.

Canterbury Museum, Christchurch, New Zealand.

Curious Shadow Effects.

I THINK that the following is probably the explanation of the phenomenon referred to in NATURE of February 4—the seeing of more shadows than your own.

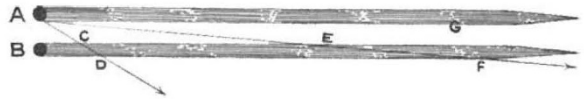
A and B are neighbouring observers; their shadows make dark tunnels in the illuminated mist.

Usually, the eye cannot penetrate far, and if A is to see his neighbour's shadow he has to look across it, as along ACD, and the layer CD is too thin to be noticeable. Or, if he can see further, as along AEF, the glare of the illuminated mist between A and E may prevent him from noticing the thicker dark layer EF. He sees his own shadow because he looks more or less along it. But under suitable conditions his eye may be able to penetrate so far that he can see the thicker layer EF of his neighbour's shadow, while yet there is not much glare near at hand, i.e. in the part AE, to dazzle him; the mist in this region may be very thin. [The diagram does not represent clearly the way in which the shadows "tail off" and vanish at a certain

distance owing to the finite angular magnitude of the sun.]

If the angle GAE be not too great, A will see B's shadow within his own halo.

This halo I have always taken to be the ordinary rainbow. It may look small, but the true criterion is its angular



magnitude. This would not, however, explain the oval bow spoken of in NATURE, January 28.

W. LARDEN.

Devonport, February 5.

It is obvious that the bow seen by Mr. Warner and described in NATURE of January 28 (p. 296) was the "Ulloa's ring," the "Nebelbild" or "Brockengespenst" of the Germans, fully explained by Fraunhofer. The oval form is a necessary consequence of our seeing the sky as a depressed vault or segment of a hollow sphere, as I have demonstrated it in my "Meteorologische Optik," I. Abschnitt, p. 29 ff.; see especially p. 33, Fig 5.

I beg to answer also Mr. John A. Harvie Brown's question on shadows in the "Brocken," asked in your issue of February 4. He says:—"How was it that more than one image was visible to each of our party?" Mr. Harvie Brown states that "not one of us saw more than one set of concentric rainbow bands or circles." The answer seems to be simple. The shadows are objective, and therefore visible to everyone; the coloured circles are only subjective, and consequently one person sees only one set of rings. I know that in text-books one reads the statement, "the observer of a 'Brocken' cannot see his companion's shadow," as, for example, in Müller's "Kosmische Physik" (even in the edition of 1894), but this is evidently erroneous.

Wien, Hohe Warte.

J. M. PERNTER.

THE staff of the Ben Nevis Observatory have had frequent opportunities of observing the coloured shadows formed round shadows thrown on mist or fog-banks; notes descriptive of these "glories," as we termed them, with measurements of their diameter, will be found in the extracts from the log-book printed with the other Ben Nevis observations (see Transactions Royal Society Edinburgh, vols. xxxiv. and xlii.). In each ring of these glories the red of the spectrum colours was outside and the blue inside, as in the primary rainbow, and as many as five successive rings of colours have been observed.

The outside diameter of the largest ring never exceeded 12°, and was more usually about half that amount. Glories are thus of the same order of size as the coronæ frequently seen round the sun or moon, and are distinctly smaller than halos, the ordinary halo having a diameter of about 44° (radius 22°), while rainbows and fog-bows are, of course, larger still.

In respect to Mr. Warner's letter, I may say that no oval-shaped glories have been seen on Ben Nevis, but other observers have described them, and a possible explanation may be that a circular ring is formed on a surface at right angles to the sun's rays, but the observer assumes that the ring is formed on a vertical surface, and therefore it appears oval to him. However, the low angle of the sun's rays at Christmas time does not differ sufficiently from the horizontal to cause in this way the elongated oval shown in Mr. Warner's sketch; there must be other factors to consider.

With regard to the shadows of other persons, our experience on Ben Nevis was that if the fog-bank was a considerable distance away, the shadows of others could be seen just as on a wall; but if the fog was close to the observers, the only shadow seen resembling a human figure was one's own. Sometimes, however, when a thin fog was close to us on one side, and bright sunshine on the other, I have seen the shadow of a man standing 10 or 20 yards away as a dim dark streak running back into the fog. The shadow, in fact, was not formed on any definite surface, but was a