

duces the most important effects, for the author regards it as only a part of a great series of disturbances which modified the earth's crust as far away as the American continent. These are mainly responsible for the Glacial epoch, and the advance or retreat of the ice and the variations in sea-level must be attributed to earth-movements during it. Often, he insists, the sea, rather than the land, has altered its level, owing to changes in the form of the ocean basins. No doubt this is true, but we think the author presses it too far. He has also such faith in land-ice as to introduce the Scandinavian ice-sheet to the Shetland Isles, without caring to explain how it got across the deep valley which contours the southern and western coast of Norway. The earth-movements already mentioned were sometimes rapid, and the author connects the later of them with traditional deluges. The fabled Atlantis is Brazil, which had been converted into an insular tract by a rise of the sea. All this is certainly ingenious, though it may be unconvincing. He also gives us an explanation of the curious "bone beds" of Pikermi. Downward movements (connected with the second set of faults) submerged the lowlands. The animals fled for refuge to the hills, where they were killed *en masse* by mephitic vapours, which, fortunately for geologists, were exhaled in the nick of time, and their dead bodies were afterwards carried lower down by floods and mudstreams. *Credat Judeus!*

Last Words on Materialism. By L. Büchner. Translated by J. McCabe. Pp. xxxiv + 299. (London: Watts and Co., 1901.) Price 6s. net.

IT can scarcely have been the intrinsic worth of these occasional essays which induced the "Rationalist Press Association" to circulate them in an English dress. The volume is marked by all the confident dogmatism and loose reasoning for which the author of "Force and Matter" is unfavourably known to serious students. Its value as a contribution to genuine thought on the ultimate constitution of the world around is of the slightest. The author's position is that thought and will are secondary derivatives of a reality which is, in its own nature, "material" in the sense of being not mental, but for this position no proof whatever is offered. The "idealist," who comes in for a good deal of abuse which, from an English point of view, must be pronounced decidedly undignified, is never fairly met. His real argument, that the physical world itself is only given us in terms of the experiences of a sentient perceiver, is quietly ignored, and he is only allowed to make the futile objection that he does not know by what special process physical energy is "transformed" into consciousness. The writer's competence in philosophic discussion is shown by the fact that he thinks the inability of savages to count beyond four a proof that mathematical science is purely empirical. Similarly, he thinks Kant's view of the presence of an *a priori* element in knowledge refuted by the irrelevant appeal to the fact that knowledge has been acquired by a process of gradual development. The real point has, of course, nothing to do with the process by which we come to know; it is purely a question of how knowledge is constituted when you have got it. The excursions into philosophic history made in such essays as those on "Hobbes" and on "Buddhism and Christianity" are even sordid stuff than the rest of the book. Büchner seems to have known little or nothing about the subject; he repeats complacently the absurd farrago by which Pythagoras has been brought into connection with Buddha, and expressly praises Hobbes for being—precisely what he was not—an empiricist. The "Rationalist Press Association" is doing scientific thought no good service in issuing such a mixture of anti-ecclesiastical rhetoric and crass metaphysical dogmatism as representing the views of serious science about the world.

A. E. T.

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 intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Misuse of Coal.

WHILE most thoroughly agreeing with Prof. Perry in his desire to see a more efficient use made of our coal-supply, I yet think that he has drawn far too gloomy a picture of the future, and I wish to draw attention to a consideration which does not seem to have been present in his mind, or to have occurred to any of those hitherto dealing with the question as either authors or inventors. Prof. Perry says that "scientific men know of no other store of energy available for man's use than fuel from the earth, except what we may get by the help of the tides or by the wind or waterfalls." With the exception of the tides, the energy of all these sources is derived ultimately, as is also that of coal itself, from the heat radiated by the sun, and what I wish to point out is that the heat of the sun may be made to furnish power in quite another way—a way, in fact, indicated by Nature herself.

Prof. Perry points to animal organisms as types of efficient engines. Now, what is the fuel consumed by these engines? Obviously it is *vegetable matter* which derives its energy from the *solar radiation of the present day*. At the same time, it is evident that at the present moment only a small percentage of the solar radiation falling on the surface of the earth is used in this way; yet it will be found that the amount of energy derived from this source is very large compared with that provided by our coal-supply. The detailed calculation cannot be attempted here, but a few figures will serve to show the order of magnitude we are dealing with. Taking Prof. Perry's figure for a year's coal-consumption at 663 million tons, and taking the average efficiency of engines at 3 lb. of coal per horse-power hour—which is probably too high an efficiency—the figures work out to an annual output of 495,000 million horse-power hours, and this is roughly equivalent to 56 million horse-power working continuously night and day. Considering the number of human beings, horses, cattle and sheep, and considering their output in heat as well as in mechanical work, it is evident that the energy supplied by food—however efficiently used—must be vastly greater than that given by our present coal-consumption. Here, then, is an enormous source of energy only partially tapped at present—the heat radiated to the earth by the sun—and the method of using it is indicated by Nature. When our stock of fuel approaches exhaustion, we shall—so it appears to me—have to set to work and—to put it crudely—grow our own fuel as we go along.

The use of vegetable matter for fuel is by no means unknown even to-day; for although wood has long ceased to compete with coal as a fuel, yet in Germany at the present time a new industry is growing up in the production of crude spirit from potatoes. This spirit is used as a *cheap fuel* in internal-combustion motors, and is therefore evidently able to compete with earth-fuels even in a northern country where solar radiation is not very intense and land-values are high. The progress from the use of wood and charcoal as a fuel to the use of potato-spirit is so great that we may reasonably expect much more in the same direction when once attention has been concentrated upon the matter. In fact, it may not be too much to expect that ultimately the regeneration of carbon from the dioxide of the atmosphere may be accomplished by means of synthetically prepared bodies which—somewhat like the chlorophyll of the living plant—are capable of decomposing carbon dioxide under the influence of sunlight. In those circumstances, the solar heat used in the evaporation essential to the growth of plants might be saved for the direct production of fuel, and the yield per acre of sunlit area greatly increased. I think, therefore, that in "fuel farming," in the first instance by the most prolific plants available, and ultimately by purely chemical agents, the problem of the supply of energy after the exhaustion of the world's coal-supply may perhaps be solved. All I am here trying to show is that the quantity of energy available by these means is large compared with the power actually in use at the present day, and even this I have only indicated in the roughest way; but I agree with Prof. Perry as to the extreme importance of the question, and I think with him that it is a matter of vital national importance. If, however, fuel farming is really a