

would have no doubt incited his just indignation if it had been performed by his friend "Sludge," of spiritualistic celebrity.

I cannot help remarking on the coolness of Prof. Lankester's assertion, that my views are "undeniably based upon a mistaken interpretation of defective preparations." Prof. Lankester evidently thinks his opinion final—but he is bold to say it is "undeniable."

My sections have been seen and approved of by a great number of competent histologists and zoologists, and, although some of them are not so pretty as those prepared by the paraffin method which Prof. Lankester extols, they certainly show a great deal more. The paraffin method is well known to me, and I have examined a great number of slides prepared by it. I have possessed a series of sections so made in the Cambridge laboratory by an excellent histologist, and have rejected them as worthless: they show nothing but the connective tissue framework. Nerve fibres and nerve end organs are alike destroyed.

The whole question of the effect of reagents on the tissues is a wide one. The paraffin process destroys much which remains in the cocoa-butter process, first devised by Prof. Schäfer. I esteem this process far superior to that now used in the laboratory at Cambridge, and by Prof. Lankester and his assistants. I should not fear to place my specimens side by side with Prof. Lankester's before an unbiassed histologist; and I am content to wait the decision of future observers upon my work. New views are met with little favour by those who are committed to old ones, and, whether I am right or wrong, I expect no justice from a critic who shows such determined bias as Prof. Lankester.

BENJAMIN T. LOWNE

If Prof. Lankester imagines that he has any complaint to make against the Council of the Linnean Society for having published Mr. Lowne's paper, I must decline to consider the subject with him in your columns. He is himself a Fellow of the Society, and the anniversary meeting of the Society is due next month. If he then thinks it wise to ask any questions upon the subject, I shall be in my place and most happy to answer them.

GEORGE J. ROMANES,
Zool. Sec. L. S.

How Thought presents itself among the Phenomena of Nature

IN your issue of the 12th inst. the Duke of Argyll asks, "Is there any difference in this respect between molar and molecular motion?" namely, as regards the persuasion which most men entertain that where there is motion there must be some "thing" to move. The answer to this question appears to be the very direct one that there is the following fundamental difference between molar motions and *some* molecular motions, and that it intimately concerns that belief. *All molar motions are secondary motions, i.e. they consist in the drifting from place to place of underlying motions (and, indeed, in the case of those motions which human beings can perceive even with the utmost aid of the microscope, they consist in the drifting from place to place of vast accumulations of such underlying motions), while, in contrast to this, there are some molecular motions which are primary—i.e. which have no other motions underlying them, and which do not consist in the drifting from place to place of more subtle motions.*

His Grace correctly expresses the common opinion in the following words—that "an atom¹ is only conceivable as an ultimate particle of matter." Now the term "particle of matter" in this statement needs to be scrutinised. As commonly understood, it means something minute which we should be able to feel or see or perceive by some of our senses were it not for the bluntness of those senses; and this, as science shows, means that

¹ The Duke of Argyll here employs the word "atom" in its etymological sense; and it is scarcely necessary to point out that the term when so used signifies a different thing from any of the sixty-seven complex bodies known to chemists as chemical atoms, which have intricate internal motions as betrayed to us by the spectroscope, and of which the molecules of compound bodies are known to be made up. The chemical "atom" could not under any view be spoken of as an *ultimate* particle of matter.

I understand the Duke of Argyll to propose these words as a description (not of anything the existence of which has been ascertained by experimental science, but) of that substance, matter, or thing the conception of which he and most other men believe to be the "inseparable concomitant" of the conception of motion, but for the existence of which in external nature no other evidence is forthcoming than this supposed law of human minds.

Now, even if the supposed law were a law from which we could not free ourselves, it might reasonably be maintained that it proves nothing about external existence; but in truth it is not a law, but only a widely prevalent habit of mind, as is *demonstrated* by the fact that the study of nature has extricated some minds from it.

certain specific motions are present, viz. motions of those particular kinds which are competent, indirectly and through a long chain of intermediate steps, to finally occasion visual, tactual, or some other sensation in our minds. The statement, accordingly, as commonly understood, *really* amounts to this—that no motion can be present unless certain underlying motions are also present!

But to the un instructed apprehension the statement has quite a different meaning, a much fuller one, and one which lies outside the domain of motion. Before they have made very careful investigation, men do not know that there is no green colour in grass or hardness in a rock. They are unaware that what is really going on in the grass is not a state of greenness, but vast myriads of motions,¹ each of which is repeated about as often every second as there are seconds in thirty millions of years, which motions in the grass occasion undulatory motions around of a like rapidity, some of which occur within our eyes, and, acting upon some compound or compounds in the black pigment which lies behind the retina, produce there an effect (probably a fugitive photographic effect consisting in some chemical change of one or more of three compounds in the pigment). This change, whatever it is, excites the optic nerve to make a stir within the brain, and *it is this last motion* (which we may safely say is utterly unlike the external phenomenon, though uniformly resulting from it through the steps enumerated above), which is what determines the perception of green in our minds. Similarly, when the vast accumulation of molecular motions which is called my finger approaches that other accumulation of motions which is called a rock, these motions act on each other, and my finger is compressed upon certain nerves, exciting them to produce those motions within my brain which, though quite unlike the motions outside, are the motions that are really accompanied by the sensation of hardness. But by un instructed minds the colour of the grass and the hardness of the rock are confidently believed to be external phenomena, and not even phenomena of motion at all, but absolutely stationary phenomena in external Nature.

Finally, we must never forget that beliefs in the human mind, whether they be pure or mixed up with errors, can neither control nor even exercise any influence whatever upon what is really taking place in external Nature, which is the object of our investigation. What is really going on in Nature is to be ascertained, so far as it can be ascertained at all, not by projecting human beliefs into external existence, but by applying whatever modicum of dry light we can win from the slow but gradually encroaching progress of scientific discovery. And the necessity for this caution is intensified where we find, as in the present instance, that the belief has resulted from the way our brains and the brains of our ancestors have grown, under the influence of an experience of motion which has been so one-sided that it has never extended to primary motions at all, nor even to any but very coarse forms of secondary motion, omitting, along with many others, all those motions, whether primary or secondary, that occasion most of our sense-perceptions; and all this, combined with suppositions about other phenomena in which these phenomena have been quite misunderstood. Scientific scrutiny, so far as it has penetrated, finds motion throughout external Nature—motions everywhere, motions underlying every phenomenon, however different from motions some of them may seem to common apprehension; and no *scientific* investigation has as yet detected anything but motions. This is the positive side of the inquiry; and its negative side is that it would be manifestly illegitimate to draw an inference about what really exists outside us from the habits of thought which have been engendered in most human minds by a narrow and one-sided experience mixed up with palpable errors. *We, therefore, are not in a position to allege that we know of anything existing in the outer world but motions and relations between motions.*

The abstract of my Royal Institution discourse, which you were so good as to publish, only attempted to give a bare statement of the successive steps of the argument with which it deals, and I fear it is too condensed for clearness; but, as I am myself persuaded that the argument is sound, I hope that your correspondent will find that a fuller account of it which I am preparing will put all its essential parts in a sufficiently distinct light.

Dublin, March 20

G. JOHNSTONE STONEY

¹ The relations which the parts of motion can have to one another or to other motions are all numerical or space and time relations. Motions may be numerous, few, simultaneous, successive, straight, curved, flat, tortuous, swift, slow, periodic, continuous, linear, or pervading a volume; but they cannot be green motions or hard motions.