

department of nature *down to the most minute details*,
Not even one grain of material is ever used,
 when less would suffice for the purpose."

This is, no doubt, admirable, and would suit the most frantic of the mischief-making teleologists. But, alas! like the Editor of the *Little Pedlington Observer*, "What in one line we state we retract in another." For there follows—

"We can demonstrate by mathematics that in the use of every such muscle [triangular, &c.] *there is a necessary loss of force*. . . . I have always maintained that beauty of form . . . was one of the pre-existing conditions in the mind of the Contriver of the universe, as well as economy of force."

As intermediate to these two quotations, and in itself amusing from its *bonhomie* and condescension, we may take the following :—

"Nature, according to my principle, is entitled to employ these two forms of muscles whenever she pleases."

The reader may take our word that these are but single gems, selected from among many similar and often richer ones, mainly on the Principle of Least Trouble (in copying out for press).

As to really scientific matters, occasionally referred to in these lectures, we need merely mention that the author is ignorant of, or ignores, Dr. Pettigrew's extraordinary researches on wings and other adaptations for progression; researches which ought to be thoroughly mastered by any one who attempts to write on the subject of animal mechanics; and that, in his remarks on the strength of the uterine muscles, he seems to have entirely forgotten to notice how thoroughly least action theories (at least as applied by him) have been upset in a late number of the *Dublin Quarterly Journal of Medical Science*.

We promised Science first and Sensation afterwards. In attempting to collect the Science we have got hold of little but Sensation: so we need give only one extract more. Would it have been considered possible (till the 23rd of last May) that a Dublin professor, an M.D., a D.C.L., an F.R.S., and a clergyman of the (till lately) Established Church, should, even in jest, speak as follows in the Royal Institution in London?—

". . . . A brilliant idea came across my mind What in the world is to hinder me from taking a farm in Westmeath, deliberately and wilfully refusing to pay my rents, and in due time shooting my landlord, and, instead of using him as a New Zealand tenant would, dissecting him at my leisure?"

We have only to add that the *British Medical Journal*, in publishing the above, conspicuously prints the remark :—

"In reproducing the *ipsissima verba* of the lecturer, and giving them a permanent place in scientific literature, an enduring service will be rendered to Science."

Which means, we hope, that all men, scientific or otherwise, will, once for all, take warning from this terrible example. If such be the result, Prof. Haughton will, indeed, not have lectured in vain. But if the *British Medical Journal* intends its remarks to signify approval, we can say of it and of Prof. Haughton, in the language of Cervantes—

No rebuznaron en valde
 El uno y el otro Alcalde.

BASTIAN ON THE ORIGIN OF LIFE

The Modes of Origin of Lowest Organisms: including a Discussion of the Experiments of M. Pasteur, and a Reply to some Statements by Professors Huxley and Tyndall. By H. Charlton Bastian, M.A., M.D., F.R.S., &c. (Macmillan and Co., 1871.)

IT may be as well to state at the outset that the present volume is not Dr. Bastian's long-promised work on "The Beginnings of Life;" and it would have been better had some title been devised to prevent the confusion that will inevitably be caused by its appearance at this juncture. We have here, however, a condensed sketch of the whole controversy on Spontaneous Generation, and a statement of some very important researches conducted by the author since the discussion which followed Prof. Huxley's Presidential Address at Liverpool last September. It will be remembered that the objections to Dr. Bastian's experiments and to the results he deduced from them were twofold. It was said that we have no proof that these minute organisms (*Bacteria*, &c.), or their germs cannot resist the heat to which they were subjected. It was also said that no proof was given that the supposed organisms found by Dr. Bastian in these boiled and hermetically sealed liquids were alive. The motions exhibited might be "Brownian" motions, and the experimenter probably found nothing in his vessels but what he put into them. The answer to these objections is now given. The test of vitality is said to be, not movement, which is admitted to be uncertain, but the *power of reproduction*. It is found that if a portion of liquid containing *Bacteria* is divided into two parts, one of which is boiled, and a drop from each of these portions is mounted as a microscopic object, under a covering glass surrounded by quickly-drying cement, the unboiled specimen exhibits a marked increase from day to day in the quantity of imprisoned *Bacteria*, while the boiled specimen continues unchanged during the same time. Making use of this test of vitality, it was next ascertained what degree of heat was fatal to these low organisms. By using a lower and lower temperature, it was found that exposure to 140° F. for ten minutes destroyed *Bacteria*, while after exposure to 131° F. for the same time they rapidly multiplied. Somewhat higher organisms—*Vibrios*, *Amæba*, *Monads*, *Vorticelle*, &c., were, however, killed by exposure to 131° F. for five minutes. It was subsequently ascertained that a four hours' exposure to a temperature of even 127° F. destroyed *Bacteria* and *Torula*. It is argued that, as in all these experiments the solutions used swarmed with *Bacteria*, &c., in various stages of increase, their hypothetical "germs" cannot be supposed to have been entirely absent; and that we may therefore conclude that the "germ" has no greater power of resisting heat than the animal itself.

Dr. Bastian also criticises many of the experiments of Pasteur, and the arguments founded on them. He maintains that the corpuscles found by the latter to exist in the atmosphere, and which "resemble" spores of fungi, have never been proved to be such; and even if they were so proved, it would not account for the constant occurrence of *Bacteria* and other low organisms, whose "germs" are quite unknown, and which there seems no reason to believe could retain their vitality in a dry state

in the atmosphere. The fact that vessels with bent necks or with plugs of cotton-wool do not produce organisms, while other vessels not so protected produce them in abundance, is shown, by numerous experiments, not to be universal. The evidence now adduced is held to prove that a variety of conditions hitherto not attended to affect the result, such as temperature, the strength of the solution, and especially the presence of particles of organic matter, other than "germs," derived from the atmosphere. A summary is given of sixty-five comparative experiments, which are believed to show, among other things, that the non-production of *Bacteria*, &c., in infusions and other suitable liquids, is so common an occurrence that the negative experiments of Pasteur and others have no weight as compared with the positive results obtained by a considerable number of observers, to whom the author refers, as well as by himself.

Some of these comparative experiments are very suggestive. Hay infusion, for instance, exposed to air, produced abundance of *Bacteria* in forty-eight hours, and these had increased considerably in sixty-eight hours. A similar infusion, sealed up after the fluid had become cold, behaved in a similar manner. The same in a flask with neck two feet long and having eight acute flexures, remained unchanged for twelve days. A similar infusion, hermetically sealed during ebullition, on the other hand, showed turbidity in forty-eight hours, which subsequently increased, and *Bacteria*, *Vibriones*, *Leptothrix*, and *Torula* were found in abundance. Here, then, whatever inference may be drawn from the first three experiments is entirely negated by the fourth. Other experiments show that ammoniac-tartrate solution sealed *in vacuo* at a temperature of 90° F. produced in eighty-four hours abundance of *Bacteria*; while the same solution, if boiled at 212° F. and exposed to the air in flasks covered with paper caps, remained quite clear for nine days; yet as soon as it was inoculated with living *Bacteria*, they increased rapidly and produced turbidity. These, and a number of other equally suggestive experiments, indicate that the conditions favourable to the *origin* and to the *increase* of these low forms are not always identical. Both are very complex, and we cannot avoid the conclusion that the advocates of the universal germ theory have been somewhat hasty in founding their doctrine upon insufficient data, for the most part of a negative character.

We have here, undoubtedly, an important addition to the experimental evidence by which alone the question can be decided, and we are glad to observe the unprejudiced and philosophical spirit with which Dr. Bastian discusses this most interesting and important problem.

A. R. WALLACE

THE WORKSHOP

The Workshop. Edited by Prof. W. Baumer, J. Schnorr, and others. (London: J. Hagger, 67, Paternoster Row.)

EVERY year of our national progress strengthens the national appreciation of the wisdom expressed in those words of the late Prince Consort, when he told the manufacturers of Birmingham that "the introduction of Science and Art as the *conscious* regulators of productive industry is destined to play a great and important part in the future development of this nation, and the world in

general." I take the liberty of italicising the word "conscious," remembering well the emphasis with which it was spoken, and being strongly impressed with the vast importance of this qualification.

Science of some sort, and art of some sort, have always regulated the operations of productive industry. The club of the savage is not uncommonly carved with much art, and shaped and poised with sound practical knowledge of the whereabouts of the weapon at which will be concentrated the whole force of the blow when it swings through the curve which the stroke of the arm will give it. The savage artisan is, however, utterly unconscious of the dynamical principles upon which the centre of oscillation or percussion is determined, and upon which his own skill depends. He follows a blind instinct but one degree higher than that which impels the bee to construct its honey-comb upon sound statical principles. The more civilised workman who merely proceeds according to the "rule of thumb" and the traditions of his trade, is in a similar intellectual condition to that of the bee and the savage. In his daily occupation his specially human faculties are scarcely exercised. The constructive instinct which he possesses in common with the beaver or the wasp is sufficient to guide his muscles in doing such work in such a manner. To talk of the "dignity of labour" when labour is thus conducted is merely to indulge in senseless and vicious phrasemongering.

The whole life and being of the artisan becomes changed immediately his daily work is *consciously* regulated by science and art. It then becomes an elevating instead of a brutalising occupation; the "dignity of labour" is removed from the sphere of platform verbiage to that of practical fact, and the workshop becomes a school of intellectual and moral culture.

We must always remember that the character of a man is formed by the daily, hourly, and continuous habits of his life, that no quantity or excellence of mere Sunday sermons, or occasional evening meetings, can overpower these. The philanthropist who would practically influence the character of the workman must operate upon him in and through the workshop; and it appears to me that there are no conceivable means so effectual for this purpose as the converting his bread-winning work from a mere mechanical brutal drudgery into a moral and intellectual exercise. To understand thoroughly the scientific principles involved in all the operations of any common handicraft is to know a great deal more than our greatest philosophers are yet acquainted with, and therefore the field of the consciously scientific artisan is wide enough for the intellectual effort of a life time. If, in addition to the physical science of his trade, he is conscious of his own social relations and functions, if he knows the part which he is playing in the great machinery of society, the motive to his industry will not be that of a merely sordid grubbing for wages, but the sense of duty and the chivalry of reciprocal beneficence will be introduced, and will perpetually operate as necessary results of this scientific consciousness of his own social functions.

If soldiers and sailors can be taught to glorify their work, and rise to heroism in their efforts to do their duty and serve their country, why should not the spinner, the weaver, the tailor, the agriculturist, the miller, and the