On Adhesion Figures

A DROP of crude carboic acid placed on the surface of cold water exhibits the most surprising and beautiful "cohesion figures." I am not aware that Mr. Tomlinson has described the behaviour of this substance. So lively and unpredicted are the movements of the drop that its action resembles that of a living creature. At first it pulsates, then its edge breaks up into crispations, and a motion begins like the waving tentacles of a sea-anemone. Sometimes the drop will sail about in a crescent shape, or shoot out independent little rings, which gyrate and rush about like a rotifer, until at last they burst into a myriad of intensely active little specks. Warm water destroys all action, by lessening, I suppose, the adhesion of the liquids.

To your readers it is trite and useless to remark upon the interest that attaches to the careful and continued observation of the most familiar things. But I wish the leisure classes could understand this. How many pleasant and instructive hours might some of them spend in examining such common things as essential oil dropped on water, even drops of ink falling through water, or puffs of smoke through air or a candle flame, or a hydrogen flame, or iron filings sprinkled on paper over a magnet, or, among other simple things, best of all a block of ice in a sun-beam. From the contemplation of such phenomena one rises with an increasing joy, and not a little humbled at one's own ignorance before the orderly mystery that pervades everything.

24, Elgin Road, W.

J. H. SPALDING

A Suggestion to Opticians

THERE is a method of mounting self-registering meteorological thermometers very commonly employed, and one which for some purposes, as, for instance, for determining the temperature immediately over the surface of the ground, is an excellent plan.

I allude to the placing of the divided thermometer stem in a larger tube forming a jacket to it, and fixing it with india-rubber packing, which makes an air-tight stopper round the neck.

Now it is frequently observed that when thermometers fitted in this manner are exposed to cold, a copious deposition of dew takes place, both on the stem and in the interior of the jacket, rendering the accurate reading of the instrument a matter of some difficulty. I would therefore suggest to makers of this class of instrument whether it would not be advisable for them to *dry*, I do not mean merely heat, the air in the tubes, or else enclose some water-absorbing substance, as calcium-chloride, in the tube before finally inserting the india-rubber stopper.

It is extremely probable my suggestion is not a new one. I have no recollection, however, of having heard of such a plan being employed by any maker.

G. MATHUS WHIPPLE

Kew Observatory, June 10

The Ferrara Floods

MAY I ask for space to draw the attention of engineers to the question whether the beds of embanked rivers rise or not? The affirmative is argued (and in reference to Ferrara) in the last chapter of "Rain and Rivers," against the negative of the eminent American engineer Ellet. The title of the chapter is "Ellet on the Mississippi."

GEORGE GREENWOOD

Brookwood Park, Alresford, June 8

FORCE AND ENERGY

THE CONSERVATION OF ENERGY A FACT, NOT A HERESY OF SCIENCE

IN an article entitled "The Heresies of Science," published in a recent number of the *London Quarterly Review*, two widely different principles are oddly linked together as heretical dogmas, the doctrine of Evolution, and the Conservation of Energy.

On the doctrine of *Evolution* the writer has nothing to say.

Before discussing with the "Reviewer" the validity of the *Conservation of Energy*, it is quite necessary to define the terms which may be employed, such as Force, Energy, Potential, Sound, Light, Heat.

It is much to be regretted that a far greater degree of logical accuracy in the use of terms than is usually met with, does not exist amongst even the ablest writers on physics, for many of the arguments adduced against physical principles lie not against the principles themselves, but against the indefinite language in which they have from time to time been expressed. There is probably no term employed in physics that has been more misapplied, and in its misuse has led to greater confusion of ideas, than "force."

Force has been thus defined by our ablest modern physicist.* "What I mean by the word force is the source or sources of all possible actions of the particles or materials of the universe."

This definition of force is substantially the same as the writer's definition † to which the reviewer takes exception, but which may perhaps with advantage be thus amplified: Force is a mutual action between the atoms or molecules of matter, by which they are either attracted towards, or repelled from, each other; and by this action energy is imparted to the matter put in motion. It may be further remarked that force is essentially either attractive or repulsive.

The writer sees no reason to amend his definition of "Energy"—namely, that it is *the power of doing work*. It may, however, be remarked that the existence of energy in matter implies the existence of motion, and *vice versa*; but it by no means follows that motion and energy are convertible terms, for motion means only the act of moving, or changing the position occupied in space.

The term "Potential" applied to force or energy means inactive, but capable of being called into action. Thus, if a weight be raised, a certain amount of energy is expended in raising it, and so long as the body is supported the energy expended in raising it remains potential in it, but when allowed to fall freely *in vacuo* to the level from which it was raised, the body acquires exactly the amount of energy that was expended in raising it. In the same manner the repulsive force of the molecules of the highly ignited gases into which gunpowder is resolved by ignition may with equal propriety be said to be potential in the unignited powder.

The remarks with which the writer's interpretation of the terms "force" and "energy" have been met by the reviewer may here be appropriately noticed. Quoting the introductory chapter already referred to, he adds: "his doctrine regarding the nature of force has thus no connection with sound philosophy; by force Mr. Brooke evidently means what other advocates of conservation mean by potential energy." Does then sound philosophy consist in the impossible task of agreeing as to the meaning of terms with those who do not agree amongst themselves? Or is sound philosophy monopolised by, and crystallised in the opinions of the reviewer? Sound philosophy would seem to consist rather in assigning appropriate meanings, involving no inconsistency or contradiction, to terms of frequent occurrence in all works on physics.

If the above definitions of force and energy be accepted, it is obvious that the term "force," as used by Grove, Tyndall, and many others, means sometimes force and sometimes energy. Thus, for example, "the conservation of force" becomes a simple truism, for its exercise being a function of matter, force must necessarily be coeval with matter. The reviewer (p. 22) thus quaintly expresses the relations of force, energy, and motion:—"A given motion viewed as a cause is force, while the very same motion thought as an effect is energy." Motion, it is presumed, can mean nothing else than the act of moving; but how the act of moving, whichever way we look at or

* Faraday, MSS. Croonian Lectures on Matter and Force, by H. Bence Jones, M.D. p. 35.

† Introductory chapter to the Sixth Edition of "The Elements of Natural Philosophy."