

skill in physical and physiological research with the technical knowledge of a trained musician, he stands absolutely alone. It need therefore surprise no one that the volume before us, the first edition of which was published in 1862 as the fruit of eight years' work, has practically revolutionised the subject with which it deals. He begins by completely clearing up the nature of the *quality* (*timbre*) of musical sounds. He fixes his reader's attention on the *harmonics* which previous observers had recognised as accompanying a fundamental note. These, he shows, are no isolated phenomena, but invariable concomitants of nearly all musical sounds. In fact, what appears to be a simple note of any assigned instrument, is really a composite sound consisting of a number of different tones, all, however, members of a series connected together by a simple law. The *quality* of the sound depends on the relative intensities in which these *partial-tones* are present in the whole mass of sound (*Klang*) heard. Helmholtz illustrates his theory by determining the relative intensities of the audible partial-tones produced by the principal kinds of musical instruments, and also those corresponding to the different vowel-sounds of the human voice. He has also invented an apparatus by which the most important members of the complete series of partial-tones corresponding to a fundamental tone can be sounded with any assigned relative intensities, and which is capable of producing a tolerably close imitation of many sounds differing widely from each other in quality. These investigations occupy the first part of the work.

In the second part the nature of the difference between consonance and dissonance is explained, and thus a problem which has baffled natural philosophers since the time of Pythagoras finally solved. Here, again, the key to the solution is a perfectly well known phenomenon, the real significance and scope of which it was reserved for Helmholtz to recognise. Intermittent noises called *beats* had been observed whenever two notes nearly, but not quite, in unison with each other, were sounded together. Helmholtz asks what becomes of these beats when they are so rapid that the ear can no longer distinguish them as separate sounds. It had been supposed since the time of Young that they coalesced into a third musical sound, and thus formed the *combination ones* discovered as early as 1740 by a German organist named Sorge, but more generally known as *Tartini's tones*. Helmholtz proves that Young's view is erroneous. The beats never coalesce into a musical sound, but when they cease to be individually distinguishable, produce the sensation which we call discord.

This fact, taken in connection with the composite character of musical sounds, leads at once to Helmholtz's theory of consonance and dissonance. When two notes of different pitch are sounded, we have two series of partial-tones co-existing. If no member of the one series produces *beats* with any member of the other, the interval between the fundamental tones of the two sounds is an absolute consonance. If, on the other hand, *beats* are so produced, the consonance ceases to be absolute, and may be classed as a good or an imperfect consonance, or pass into a dissonance, according to the amount of discord involved in the combination. Helmholtz goes through the ordinary scale, and classifies the different intervals accord-

ing to the above theory, his results tallying perfectly with those of the best writers on harmony. For the case of the comparatively unimportant class of sounds which have no upper-tones, Helmholtz employs a different method, which need not be detailed here. It is interesting to observe that his theory not only confirms some of the ordinary rules of musical composition, but is able to deduce principles which, though actually adopted by great masters, Mozart for instance, have never been explicitly stated by any theoretical writer. The third and last part of the work discusses the construction of musical scales, and the relation of each to its key-note. In this investigation æsthetic considerations necessarily assume an importance which they could not claim in the two earlier purely scientific parts of the work. As, moreover, musical technicalities of much complexity abound throughout the inquiry, it is not possible to give a popular *résumé* of the general results obtained in the third part.

The above is the most meagre outline of the subjects treated in the "Tonempfindungen." Indeed it is absolutely hopeless, within any reasonable limits, to try to convey an idea of the thoroughness, the laborious accuracy, the wonderful many-sidedness which appear on every page of it. The author, though a great mathematician, is fortunately too great an experimentalist to allow the laws of nature to figure as mere examples of the integration of differential equations, or as but affording subject-matter for new mathematical conundrums. Each acoustical law is thoroughly explained in popular language, with the most attractive richness and variety of illustration, a method of treatment infinitely refreshing to a student who has hitherto experienced only the husks of our arid examination-ridden manuals. All details of calculation are relegated to an appendix, and, though mathematics has its due honour given it, as a science absolutely indispensable for *thorough independent mastery* of any branch of physics, the most effective practical discouragement is given to the pedantic notion that no valuable knowledge can be gained without it. We may well doubt, indeed, whether the long exclusive domination of theory has made anything beyond mathematical symbols really *understood*. Cambridge honour-men will know what we mean by saying that an average wrangler, if asked what a *wave* was, would probably unhesitatingly answer—

$$"a \sin \frac{2\pi}{\lambda} (vt-x),"$$

and refuse to produce any further explanation. We desire for works like the "Tonempfindungen" a triumph in this country over English books "adapted for writing out in examinations" as decisive as the victory of the German armies on the soil of France. SEDLEY TAYLOR

OUR BOOK SHELF

A Monograph of the Alcedinidæ, or Family of Kingfishers. By R. B. Sharpe, F.L.S., &c. Librarian to the Zoological Society of London. 4to. (Published by the Author. 1868—1871.)

THIS work reflects the highest credit upon its author, and will establish his reputation as an Ornithologist. Very few monographs published in England are so entirely satisfactory as this one, for not only have the several parts appeared regularly during the last three years, but the concluding double number just issued contains a copious and well-written introductory chapter on classifi-

cation, geographical distribution, and literature, which renders the book a model of what such a work should be. The Kingfishers, although represented in our country by only one species, are especially abundant in the Eastern Tropics, where they exhibit a great variety of form and the most exquisite beauty of plumage. A considerable number of them are inhabitants of the forests, and never frequent water, subsisting on insects, small crustacea and mollusca, and the larger species even on snakes, lizards, and other reptiles, which they capture by darting down upon them from a branch just as our own species pounces upon a fish. Mr. Sharpe has been fortunate in securing the services of a young Dutch artist, Mr. Keulemans, who has himself studied birds in the tropics, and seizes upon their various attitudes with the happiest fidelity. He also surrounds his figures with little bits of appropriate scenery, so that a considerable number of the 120 plates with which the book is illustrated are beautiful pictures, as well as admirable representations of the several species. We do not hesitate to say that many of these plates are equal to the very best that have appeared in any illustrated work of Natural History. The body of the work consists of coloured figures of every known species of kingfisher, with full synonymy, careful description, and record of whatever is known of its habits. In the introduction, the classification of the species is carefully considered, only those generic groups being retained which can be characterised by marked structural differences. The whole family is first divided into two sub-families: the Alcedinidæ, or true kingfishers, characterised by a compressed keeled bill; and the Daceloninæ, or king-hunters, which have a depressed bill rounded or furrowed above. These are subdivided into nineteen genera, in which are grouped the 125 species of kingfisher now known. The groups are all characterised by modifications of the bill, feet, or tail, and a plate exhibits these generic characters at one view. There is also a tabular key of the species in every genus and of the genera in each sub-family, and the reasons are given for rejecting numerous genera proposed by other authors on insufficient characters. The geographical distribution of the species is then discussed in the same careful manner, an exact account of the known range of every species being given, as well as tables showing at a glance the distribution of all the species of a genus or group of allied genera; after which the results of the examination are ably summed up. Kingfishers present us with some of the most curious anomalies of distribution to be found in the whole class of birds. There is no part of the world so rich in peculiar forms of bird-life as America, more especially the southern half of it, yet it is the poorest of all parts of the world in kingfishers, only eight species being found in the whole continent,—a continent with more rivers and more fish than any other! The single island of Celebes actually contains as many different kinds of kingfisher as all North and South America, while New Guinea contains more than twice as many. It is perhaps even a more extraordinary fact that there is no peculiar type of kingfisher in America, all the eight species belonging to one genus, and that genus found also in Europe, Asia, and Africa. In Africa we have three peculiar genera of kingfisher, and twenty-four peculiar species. In continental India there are only five peculiar species, and not one genus. The western Malay Islands (Indo-Malayan sub-region) have one peculiar genus, and eleven peculiar species; the Philippines, seven peculiar species; but the Australian region has no less than ten peculiar genera and fifty-nine peculiar species, or nearly half those of the whole world. The peculiarities of the island of Celebes are well shown by the kingfishers, for not only has it eight peculiar species and three peculiar genera, but one of the latter has affinities with an African genus. In discussing the general relations of this isolated group of birds to the rest of the order, and the mutual affinities of the genera, the conclusion is arrived at that they are most nearly

allied to (although still very remote from) the hornbills; and their relations are expressed by a branching diagram, as well by a map of the genus on the plan of Professor Flower. A copious account of the literature of the family is also given, no less than 135 separate works being enumerated, with references to every species of kingfisher described or noticed in them. An elaborate paper on the anatomy of these birds by Dr. Murie, with a full index, completes this exceedingly valuable work, which will be equally acceptable to the naturalist for its detailed and accurate information, and to all who love nature for its beautiful and artistic illustrations.

ALFRED R. WALLACE

The Wind in his Circuits, with the Explanation of the Origin and Cause of Circular Storms and Equinoctial Gales. By Lieut. R. H. Armit, R.N. (London: J. D. Potter, 1870.)

ACCORDING to Lieut. Armit "all the various phenomena which occur in Nature are accounted for by one theory forming one law, and the force which governs and regulates everything, even to imparting perpetual motion to the world, is Electricity" (p. 122). When the reader is informed of the author's opinion that the east wind is formed of compressed vapour or steam (p. 57), that lightning and thunder are caused by the Arctic current descending to fill any vacuum that may suddenly be found in the warm currents below it, the "grating" of the currents against each other causing friction and lightning, and the sudden shock of the impenetrable masses the thunder (p. 68); and that, by an attentive study of his theory, it will in future "be as easy to foretell and evade a storm and keep in a fair wind, as it is to drive over good roads and evade the bad ones, when you know the country you are driving through" (p. 126), he will understand that the book may be consulted out of curiosity, or for its psychological interest, but not for instruction in what concerns atmospheric phenomena and the laws which govern 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.]

Pangenesis

ON the introduction of Mr. Charles G. Leland, the author of the famous "Breitman Ballads," who was present at the reading of Mr. Galton's paper on Pangenesis before the Royal Society on the 30th ult., I have seen Mr. Lewis Ware, a young American gentleman who has been studying science in Paris since 1868.

By him I am informed that M. Leconte (I presume the physiological chemist of that name) is accustomed to mention in his lectures that he had frequently transfused the blood of one kind of animal into the veins of another; but it does not appear, in reference to those experiments, that any subsequent effects were noticed, as regards the offspring of such animals.

M. Leconte, however, further relates that once, not by way of experiment, but in order to save life, endangered, it must be supposed, from the occurrence of previous hemorrhage, he transfused into the veins of a white man blood drawn from a negro, and that the subsequent offspring of this white man by a white mother were *swarthy* in complexion.

Now, I cannot find any *published* record of M. Leconte's operation and its singular consequences, and it is impossible at the present moment to reach him by letter. I desire therefore to give publicity to what *seems* to be a conclusive proof of the theory of "pangenesis," with the view of eliciting a confirmation or refutation of the statement from some one who may chance to read this note, and who may have the necessary opportunities and leisure for further inquiry into the particulars of so very remarkable an incident. It is obvious that the number of children so affected, and the coincidence or absence of other changes in the hair, the form of skull, &c., require to be investigated, and the *credibility* of the parents fully authenticated.

10, Savile Row, W., April 8

JOHN MARSHALL