

3. Between the dates of these two cold waves there are located, according to all the cycles observed, even including that earlier one otherwise exceptional, three moderate and nearly equidistant heat-waves, with their two intervening and very moderate cold waves, but their characters are quite unimportant as compared with what is alluded to under heads 1 and 2; and with regard to all the waves, it may be just to state that there has been in observation more uniformity, and will be therefore in prediction more certainty for their dates than for their intensities.

C. PIAZZI SMYTH

February 1872

DARWIN'S ORIGIN OF SPECIES

The Origin of Species by means of Natural Selection; or the Preservation of Favoured Races in the Struggle for Life. By Charles Darwin, M.A., F.R.S. Sixth edition, with additions and corrections. (London: J. Murray, 1872.)

FEW are the writers, scientific or otherwise, who can afford, in every successive edition of their works, to place side by side the passages which they have seen reason to alter, from a change of view or any other cause. And yet to this point we find especial attention called in each succeeding edition of Mr. Darwin's "Origin of Species." And herein lies the true humility of the man of science. Science is often charged with being arrogant. But the true student of Nature cannot be otherwise than humble-minded. That man is unworthy of the name of a man of science who, whatever may be his special branch of study, has not materially altered his views on some important points within the last twelve years.* The means at our command for obtaining correct views of the laws which govern Nature are ever increasing, and if we only

Let knowledge grow from more to more,
this can but cause that

More of reverence in us dwell,
reverence for the eternal constancy of Nature's laws, with respect to which we even yet know so little. But a false pride more often tempts men to conceal than to avow their change of opinion. Mr. Darwin carries the contrary practice perhaps to an excess. But such a course necessarily disarms criticism of its sting; and if the learner sometimes ventures to point out wherein he differs from the master's conclusions, it is only in the hope that the interchange of opinion may lead to a removal of the difficulties which prevent a complete accord of thought.

The sixth edition of the "Origin of Species" is considerably smaller than its predecessors; but this does not arise from any diminution of matter, but from the use of smaller type. There has been, in fact, considerable addition, and our province will be simply to call attention to those points in which previous editions have been amended or amplified. Already, in the fifth edition, Mr. Darwin had stated that the able criticism of his work which appeared in the *North British Review* had induced him to modify his views with regard to the frequency of the occurrence of characters which are not useful to the

individual; we find now, on some other points, a similar modification of opinion.

It has always seemed to us that one of the weakest parts of Mr. Darwin's statement of the theory of natural selection is the emphasis with which he asserts that single instances of departure from the law would prove the theory to be unsound. In the present edition, speaking of the rattle of the rattlesnake—the only effect of which has been stated to be to direct to the snake the attention of its enemies—he goes out of the way to repeat that "if it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate his theory." Why it would annihilate his theory, we must confess we are unable to understand; since Mr. Darwin repeats in this edition even more emphatically than in previous ones that "he is convinced that natural selection has been the main, but not the exclusive, means of modification of species." Since then other causes have been at work to cause the evolution of species, why may not some of these causes be able to produce parts beneficial to the race rather than to the species? In the special case, however, under consideration, the rattle of the rattlesnake, an American naturalist comes to the rescue of the Darwinian theory. Mr. Darwin was probably not aware at the time of writing that Prof. Shaler had stated his belief, from the result of observation, that the rattlesnake's rattle is actually beneficial to it, its object being to imitate the sound of the cicada or other insect which forms the food of many birds, thus attracting them within its power, and accounting for the apparent "fascination" of its prey, which must now be consigned to the limbo of travellers' tales.

The greater part of the additional matter in this edition is naturally devoted to a reply to the objections urged in Mr. Mivart's "Genesis of Species." In replying to Mr. Mivart's objection to the theory that "mimicry" has resulted by the process of natural selection, on the ground that the early stages of resemblance would have no useful tendency, the following sentences appear to us to be open to objection, or to be wanting in clearness:—"But in all the foregoing cases the insects, in their original state, no doubt presented some rude and accidental resemblance to an object commonly found in the stations frequented by them." "Assuming that an insect originally happened to resemble in some degree a dead twig or a decayed leaf." What is meant by the "original state" of an insect? Every insect-form must have been evolved from some previously existing simpler form by a gradual process, and the "rude or accidental resemblance" must be due to the operation of the same causes that produced the finished likeness. We must acknowledge that Mr. Darwin appears to us to fail to grapple with the difficulty in the way of the application of his theory, that either the early stages of the "mimicry" are useless, or that the exact reproduction of figure and pattern in the "mimicking" insect is a mere freak of nature. Mr. Darwin states his belief that "the sight of birds is probably sharper than ours," which would tell heavily against the utility of the first approaches towards resemblance; Mr. Wallace, if we recollect rightly, has expressed a contrary opinion.

Mr. Mivart's objection with regard to the curious fact

* The first edition of the "Origin of Species" was published in 1859.

that in the Pleuronectidæ, or Flat-fish, the eyes are opposite in the young state, and afterwards become placed both on the upper side of the head—that this change must have taken place suddenly, since any small approach to it would not be useful—is met by an ingenious argument, previously advanced by Malm. It is stated that “the Pleuronectidæ, whilst still very young and still symmetrical, with their eyes standing on opposite sides of the head, cannot long retain a vertical position, owing to the excessive depth of their bodies, the small size of their lateral fins, and to their being destitute of a swim-bladder. Hence, soon growing tired, they fall to the bottom on one side. While thus at rest, they often twist, as Malm observed, the lower eye upwards to see above them, and they do this so vigorously that the eye is pressed hard against the upper part of the orbit. The forehead between the eyes consequently becomes, as could be plainly seen, temporarily contracted in breadth. On one occasion Malm saw a young fish raise and depress the lower eye through an angular distance of about 70° .”

The objections urged by Nägeli in his “Begriff und Entstehung der naturhistorischen Art,” with respect to plants, that the families of plants differ chiefly from each other in morphological characters, which appear to be quite unimportant to the welfare of the species, are combated on the ground that we ought to be exceedingly cautious in pretending to decide what structures now are or have formerly been of use to each species. While admitting that in earlier editions he underrated the frequency and importance of modifications due to spontaneous variability, Mr. Darwin points out that many peculiarities of structure, lately supposed to be simply morphological, are now known to be intimately connected with facilities for fertilisation.

On the whole it seems to us that each succeeding edition of the “Origin of Species” lessens the distance between Mr. Darwin and those who believe that the influence of natural selection, though a *vera causa*, has been overrated as an element in the evolution of species. If it is admitted that important modifications are due to “spontaneous variability,” that natural selection is not the exclusive means of modification, Darwinians and non-Darwinians have equally before them the problem to discover what these other laws are which are co-efficient in the production of new species, and what part each of these plays in producing the final result. Until this is accomplished we can hardly consider the great problem of the Origin of Species as solved. Towards the solution of it, however, the labours of Mr. Darwin will ever be held as having contributed a larger share than those of any other naturalist. When we look at the title-page, and see that a work which has produced a greater revolution in the scientific thought of the day than any published in this country since Newton’s “Principia” is yet only in its eleventh thousand, and reflect that, although this is not a small sale for a scientific work, yet books which contain the germ of no new thought, and contribute not one iota to our sum of knowledge, have sold their hundreds of thousands, we cannot but think that in the coming age, when the people will really care about science, our descendants will regard this unworthy fact in the light that we do the unpopularity of the writings of Milton and Goldsmith during their lifetime.

We must not omit to mention a very useful addition, for the unscientific reader, made to this edition, in the shape of a glossary of the principal scientific terms used, prepared by Mr. W. S. Dallas.

ALFRED W. BENNETT

MAXWELL ON HEAT

Theory of Heat. By J. Clerk Maxwell, M.A., LL.D. (London: Longmans and Co. 1872.)

IT is very seldom that we meet with a book so instructive and delightful as Prof. Maxwell’s “Theory of Heat.” It has peculiar claims upon the student of Physics, inasmuch as it supplies a want which has been long and widely felt. The point of view is undoubtedly a new one, and to enable our readers to perceive the value of the book, we ought to make a few remarks upon the kinds of text-books that we have hitherto had. In these books the aim has been to inform the student’s mind, and the fault to inform it too minutely and too exclusively. They have been of two classes—elementary books, in which the information is given in a popular manner, and advanced books, through the pages of which mathematical formulæ are very liberally interspersed.

In reading such a book the strength of the student’s mind is devoted to one or at most two objects. If the book be elementary, he is bent upon acquiring a good knowledge of the facts, along with a knowledge, more or less complete, of the experimental methods by which these facts have been obtained. If, on the other hand, the book be an advanced one, his strength is devoted to grappling with and overcoming its analytical difficulties. But after he has studied both classes of text-books, he rises from their perusal with the belief that there is something wanting before he can have a thorough grasp of the subject, and a clear view of its truth and beauty. He has followed the experimenter only too zealously into his elaborate and accurate calculations, or it may be the mathematician into his profound investigations, and he now begins to realise the truth of the poet’s saying—

He who hath watched, not shared, the strife
Knows how the day hath gone,

and to sigh for some elevated spot from which he may obtain a clear view of the whole field. He hears vague rumours that the caloric battalions and their allies the corpuscular forces, have lost the day, but he wishes to see their discomfiture more completely with his own eyes.

Such a point of view is afforded by Prof. Maxwell. He has—wisely, we think—confined himself to this one object, to give the student a clear logical view of the whole subject; nor has he broken the unity of his treatment by going into details, whether experimental or mathematical. Every true student of physics should read this book, and he will unquestionably find it a most delightful study. He will, we venture to say, rise from its perusal with a much truer and wider conception of the science of heat; and if he then wants more detailed information upon any branch, he may consult one of the ordinary text-books. Another beauty of the book is the accuracy and completeness of its historical notes. The author has successfully combined the part of historian and that of logician, and has given us very many valuable references to original memoirs, in which we may see for