VI. WORKING *V.* FIGHTING.*

By J. W. SLATER.

"TAKEN with other recent scientific contributions, including especially the work of Professor Huxley 'On the Cray Fish,' the addresses of Prof. Agassiz on the echinoderms, and of Professor Le Conte before the Entomological Club, show a certain change of attitude, which naturalists are now assuming, on the subject of the development of vegetable and animal forms. There was a time, not long ago, when every voice was strident in advocacy of evolution. Now evolution is received as an established fact, and scientific effort is directed in explaining the many difficulties that lie in the way of the special working and applications of the hypothesis. This is the better and the truer spirit; for to increase our knowledge we need research not polemics."

Thus writes, most justly, the *New York Medical Record* (Sept. 18). But what has so long delayed biologists from entering upon this "more excellent way" and compelled them to spend twenty years in controversy often of doubtful

* Die Natürlichen Existenz-Bedingungen der Thiere: Von KARL SEMPER, Professor an der Universität zu Wurzburg. Leipzig: F. A. Brockhaus.
Island Life; or, the Phenomena and Causes of Insular Faunas and Floras. By ALFRED RUSSEL WALLACE. London: Macmillan and Co.

merit? Not, assuredly, their own good pleasure. The polemics have been due to the "parsons, poets, artists, lawyers," metaphysicians, and the like, who, *as such*, and without the biological discipline needful for understanding the evidences of the question, have come forward to dogmatise on the formation and the correlations of species and have even laid the flattering unction to their souls that they, forsooth, were better able to appreciate facts than the men whose special task is observation and discovery.

These Babel-voices, literary, æsthetic, teleological, are now fading into a wholesome quiet, and Evolution is about to undergo its veritable trial—the scrutiny whether it can be fairly made to harmonise with and to account for the many puzzling phenomena which we recognise on every hand—whether the hypotheses which have been set up can be verified by exact research. If unable to stand this test they will be laid aside by naturalists without any bidding from the lay public.

The two works just mentioned, proceeding from authorities whose competence is beyond question, are valuable contributions to this great task, and though approaching the subject independently and from different sides, they are substantially in accord with each other. Prof. Semper—after a thoughtful and suggestive introductory section, of which anon—considers in detail the influence upon animal life of the environment in which it is placed, *i.e.*, nutriment, light, temperature, standing water, still air, flowing water, and living organisms. All these agencies may act upon animal species by transformation, by selection, and by dispersion, and their effects have as yet been but very slightly and imperfectly studied. Lamarck, indeed, as is well known, ascribed the development of plants and animals as we now find them to such causes as abundance, scarcity, or peculiar quality of food, excess or deficiency of moisture, and the like. But his views, however important, remained mere speculations, not verified by observation and experiment,—an undertaking which in his day would certainly have been found impracticable. "The task of the zoologist, therefore," says Prof. Semper, "is to examine how vital conditions act upon individual animals and their organs, in order to infer back to the physiological causes of the origin of different animal forms." It will be noted that he does not overlook the transforming or modifying agency of outward circumstances. Most naturalists now fully admit that "natural selection," or, indeed, selection of any kind, though it may preserve and increase advantageous modifications when once

they have taken their rise, cannot possibly explain their first appearance. Hence, before we can account for the origin of species we must know whether such conditions are in any case found to set up a tendency to variation, of which selection may take hold.

Mr. Wallace treats of the origin, and especially the dispersal, of species from a different point of view, basing his considerations on the faunas and floras of islands. He classes islands as oceanic—those formed by volcanic or coralline action in the midst of wide seas—and as continental, *i.e.*, such as have evidently at one or other point of time formed part and parcel of some adjacent continent. This latter group he sub-divides according as their separation from the mainland is of recent or of ancient date. The three classes thus formed present respectively most remarkable differences in their animal and vegetable population, and in pointing out these distinctions and explaining how such regions have first received their inmates, he is led to conclusions which may be usefully compared with those of Prof. Semper. Both authors examine the influence of temperature and recognise the changes of climate which have undoubtedly occurred upon our earth as important factors in the origin of species. Mr. Wallace shows, however, that "we find no indication that the almost perfect similarity of climate and general conditions has any tendency to produce similarity in the animal world." Prof. Semper, who has conducted very important experiments on certain species of mollusks exposed to abnormal temperatures, comes to the kindred conclusion that the fossil fauna of any region affords no trustworthy evidence as to its climate at any particular past epoch. He brings forward the remarkable fact that parrots, distinctly tropical birds, accustomed to an average temperature of 80° Fahr., have been found capable of living and increasing in the open air in England with a mean temperature not exceeding 50° Fahr.

Such considerations ought to inspire geological speculators with a wholesome caution.

Mr. Wallace enters at length into the action of oceanic currents and of storms in the distribution of species, and by their means he explains, as it seems to me very happily, the peculiarities of the faunas of the Azores, the Bermudas, the Gallapagos, and other remote island groups.

Professor Semper, too, examines very fully the agency of currents both as promoting and as limiting the distribution of animals, and as sometimes checking the formation of new species. As regards the action of the wind in regulating

the fauna of the West African islands above referred to, he agrees substantially with Wallace.

With reference to the zoo-geographical classification adopted by our illustrious countryman, he remarks, however, that it is scarcely possible to conceive a greater contrast than that existing between the fauna of Hong Kong, Amoy, or even Siam on the one hand, and that of Borneo, Java, and Sumatra on the other,* a distinction which is repeated in a very striking manner in the Phillippines, whose northern portion shows an unmistakable approach to the true Chinese type, whilst the southern islands point very decidedly towards Borneo on the one hand, and towards Celebes and Gilolo on the other. These features may be traced in the mammals, fish, reptiles, insects, and very clearly in the mollusks. What may be called the endemic fauna of the islands occurs in its nearest approach to purity in the centre of the group. These characteristics he explains by oceanic currents and by the changes of the monsoons. He does not, however, suppose that affinities between locally remote faunas can be universally thus explained.

We meet, further, with a criticism of Wagner's "Theory of Migration," which Prof. Semper considers as not really in opposition to Darwinism, as its author supposes, but as therein included. It may be said, then, when Mr. Wallace declares that species can arise only where there is room for them, he gives all that is really valuable in this supposed new theory.

Prof. Semper deals thoroughly with the vexed question of hybridism, refuting *seriatim* the four positions of the old school, viz., that hybrids do not exist at all, save in a few exceptional cases; that, if produced, they are always, or nearly always, unfruitful; that hybridisation never occurs without human intervention; and that species which have been known to produce fertile hybrids are mere varieties, morphologically but not physiologically distinct. All these popular delusions are completely shattered to pieces by the facts here adduced, observed among mammals, birds, reptiles, fishes, insects, and even mollusks. One of the most interesting cases is that of *Tetrao medius*, now known to be a hybrid between the great *Tetrao urogallus* (cock of the woods, or capercailzie) and the black-game, *Tetrao tetrix*, and which in many districts is fast superseding the latter. But the most important lesson hence to be learnt is that in hybrids there

* It must here be remembered that Mr. Wallace places the former realms in the Indo-Chinese, and three latter in the Indo-Malayan sub-division of his Oriental region.

appears not merely an intermixture in varied proportions of the parental attributes, but the latter are rendered unstable or mobile, and the young become more easily modified by the conditions in which they are placed. A splendid field for experimental research is here opened.

Mr. Wallace does not discuss hybridism and its consequences. But he holds that species are not all and at all times equally variable, and he shows reasons for assuming that the present condition of the earth is one of exceptional stability as to climate, and consequently of exceptional stability of species. It need scarcely be said that these considerations supply the solution of certain serious difficulties. They meet the objection of the almost infinite lapse of time required for the evolution of species, if its rate is supposed to be constant: they answer—if any answer is needed—the cavil that none of us have witnessed the evolution of a new species, and they will surely satisfy those "eingefleischte anti-Darwinianer" who still cling to the "Egyptian" fallacy.* It is remarkable that the the climatic conditions of Egypt have probably undergone less modification during the past three thousand years than those of most other countries. If, then, its present animals are exactly similar to those found as mummies or depicted on its monuments, the fact is in accordance with, and not in opposition to, the doctrine of Evolution.

Prof. Semper gives a much-needed caution against the too common error of arguing from the position of an animal in the zoological series and from the structure of its organs, *e.g.*, its dentition, to its habits and its selection of food. The well-known pond-snail, *Lymnæus stagnalis*, belongs not merely to a herbivorous group of snails, but its teeth are formed on the true plant-eating type. Yet it attacks and devours the small water-newt, *Triton tæniatus*, even in an aquarium full of flourishing water-plants. The present writer has seen the same species feasting on frog spawn, though there was at hand vegetable food in abundance. Some of the rodents are purely vegetarian; others, with similar dentition, are semi-carnivorous, like the rat or the squirrel, which the author very correctly pronounces "the greatest enemy of our song birds, whose eggs and young it devours in great numbers."†

He holds that "by far the greater number of animals

* Journal of Science, 1880, p. 166.

† As this marauder has also a decided taste for wall-fruit he ought to be extirpated wherever practicable.

depend upon light only through the mediation of the eyes." With all due deference I must beg to point out that according to the researches of Moleschott and Fubini (*Mitheilungen aus dem Embryologischen Institut zu Wien*, iv., p. 265) "the action of light in promoting the metamorphosis of matter is exerted not merely through the eyes but through the skin, and can be traced even in blind frogs, birds, and mammals. If the eye alone or the skin alone is stimulated by light, the increased escape of carbonic acid is smaller than when the entire body is exposed to light.

With reference to the brilliant colouration of the sea-anemones and the true coral-polypes often compared to submarine flowers, Prof. Semper shows that this beauty is not to be explained on the principle of sexual selection. Both males and females being rooted fast cannot seek each other, but emit their sexual secretions into the water, leaving it to the currents to effect the fertilisation of the ova. As little can the decoration of these polypes be classed among the "protective" or the "warning" colours. They are not concealed but rendered more conspicuous, both to their possible prey and to their enemies, and the latter, such as the *Scaridæ* and the *Diodontidæ*, are not in the least deterred by the sight. We must, therefore, refer these colours to the "typical" class described by Mr. Wallace.*

Prof. Semper is, however, inclined to hope that both the production of pigments and their distribution in different parts of the animal system may be soon rendered intelligible. He admits the existence of mimicry, as established by Bates and Wallace, and detects instances of it even among snails. But he adds the caution that any agency which may, indeed, select, but is unable to transform, cannot be regarded as the efficient cause of any phenomenon. This warning, which the author reiterates, marks his distinction from that of not a few naturalists who have dealt with the question of Evolution. But the same lesson is to be found, though perhaps less explicitly, in the work of Mr. Wallace. He, too, urges that geographical and geological changes, "the alternations of warm and cold, or of uniform and excessive climates—of almost perpetual spring in arctic as well as in temperate lands, with occasional phases of cold culminating at remote intervals in glacial epochs," have played not a mere selecting but a modifying part, and have thus produced "some of the more remarkable changes in the specific character of organisms." Hence it is plain that the co-discoverer of "natural selection" guards

* Macmillan's Magazine, Sept., 1877, p. 392.

us against the popular error of ascribing to such selection the origin of the variations upon which it has afterwards to act. In one case Mr. Wallace advances statements which have the semblance at least of discrepancy. On p. 73 he remarks that "reptiles appear at first sight to be as much dependent on land for their dispersal as mammalia, but they possess two peculiarities which favour their occasional transmission across the sea—the one being their greater tenacity of life, and the other their oviparous mode of reproduction." Yet on p. 319 we read:—"To this cause we must impute our comparative poverty in mammalia and reptiles—more marked in the latter than the former, owing to their lower vitality and smaller powers of dispersal."

Mr. Wallace's sections on the permanence of the distribution of land and water and on the causes of glaciation must be passed over, as I find that they will be considered separately in some future number of the "Journal of Science."

Prof. Semper's introductory chapter is fraught with useful lessons which are sometimes left out of view even by the more advanced student. The author considers the distinctions between adaptive and hereditary peculiarities. He shows that parts, which from their adaptive character have little or no meaning in determining the affinities of the higher systematic groups, acquire a very great diagnostic value for smaller divisions, within which they must rank as hereditary. Hence it is impossible to draw an *à priori* distinction between adaptive and hereditary characters. He shows the necessity for the naturalist, of a "physiology of organisms" superadded to the physiology of organs which has been vitiated by being ordinarily treated and, studied exclusively with reference to medical practice. This is a deplorable fact. It may be inquired what would be the state of chemistry if cultivated merely from a pharmaceutical point of view, or of astronomy if confined to the service of navigation? If it be asked what is such a "physiology of organisms," the author replies that it comprehends all those laws which are perceived on investigating the vital relations of different animal species to each other, and to the conditions by which they are, as such, preserved, destroyed, or transmuted. As an instance of the problems with which this branch of science has to deal he mentions the discovery of the causes which have led, in vertebrate animals, to the development of the two pairs of limbs and two only.

There is very much more in this work well deserving of special notice, such as the account of the eyes—of the true vertebrate type—found in the back of the molluskous genus

Oncidium, and the author's speculations on their origin. But space forbids any further remark or exposition, save of Prof. Semper's hypothesis of coral formations, which cannot be passed over in silence.

Few men of general reading are in these days ignorant of the theory now generally received on this subject. It was first propounded by Mr. Darwin in his "Naturalist's Voyage," and explained more in detail in his subsequent treatise on the "Structure and Distribution of Coral Reefs," and was independently discovered by Prof. Dana.* Its leading points may be shortly recapitulated as follows:—There are three great classes of coral reefs, atolls, barriers, and fringing reefs. The first kind are ring-like reefs enclosing a lagoon or tract of water; the second class "either extend in straight lines in front of the shores of a continent or of a large island, or they encircle smaller islands; in both cases being separated irom the land by a broad and rather deep channel of water, like the lagoon within an atoll." The fringing reefs where the land slopes abruptly under water are only a few yards in width, but where the slope is gentle there may be a channel—usually narrow and shallow—between the coral formation and the land.† Mr. Darwin's theory is that the atolls and the barrier reefs are founded on and intimate areas of subsidence, the coral polypes building in shallow water and working upwards as the foundation subsides. Fringing reefs, on the contrary, show that the shore must either have remained stationary or have been elevated.

Professor Semper, during a somewhat prolonged residence in the Pelew Islands, has been led to decidedly different conclusions. In these islands he has found shallows without any reefs closely bordering on atolls. The west coast of this group is steep, whilst the eastern shores slope very gradually down. According to the Darwinian theory there should hence be a fringing reef on the western side and a barrier on the eastern. The reverse is the actual case. On the eastern side there is a fringing reef, whilst on the western is found a barrier reef four or five miles from the land, and interrupted by three channels which do not lie opposite the mouths of rivers, or even of streamlets. He considers that the occurrence of large detached blocks of coral at the outer margin of all the reefs on the western side, the large, almost horizontal submarine plain to the north of Peleliu, the uninterrupted con-

* See Journal of Science, 1875, p. 534.

† Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. *Beagle*. By C. DARWIN. P. 472.

nection of the eastern reefs of Pelelin and Kreiangel with the dead elevated coral cliffs all argue against any recent subsidence. The author's own theory is that the growth of corals is chiefly influenced by the strength and direction of the oceanic currents. Wherever constant and deep currents strike a coast tangentially the reefs are compelled to grow vertically upwards, and on the other hand many corals have the tendency to spread out equally on all sides, as far as possible, when shallow currents sweep over them. He considers that the peculiarities of the Pelew reefs can all be explained by the action of such currents during a period of elevation.

He observes that certain corals, such as the Astreæ and Porites, form circular masses of a regularly convex surface. The polypes on the summit are as well developed as those on the sides, so long as they are never laid dry at time of ebb. Larger blocks of the same kinds become flat on the summit, which is exposed even at ordinary ebbs, the polypes being dead and covered with sand and sea-weed. In still larger masses the surface is concave with an elevated margin, presenting, in fact, the likeness of an atoll in miniature.

It is obvious that if Professor Semper's theory holds good, much of our present conclusions concerning supposed areas of subsidence will require to be carefully reconsidered. On Mr. Darwin's hypothesis an atoll in the present day is the monument over, or rather around, the grave of a submerged island. At an earlier date it must have been a barrier reef surrounding a small, generally mountainous, plot of land. Would it not be important to search whether at or near the centre of a lagoon within such atolls there could be found traces of rocks other than coral or its transformations? It will also be essential to examine the relations of the more characteristic atolls, barrier reefs, and fringes, to prevailing currents.

Regretting the necessary shortness of this survey of the teachings of two most significant works, I must recommend them to the careful study of the reader.