

to the untechnically instructed. Its natural meaning implies echo or reverberation, and has a definite relation to sound. Now, although a sort of reverberation or repetition is part of the effect intended to be denoted by the phrase resonance, yet the most essential feature of that phenomenon, and the one most to be emphasized in the recent extensions of the term, viz. the accord of frequency or similar tuning between two vibrators, is not connoted at all. Hence, even in acoustics the term is hardly satisfactory, while its extension to other departments of physics may be misleading.

It was suggested, however, by Dr. Arthur Myers, that the existing word *ὀρρωτος* has almost exactly the right connotation, and has no special limitation to sound; while the derivatives *syntony*, *syntonic*, and *syntonise* may readily become English without exciting repulsion.

The adjective "symphonic," suggested by the reporter of the Physical Society, does not strike me as so good, because it specially refers to sound again, and because the word "symphony" has already another definite meaning.

July 10.

OLIVER J. LODGE.

#### Force and Determinism.

I DO not think there are many non-physicists who will attempt to gainsay the fact that, under physical constraint, the direction of motion may be determined without affecting the quantity of the energy concerned, and without expenditure of energy. This is seen when the earth and sun revolve around their common centre of gravity, or when I twirl my stick around my finger and thumb; the earth and sun in the one case, and the ferrule and knob of my stick in the other case, being bound into one system physically. But I do think that an able and clear-headed physicist like Dr. Oliver Lodge would be doing a great service to non-physicists if he would, in your widely-circulated columns, explain and solve, shortly and in non-technical language, the difficulties which trouble some of them; aiding them, for example, to comprehend the exact force of the words expenditure of energy, and helping them to see that in all known cases of change of direction of motion such change is effected under physical constraint. It is when they are told by a certain class of metaphysicians, who quote, or misquote, physics in support of their assumptions, that physical motion is controlled by will-power or volition, always acting at right angles to direction of motion, and therefore leaving the amount of energy unchanged; it is *then*, I say, that they begin to grow restive, and to demand definite and verifiable evidence that such metaphysical constraint is (*pace* Sir John Herschel) a necessary or philosophical conception, and that it is impossible to explain the phenomena without having recourse to it. If Dr. Lodge would consent to help non-physicists in this way, and would indicate what are the "important psychological consequences" to which he alludes, he would be doing some of us a good turn.

C. LLOYD MORGAN.

University College, Bristol.

As Prof. Lodge says he is glad to see that his statement, "although expenditure of energy is needed to increase the speed of matter none is required to alter its direction," called in question, and as he has so kindly answered one letter on the subject, may I ask him to criticize the following remarks?

The theory of kinematics is based on certain geometrical concepts, which may be summed up in the term space, and on the concept of time. The laws of motion, together with the assertion that mass is not a function of space or time, may logically be regarded as implicitly defining mass and force. Energy may similarly be defined, in terms of these kinematic concepts, as  $\Sigma mv$ . For I think the progress of science is tending to show that the term "potential energy" is only a cloak to cover our ignorance of the kinetic energies which for the moment have escaped our ken. But in any case the statement quoted is logically only a truism, deduced from the definitions of its terms, and is therefore indisputable in all mechanical theorems. But if it is to be applied outside the sphere of pure mechanics, the moral will lie in the application of it—that is, it will be necessary to examine, before applying it to any new subject-matter, whether the definitions from which it was deduced apply to that subject-matter or not.

For example, by the third law of motion, mechanical force only acts *between two masses*, the momenta generated in them being equal and opposite. If, therefore, psychic force is to

come under the definition of mechanical force, it can only act *between* two particles. And, therefore, if psychic force is to do no work, by reason of its always acting in a direction normal to the path of a particle, it can only act between two particles whose paths happen to have a common normal—an occurrence which must be infinitely rare.

EDWARD T. DIXON.

12 Parkston Mansions, South Kensington, July 4.

#### Magnetic Anomalies.

THE discovery of very strong magnetic anomalies between Charkov and Kursk in Russia, to which A. de Tillo has lately referred in the *Comptes rendus* and in NATURE, raises the question whether the values there observed are strictly local, or extend over a relatively wide area. Thus, it would be of great interest to know if, on moving, say, some metres away from a station, the declination and inclination hold the same value. If not, there is clearly some cause which acts at a short distance; but if constancy is observed, a great step would be taken towards the settlement of the question as to the existence of strong variations common to a wide area.

When magnetic anomalies are observed, the first thing to be done is to ascertain whether the values found in a given locality have a definite meaning—that is, whether they do not change for slight displacements; otherwise, the determination of the magnetic elements has no meaning, as it is impossible to refer them to geographical co-ordinates.

The overlooking of this precaution has often led to serious mistakes.

ALFONSO SELLA.

Biella, July 4.

#### Physical Religion.

AS a constant reader of NATURE from its commencement, and the possessor of its forty-three and a half volumes, I venture (after reading the review of "Physical Religion" in this week's number) to ask if it is intended to develop it into a theological journal. Because, however smart it may be to abolish Abraham without "even taking the trouble to discuss" him, or to dispose of *Lux Mundi* in a contemptuous sentence, it is hardly in accordance with scientific methods.

It is curious that many "Agnostics," though by their own showing (if they would talk Latin instead of Greek) they are *Ignoramuses* at best, should be so certainly sure of everything, when a little reflection and modesty might satisfy them that as "*Know-nothings*" (in plain English) they have no more right to *deny* than to *assert*.

The standing motto of your title might be improved by the addition of "*Ne supra crepidam sutor.*"

Hampstead Heath, July 11.

B. WOODD SMITH.

#### SOME APPLICATIONS OF PHOTOGRAPHY.<sup>1</sup>

ONE of the subjects to which I propose to invite your attention this evening is the application of instantaneous photography to the illustration of certain mechanical phenomena which pass so quickly as to elude ordinary means of observation. The expression "instantaneous photography" is perhaps not quite a defensible one, because no photography can be really instantaneous—some time must always be occupied. One of the simplest and most commonly used methods of obtaining very short exposures is by the use of movable shutters, for which purpose many ingenious mechanical devices have been invented. About two years ago we had a lecture from Prof. Muybridge, in which he showed us the application of this method—and a remarkably interesting application it was—to the examination of the various positions assumed by a horse in his several gaits. Other means, however, may be employed to the same end, and one of them depends upon the production of an instantaneous light. It will obviously come to the same thing whether the light to which we expose the plates be instantaneous, or whether by a mechanical device we allow the plate to be submitted to a continuous light for

<sup>1</sup> Friday Evening Discourse, delivered at the Royal Institution of Great Britain, on February 6, 1891, by Lord Rayleigh, F.R.S., Professor of Natural Philosophy, R.I.