

system of artificial culture, which unfortunately all ended in failure. He then asks the question whether artificial culture after the French method would be possible on the German coasts of the German Ocean, and in a well-written chapter arrives at the conclusion that this question must be answered in the negative. An important query is whether natural oyster-beds can be artificially enlarged, and whether new oyster-beds can be established. Prof. Moebius thoroughly ventilates this question, and an attentive perusal of the little work will not leave anybody in doubt as to whether any intended experiments will or will not be crowned with success. The author quotes several examples of natural beds which were ruined by over-fishing; he also gives an account of the repeated experiments made in the Baltic with a view of establishing natural oyster-beds, all of which failed, the last with 50,000 oysters deposited in 1843 near the Island of Rügen, of which only two years afterwards not a single one remained alive. One of the most interesting chapters in the book is the one treating of the increase in the number of oyster-eaters, the rise in the price and the decrease in the quantity of oysters; it contains numerous statistical data showing how, in 1740, fresh oysters were sold at Hamburg at 3*d.* per hundred! Even as late as 1830 they were sold at 1*s.* per tub (about 1,600) at Falmouth; but Prof. Moebius doubts whether in this age of railways and steamboats we shall ever return to such a state of things. A chapter on the chemical constituents and the taste of oysters, and another on the object and results of a rational culture of oysters, form the conclusion to this clever little work.

Die Naturkräfte. — Die Gesetzmäßigkeit im Gesellschaftsleben. Statische Studien von Dr. Georg Mayr, Ministerialrath und Universitäts Professor. (München: R. Oldenbourg, 1877.)

THIS small and readable volume contains a slight but comprehensive sketch of the main features of political and social statistics. It shows how the necessary data have to be obtained, how they should be discussed, and how the final results may be most clearly published, whether in a graphic or a tabular form. It enters into no technicalities, it is of very little value as a storehouse of information, and it contains perhaps no remarks that are strikingly original, but being written by a very competent statistician it has the merit of giving a good, general idea of the range of statistical inquiry and of its national value. It is well calculated to instruct those who may desire to obtain a broad and just view of the efforts, the difficulties, and the achievements of modern statisticians. F. G.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications. The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Potential Energy

MOST persons must agree with your correspondent, "X.," that the term "potential energy" has been used with considerable vagueness and with some difference of meaning by various writers. They may even go further, and doubt at times whether they are quite clear with respect to the cases to which the terms "force" and "energy" are respectively applicable. But this arises, I am inclined to think, from the difficulty of understanding what is force, and would certainly not be removed by bringing these two terms into more frequent and closer juxtaposition than that in which they are now found.

Without attempting to reconcile the somewhat conflicting views of different writers on the subject of potential energy, which, however, I must own, are not so far apart from one another as "X." seems to suppose, I should like to make a few remarks

with respect to his proposal to transfer "potential energy" from the body in which it is said to exist to the force to which it owes its existence.

Energy, as generally understood, is of two kinds: the one is energy of motion, and the other energy of configuration. In both cases the system possessing energy has the power of doing work; in the one case actually, in the other potentially. Now it is against this potential power of doing work that "X." protests, for he considers the expression tautological. But here I disagree with him. I can see nothing incomprehensible in the statement that a body has the power of acquiring the power of doing work; and, to restrict myself to the very simple illustration of a stone raised to a certain height, I should say that the system of the stone and earth, by the action of a certain force through a certain distance, had gained the power of acquiring a certain amount of kinetic energy, *i.e.*, the power of acquiring the power of doing a certain amount of work.

This seemingly tautological phrase is more in the language than in the idea; for we often use, with respect to other subjects than physics, similar expressions. We may say that the possession of wealth confers the power of purchasing, and a wealthy man is one who possesses a certain power which he may have gotten himself, or which may have been transferred to him from another. But a youth with a certain education, and placed in a certain position, though not yet wealthy, may be said to be in a position to acquire wealth,—to have in himself the power of acquiring the power of purchasing.

One other point I would notice before considering "X.'s" new proposal.

But first I would say that justice is hardly done to every "doctor" (I am none myself) when we are told, in connection with the projection of a stone upwards, that "the gravitation attraction is usually and conveniently conceived and spoken of as all the earth's; and the stone is usually regarded as being simply attracted," and that "every doctor will frequently speak thus." Certainly one doctor whom "X." has quoted is careful to say that "when a stone has been lifted to a certain height above the earth's surface, the system of two bodies, the stone and the earth has potential energy, and is able to do a certain amount of work during the descent of the stone."¹

"X." finds considerable difficulty in understanding that if the leaden weight of a clock is raised by winding it up the energy of the clock is thereby increased. He says that "the weight sets-to and works with E., which it has not in possession, but only has the power of acquiring, and which it loses the power of acquiring!" and in a note we are told that "the weight never acquires more than a quite insensible amount of actual E. so called." This is quite true, because the "actual E." is continuously used up as fast as it is acquired. If the weight could have fallen freely it would have possessed a store of "actual E." at its lowest point; but instead of being able to do this it has been continuously transferring its actual energy to the machinery of the clock which it has set in motion. The weight at its highest point was in a position for doing work, and during its descent work has been done.

Let us see now if there are no difficulties connected with the proposal to call potential energy "energy of tension," and to locate it in the force rather than in the body. We are told if you spend E. "in raising a stone to a certain height, you have bestowed your E. on that attraction, you have transferred your E. to gravity." This is not very clear, but "X." goes on to say "that attraction was beforehand pressing at the stone as hard as it could (this looks as if "X." placed the attraction in the earth only), but it had no power of doing work." Well, why not? Because, practically, there was no force acting on the stone. The force of gravitation was counteracted by the reaction of the surface on which the stone was resting. A force free to act has always the power of doing work; but the existence of a force presupposes the existence of a body, and the confusion is, therefore, considerably increased by speaking of the transference of the power of doing work from a body to a force. There seems to be no harm in speaking of the energy of a force, but then we mean the energy due to a force; and this can be as well said of kinetic as of potential energy.

With the metaphysical difficulty about force staring us in the face, it surely would be very unwise without the gain of some much more solid advantage than "X." has made out, to complicate the idea by giving it the attribute of possessing energy; the connection between force and matter is so intimate that let energy mean what it may, the idea of its transference from

¹ Clerk Maxwell, "Matter and Motion," p. 81.