

the earth. The coloured illustrations showing the characteristic appearances of the various zones are as successful as anything of the kind we have seen, although, what perhaps cannot be avoided in coloured illustrations of this kind, there is a little too much of "the light that never was on sea or land" upon them.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.

Necessary Truths—Physical and other

I AM not about to continue a controversy which I regret having been provoked into by the misrepresentations of one who ignored the contents of works he professed to review. Reply and rejoinder may go on endlessly. I could not, to much purpose, argue with Mr. Hayward, who, instead of taking such unconsciously-formed preconceptions as those resulting from the infinite experiences of muscular tensions and their effects, proposes to exemplify unconsciously-formed preconceptions by a consciously-formed hypothesis concerning the relation between weight and motion. Nor should I care to discuss any question with my new anonymous assailant; who, when certain examples given show the "exact quantitative relations" spoken of to be those of direct proportion, describes me as "intensely unmathematical" because I subsequently use the more general expression as equivalent to the more special—which, in the case in question, it is.

The first of my objects in now writing is to remind "some bystanders, who may from their antecedents be presumed competent to judge," that the essential question is not a mathematical one, but a logical and psychological one, in respect of which I am not aware that senior wranglers, as such, can claim any special competence. Further, even admitting the assumption that the question is mathematical, I have to warn the reader that he will be much misled if he infers that there are not "some bystanders who may from their antecedents be presumed" *more* "competent to judge," who concur in the opinion that the laws of motion cannot be demonstrated experimentally.

My second object is to inclose, for publication in NATURE, a passage now standing in type to be added to future impressions of "First Principles" in further elucidation of necessary truths, and our apprehensions of them.

HERBERT SPENCER

"The consciousness of logical necessity, is the consciousness that a certain conclusion is implicitly contained in certain premisses explicitly stated. If, contrasting a young child and an adult, we see that this consciousness of logical necessity, absent from the one, is present in the other, we are taught that there is a *growing up* to the recognition of necessary truth, merely by the unfolding of the inherited intellectual forms and faculties.

"To state the case more specifically:—Before a necessary truth can be known as such, two conditions must be fulfilled. There must be a mental structure capable of grasping the terms of the proposition and the relation alleged between them; and there must be such definite and deliberate mental representation of these terms as makes possible a clear consciousness of this relation. Non-fulfilment of either condition may cause non-recognition of the necessity of the truth; and may even lead to acceptance of its contrary as true. Let us take cases.

"The savage who cannot count the fingers on one hand, can frame no definite thought answering to the statement that 7 and 5 make 12; still less can he frame the consciousness that no other total is possible.

"The boy adding up figures inattentively, says to himself that 7 and 5 make 11; and may repeatedly bring out a wrong result by repeatedly making this error.

"Neither the non-recognition of the truth that 7 and 5 make 12, which in the savage results from undeveloped mental structure, nor the assertion, due to the boy's careless mental action, that they make 11, leads us to doubt the necessity of the relation between these two separately-existing numbers, and the sum they make when existing together. Nor does failure from either cause to apprehend the necessity of this relation make us hesitate to say, that when its terms are distinctly represented in thought, its necessity will be seen; and that apart from any multiplied experiences, this necessity becomes cognisable when

structures and functions are so far developed that groups of 7 and 5 and 12 can be intellectually grasped.

"Manifestly, then, there is a recognition of necessary truths, as such, which accompanies mental evolution. Along with acquirement of more complex faculty and more vivid imagination, there comes a power of perceiving to be necessary truths what were before not recognised as truths at all. And there are ascending gradations in these recognitions. Thus a boy who has intelligence enough to see that things which are equal to the same thing are equal to one another, may be unable to see that ratios which are severally equal to certain other ratios, that are unequal to each other, are themselves unequal; though to a more developed mind this last axiom is no less obviously necessary than the first.

"All this, which holds of logical and mathematical truths, holds, with change of terms, of physical truths. There are necessary truths in Physics, for the apprehension of which, also, a developed and disciplined intelligence is required; and before such intelligence arises, not only may there be failure to apprehend the necessity of them, but there may be vague beliefs in their contraries. Up to comparatively recent times, all mankind were in this state of incapacity with respect to physical axioms; and the mass of mankind are so still. Various popular notions betray inability to form clear ideas of forces and their relations, or carelessness in thinking, or both. Effects are expected without causes of fit kinds; or effects extremely disproportionate to causes are looked for; or causes are supposed to end without effects. But though many are thus incapable of grasping physical axioms, it no more follows that physical axioms are not knowable *a priori* by a developed intelligence, than it follows that there is no necessity in logical relations because many have intellects not developed enough to perceive the necessity.

"The ultimate physical truth of which clear apprehension is eventually reached, is that force can neither arise without an equivalent antecedent, nor disappear without an equivalent consequent. Along with power of introspection there comes recognition of the fact that existence cannot be conceived as beginning or ending: the Laws of Thought themselves negative any such mental representation. And if it be asked why this intuition, which all physical axioms indirectly imply, and which is postulate in every physical experiment, is to be taken as authoritative because its negation is inconceivable, the answer is that no argument which sets out to discredit it can do this without logical suicide; since there is no other warrant for asserting the dependence of any conclusion on its premisses than the inconceivability of its negation."

This passage forms part of a revised version of the chapters on Matter, Motion, and Force, which I have contemplated making for this year past. When those chapters were written and stereotyped in April 1861 (see Preface), the modern doctrines concerning Force and its transformation were so imperfectly developed, that some of the leading technical words now currently used were not introduced. The reorganisation of "First Principles," which I made in 1867, for the purpose of more truly presenting the general Theory of Evolution, did not implicate these chapters, and I believe I did not even re-read them: the stereotyped plates, in common with those of many other chapters, with the numberings of pages and sections altered, were used afresh, and continue still to stand as they originally did. But while now rectifying defects of statement which it was scarcely possible to avoid thirteen years ago, I find no reason for changing the essential conception set forth in those chapters; nor is the need for changing it suggested to me by those on whose judgments I have the best reasons for relying.—H.S.

Royal Society Soirée

WITH reference to your account of the Royal Society's soirée (NATURE, vol. ix. p. 502), will you allow me to explain that all I "promised" concerning the missing pair of Paradise-birds was to deliver them when sent for.

They were not sent for, owing to some mistake, and consequently not exhibited.

May 5

P. L. SCLATER

Father Secchi's Work on the Sun

WITH great surprise I read in NATURE, vol. ix. p. 390, the following note:—

"Father Secchi is preparing at Gauthier Villars a second