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CHAPTER V.

The strongest evidence of the decay of Darwinism is to be found in the fact that, since Darwin first enunciated his theory, many and diverse attempts have been made to explain the origin of species on other principles. Names of men, like M. Wagner, Naegeli, Wigand, Koelliker, and Kerner mark these attempts; but of these investigators Naegeli alone proposed a well-developed hypothesis. Finally, however, Eimer, professor of zoology in Tuebingen came forward with a detailed theory of Descent. As early as 1888 he published a comprehensive work dealing with it, under the title: "The Origin of Species by Means of the Transmission of Acquired Characters According to the Laws of Organic Growth." As the title itself indicates, a very marked divergence was even at that time manifesting itself between Eimer and his former teacher and friend, the great defender of Darwinism in Germany, Aug. Weismann, professor of zoology in Freiburg in Breisgau. For, while the latter vigorously attacks the transmission of acquired characters, Eimer's whole theory is founded on this very transmission. Observations regarding the coloring of animals, in fact, form the basis of Eimer's theory.

Eimer attributes the origin of species to "organic growth" by which he means not merely increase in size, but also change of form, etc. This growth does not pro-

ceed blindly or aimlessly, but proceeds on rigidly determined lines, which depend upon the structure and constitution of the particular organism. External influences, however, also affect it. Eimer specially emphasizes four points in this connection: 1. This rigidly determined development of a character exhibits well defined, regular stages, and the evolution of each individual repeats the whole series of transformations (the Mueller-Haeckel "biogenetic-law." 2. New characters are first acquired by strong adult males (the law of male dominance). 3. New characters appear on definite parts of the body, spreading especially from the rear to the front, (the law of undulation). 4. Varieties are stages in the process of development, through which all the individuals of the respective species must pass.

These points indicate how important for Eimer is the transmission of those characters which the parents themselves have acquired in the course of their own development. He conceives that this transmission takes place when the causative influences exert themselves permanently on many succeeding generations. Eimer thinks that in this way the constitution of the respective species is gradually transformed. Besides the effect of external influences (which may vary according to the climate, etc.: Geoffroy St. Hilaire), Eimer mentions as important and active factors in this development, (1). The use and disuse of organs (Lamarck); (2). The struggle for existence (Darwin); (3). The correlation of organs, that is, the inner relation of organs in consequence of which a change in one organ may

occasion a sudden change in another organ; (4). Cross fertilization and hybridism.

It is clear that with reference to the factors of evolution Eimer is, and perhaps not unreasonably, an eclectic, whose aim is to do justice to the predecessors of Darwin as well as to Darwin himself. His antagonism to Darwin and Weismann in this work is still quite moderate, although even here it appears with sufficient clearness that selection and the struggle for existence, the two principles peculiarly characteristic of Darwinism, do not give rise to new species, but can at best only separate and differentiate species already existing.

The second part of Eimer's work dealing with the origin of species, which appeared after an interval of ten years, bears the title: "Orthogenesis of Butterflies." The Origin of Species, II. Part (2 tables and 235 illustrations in the text). Leipzig, 1897. In this book substantially the same thoughts occupy the mind of the author as in the former volume, but in many respects they are more mature, and conspicuously more definite and precise. The most salient features are the following:

1. Eimer establishes his theory by means of very minute observations on a definite species of animals, viz., butterflies.

2. He attributes evolution almost exclusively to development along definitely determined lines.

3. He proves the utter untenableness of Darwinian principles and repudiates them unqualifiedly.

4. In a very distinct and severe manner he gives expression to his opposition to his former friend Weismann.

5. He attacks with telling effect the fantastic Darwinian "Mimicry."

In his "General Introduction" Eimer first treats of Orthogenesis in opposition to the Darwinian theory of selection. The very first sentence gives evidence of this antagonism: "According to my investigation, organic growth (Organophysis), which is rendered dependent on the plasm by permanent external influences, climate and nourishment, and the expression of which is found in development along definitely determined lines, (Orthogenesis), is the principal cause of transformation, its occasional interruption and its temporary cessation and is likewise the principal cause of the division of the series of organisms into species."

Lamarck's theory of the use and disuse of organs and Darwin's hypothesis of natural selection are consequently pushed into the background. Here also Eimer at once places himself at variance with Naegeli who had enunciated a similar theory. Naegeli took as a starting point an inherent tendency in every being to perfect itself, thus presupposing an "inner principle of development," and making light of external influences as transforming causes. Eimer flatly contradicts this view. We shall revert to this point in our criticism of his theory. In opposition to the theory of selection, Eimer lays special stress on the fact that its underlying assumption, viz., fortuitous, indefinite variation in many different directions, is entirely devoid of foundation

in fact, and that selection, in order to be effective, postulates the previous existence of the required useful characters, whereas the very point at issue is to explain how these characters have originated. Since, therefore, according to Eimer's investigations, there are everywhere to be found only a few, definitely determined lines of variation, selection is incapable of exercising any choice. The development, furthermore, proceeds without regard for utility, since, for instance, the features that characterize a species of plants are out of all reference to utility. "Even if nothing exists that is essentially detrimental, nevertheless very much does exist that bears no reference whatever to immediate good, and was therefore never affected by selection."

Further on, Eimer expresses still more clearly the opposition of his theory to that of Darwin, and in so doing he attacks vigorously the omnipotence of selection, so unreasonably proclaimed by the followers of Darwin. Eimer's theory, consequently, asserts that: "The essential cause of transmutation is organic growth, a definite variation, which, during long periods of time proceeds unswervingly and without reference to utility, in but few directions and is conditioned by the action of external influences, of climate and nourishment." In consequence of an interruption of orthogenesis a stoppage ensues in certain stages of the development, and this stoppage is the great cause of the arrangement of forms in different species. Of vital importance also "is development through different stages (Hetero-epistase), which results in the arrested devel-

opment of certain characters in an organism, while others progress and still others become retrogressive. As a rule use and disuse are of great efficacy in this regard, and conjointly with these compensation and correlation." Occasionally also irregular development sets in, which proceeds by leaps.

Of course, Eimer could not but in his turn burn incense before Darwin by declaring that he would not dare to cross swords with such a man, while in reality he repudiates all of Darwin's fundamental tenets.

It may be well to state here in addition a few important supplementary considerations: "Development can everywhere proceed in only a limited number of directions because the constitution, the material composition of the body, conditions these directions and prevents variation in all directions." This is an important statement because Eimer clearly expresses therein the difference between his own theory and that of Naegeli. He makes the direction of development dependent on the material composition of the body, whereas Naegeli considers it dependent upon an internal tendency of every being to perfect itself, hence upon a power inherent in the body. Eimer's view therefore tends towards a mechanical explanation, while Naegeli postulates a vital energy. The "internal causes" according to Eimer find their explanation in the material composition of the body. Since the growth of the individual organism depends on this composition and on the external influences, Eimer compares family-development with it and designates the latter as "organic growth." In opposition to Naegeli

he maintains that this "organic growth" does not always aim at perfection but often tends to simplification and retrogression.

The following, then, according to Eimer, are the directive principles of variation: (1). The general law of coloration (stripes running lengthwise change into spots, stripes running crosswise change to a uniform color). (2). The law of definitely directed local change (new colors spread from the rear to the front and from above downward or vice versa, old colors disappear in the same directions). (3). The law of male predominance (males are as a rule one step in advance of the females in development). Female predominance is an exception. (4). The law of age-predominance (new characters appear at a well-advanced age, and at the time of greatest strength). (5). The law of wave-like development (during the course of the formation of the individual organism a series of changes proceed in a definite direction over the body of the animals). (6). The law of independent uniformity of development (the same course of development is pursued in non-related forms and results in similar forms). (7). The law of development through different stages (different characteristics of the same being may develop to a different degree and in different directions). (8). The law of unilateral development (the progeny does not present a complete combination of the characters of the parents but manifests a preponderance of the characteristics of either parent). (9). The law of the reversal of development (the direction of development may reverse and tend towards the

starting point). (10). The law of the cessation of development (a protracted cessation of development frequently ensues in one or the other stage).

The origin (perhaps rather the distinction) of species is accounted for principally by the last named law, by means of which Eimer also explains the so-called atavism or reversion. To this law are joined other factors, e. g., development proceeding in leaps, as demonstrated by Koelliker and Heer; local separation (through migration; prevention of fertilization, e. g., the impossibility of cross-fertilization between certain individual organisms (which Romanes had already opposed to natural selection), and crossing.

The second main division of the book is taken up with a very searching and detailed criticism of Weismann. This criticism seems to me entirely warranted; because not only the latter's unintelligible position with regard to natural selection (the repudiation of which he seems to regard as synonymous "with cessation of all investigation into the causal nexus of phenomena in the domain of life") but likewise his fanciful theory of heredity, utterly devoid as it is of any support from actual observation, bespeak an utter lack of qualities essential to a naturalist; and the manner in which he ignores his former pupil and his labors, because they proved embarrassing to him, is entirely unworthy of a man of science.

Eimer devotes special attention to "mimicry"; and indeed he was forced to be very solicitous to dispel this fanciful conception of Darwinism which radically contradicted

his own views. Moreover, the untenableness of the mimicry hypothesis must have revealed itself very clearly to him in the course of his investigations regarding the coloring of butterflies. Mimicry, as our readers are well aware, consists in this, that living beings imitate other organisms or even inanimate objects; Darwinism maintains that this is done for the sake of protection against enemies. This phenomenon is said to have been produced by selection. Those animals that possessed, for instance, some similarity to a leaf, in consequence escaped their enemies more easily than others and survived, while those that had no leaf-like appearance succumbed; when this process had been repeated a few times, many animals (butterflies) gradually developed that marvelous leaf-like appearance, which frequently deceives the most practiced eye.

It appears so simple and natural that one need not wonder that this peculiar phenomenon gained many an adherent for Darwinism. But, of course, it is directly opposed to the views of Eimer; and it is for this reason that he endeavors so assiduously to disprove the error of Darwinism in this regard. As the underlying color design of the butterfly Eimer designates eleven longitudinal designs; and the examination of the leaf-like forms leads him to the conclusion, that their appearance always depends on "the unaltered condition or the greater prominence of certain parts of this fundamental design." There is to be observed a shifting of the third band, so that in conjunction with the fourth, which is curved, it forms the mid-rib of the leaf. Eimer finds the cause of this phenomenon in the alteration

of the form. The leaf-like form results from an acumination and elongation of the wings, which in turn results from a marked elongation of the rim of the fore-wing. And this again is produced by the proportionately greater growth of one part of the wing-section than of the others.

With reference to the reason of this growth it is of importance to note that experiments, consisting in the application of artificial heat to the chrysalis of the swallow-tail and sailor-butterfly, demonstrated that by this means "the fore-wing is drawn out more toward the outer wing-vein, and the rim of the fore-wing becomes more elongated and curved." It is observed, however, that the natural heat-forms of the same genera and species, namely, the summer-forms and those which live in the warm southern climate, exhibit, for instance, in the case of butterflies akin to the sailor, the same features, the elongation and more marked curvature of the fore-rim of the fore-wings and the consequent more extended form, that are produced by the action of artificial heat. Manifestly this is a matter of vital importance for the solution of the question; heat, whether artificial or natural, produces a difference in growth, which results in a change of form and coloring. There is consequently no room for natural selection or the struggle for existence.

The leaf-like form is generally associated with the dark, faded colors of dry leaves, and when this similarity disappears even bright colors appear on the fore-wings. In many cases the resemblance to leaves is very imperfect;

different forms of the same species live side by side and among them are to be found those, the resemblance of which to leaves is extremely slight. All these facts, and especially the frequently recurring retrogression of the leaf-like appearance, justify serious doubt regarding the Darwinian assumption, that adaptation was a necessity for the forest-butterflies on account of the protection which it provided.

An eye witness furthermore declares that the butterflies that resemble leaves most closely do not always alight on withered leaves, on which they would be almost invisible, but frequently rest on a green background, against which they show off very clearly, and therefore could not long escape the keen eye of birds. Besides, these butterflies are but seldom pursued by the birds, of which there is question here, and hence are in no need of protection.

The longer Eimer devoted his attention to the origin of this resemblance the more "the poetic picture of the imitated leaf" vanished out of sight, and he became convinced that it involved the necessary expression of the lines of development, which the respective beings were bound to follow, and that there was no question of imitation.

Apart from the resemblance to leaves, by reason of regular changes of color, design, and wing-structure, numerous non-related butterflies often develop such wonderful similarities—which are not, as hitherto supposed, imitations or disguises produced by selection, but are either the outcome of an entirely independent uniformity of development or, at least, of its consequence—that it must be

admitted that external similarity may arise by different means and in various ways. These relations of similarity are of such frequent recurrence because of the limited number of directions of development in which changes of color and design in butterflies may tend. Eimer finds the reason of this small number of directions, in which development may proceed, in the fact "that the elementary external influences of climate and nourishment on the constitution of the organism are everywhere the cause of the transformations."

Another important point is the difference of sex. If the butterflies are of different sex, the males as a rule exhibit a more developed stage of design and color than the females. These frequently present on the upper side the stage of coloration, which the males present on the lower side, while the upper side of the males is one stage in advance. It is of special significance that the characters of the more advanced sex frequently correspond to those of a related, superior species, and occasionally to those of widely separated species. Eimer endeavors to explain male predominance "by a more delicate and more developed, i. e., more complex, chemico-physical organization of the male organism." Even this development tends toward simplification, the origin of dull-black colors.

This most interesting question brings Eimer into conflict with another Darwinian principle, the so-called principle of "sexual election," according to which the more striking characteristics of the male sex become strengthened for the reason that females invariably give the prefer-

ence to the males endowed with them, over those that are less "attractive." These exceedingly romantic ideas have been often and deservedly repudiated, e. g., even by Wallace only a short time after their first appearance. Eimer really does them too much honor when he again undertakes, even with a certain amount of respect, a thorough refutation of them, "as in every regard unfounded." It is of primary importance to note here, that in the case of dimorphism of the sexes abrupt modifications occur in connection with unilateral heredity. "It is impossible for sexual selection to produce a change of design and color, which results in the sudden kaleidoscopic formation of wholly different designs, as we find actually taking place through the action of artificial heat and cold and other factors in nature."

This brings us to a brief consideration of the answer, which Eimer proposes to give to the question of the real causes of the formation of species among butterflies. A precise and clear statement of this important part of Eimer's theory of Descent, is contained in the following extracts: "The transformation of organisms is primarily conditioned by the action of immediate external influences on the organisms. The same causes, which produce individual growth, especially climate and nourishment, also produce the organic growth of organisms, that is, transmutation, which is but a continuation in the progeny of individual growth, through the transmission of the characteristics acquired during the lifetime of the individual."

Hence, transmutation is simply a physiological process, a phyletic growth.

The changes, which the individual organism experiences during its life in its material, physiological and morphological organization, are in part transmitted to its progeny. The changes thus acquired become more marked from generation to generation, until finally they result in a perceptible new structure."

"In this process, new or changing external influences undoubtedly exercise great activity, but the same influences, constantly repeated, must in the course of time also produce a change in the organisms through the physiological activity, which is conditioned by them, so that after a long time elapses, a species will have changed even in an unvarying environment and will react on new influences in a manner quite different from their progenitors; their "constitution" has undergone a change."

"This organic growth of living beings takes place regardless of the active use of the organs and in many cases remains independent of this (Lamarckian) factor of transformation. But use may exercise considerable influence on the formation resulting from the primitive organic growth, by modifying the growth, by restricting it to those parts most frequently called into use, or even by depriving other parts of the necessary matter (compensation)."

"The Lamarckian principle, therefore, offers but a possible aid to transformation, the principal cause is to be found in organic growth."

"* * * The organic growth of butterflies is primarily conditioned by climatic influences. * * * The proof is to be found in the facts revealed by the geographical distribution of butterflies, by the variations corresponding to the seasons, and by experiments regarding the influence of artificial heat and cold on development."

Experimental proof is naturally of vital importance for Eimer's theory. He cites in this regard especially the experiments of Merrifield, Handfuss, Fischer, Fickert, and Countess Maria von Linden. In Eimer's own laboratory the latter performed experiments on Papilionides, "which prove in the most striking manner the recapitulation of the family-history in the individual." "The fact that it is possible by raising or lowering the temperature during the time of development to breed butterflies, possessed of the characteristics of related varieties and species living in southern and northern regions respectively, characteristics not merely of color and design, but also of structure, is complete irrefragable proof of my views."

Eimer therefore belongs to the class of naturalists, like Wigand, Askenasy, Naegeli, and many others, who reject the purely mechanical trend of Darwinism and recognize an "immanent principle of development." He seeks the essential cause of evolution in the constitution of the plasm of organisms. This very analogy between the development of the family and that of the individual should, in fact, convince any one of this. If Eimer chooses to refer the analogy to "growth" and to designate the evolution of

the whole animated kingdom as also a process of growth, there is, strictly speaking, no room for objection. However, there is here a danger, which he does not seem to have guarded against. To designate the whole process as a growth, as Eimer does, really explains nothing, but merely defines more clearly the status of the problem. For, what do we know of the so-called process of growth? In truth, nothing, so that very little is gained by referring evolution to organic growth; the problem remains unsolved.

The most important and correct part of Eimer's conclusion seems to be the establishment of definite lines of development. He has, in fact, permanently disposed of the Darwinian assumption of universal chaos in evolution, upon which good mother Nature could at will exercise her choice. Fortuitously initiated development is a *conditio sine qua non* of Darwinism and Weismannism. For any one, who has studied the work of Eimer and still adheres to this fundamental error of Darwinism, there is no possible escape from the labyrinth into which he has allowed the hand of Darwinism to lead him.

If, on the one hand, Eimer recognizes the immanent principles of development, he, nevertheless, on the other hand, also accords due consideration and ascribes great efficacy to external influences; in fact, he represents them as perhaps the more essential factor. Climate, nourishment, etc., affect the inner structure, the plasm, transform it and thus produce variation which is transmitted to the

progeny. But, however great may be the influence of environment, Eimer seems to overestimate it. Indeed, the analogy of "growth" should have led Eimer to a conception of the true relation between "internal" and "external" causes. Warmth, air, light, moisture and nourishment, are undoubtedly necessary factors in the process of growth, but they are only the conditions which render it possible, and not the causes which produce it. The latter are to be found in the individual organism itself. The conditions may be ever so favorable and well-adapted for growth, still the organism will not develop unless it bear within itself the power to do so. On the other hand, although it is hampered and may become abnormal, it will readily grow even in an unfavorable environment, as long as it retains its inherent vital force. The same is very likely true of the genealogical growth. Evolution took place in virtue of the power inherent in the developing organisms. But only when the environment was favorable and normal, did the evolution proceed favorably and normally, that is, toward the perfection of the animate kingdom.

It appears as if the internal principle of development were losing influence and significance with Eimer; but the ulterior reason for this is not far to seek. Whoever recognizes the validity of the internal principle of development, eliminates chance, that stop-gap of materialism, from evolution, and is led at once to a supreme Intelligence which directs evolution. As soon as it comes in sight, however, certain persons take fright and turn aside or even turn back in order to avoid it. This was the case with Eimer, al-

though perhaps in a lesser degree. This is sincerely to be deplored, since his theory would have gained in depth if he had but done full justice to the internal principle of development. For the same reason he seems to have attacked Naegeli's principle of perfection, another fact which is very much to be regretted. True, it is as anti-mechanical as it can be and hence has gained but few adherents; but it is based on truth nevertheless, and will some day prevail in the doctrine of Descent.

It is perfectly intelligible that the thought of "perfection" should not have occurred to Eimer or should have slipped his memory during his observations on butterflies. The fact however, reveals a one-sidedness which he could have avoided. When the notion of utility is rejected—and Eimer rejects it very emphatically in his discussions on mimicry—it is undoubtedly difficult to arrive at the concept of a perfecting tendency. This, however, can in no way mean that this concept should be entirely banished from nature, even as the notion of utility cannot be banished. Even if the coloration and design of the wings of the butterfly do not reveal utility, other characteristics certainly do reveal it. It is one of the fatal mistakes of Darwinism, that it fails to recognize the possibility of dividing the characters and qualities of organisms into two large groups, as I attempted to do with more detail, for instance, in my "Catechism of Botany." There I called them (p. 89) "Autochthon-morphological" and "adaptive-morphological characters." The former reveal no relation to utility, they are innate and distinguish the organ-

ism from other organisms; the latter can be explained by means of certain vital functions, hence they possess a certain utility and adapt themselves more or less to environment. The former are permanent, the latter changeable. Darwinians regard all the characters of organisms as useful, physiological, and adaptive. If they have been hitherto unable to make good this assumption, they appeal to our lack of knowledge and console themselves with the thought that the future may yet reveal the missing relations. The presence on plants and animals of any autochthon-morphological characters means death to Darwinism, because these can never be explained by means of selection and struggle for existence.

Eimer is too much inclined towards the other extreme; he does not admit the existence of adaptive-morphological characteristics. Viewed in this aspect, his repudiation of mimicry may perhaps also seem somewhat harsh and one-sided. In this narrowness of view must also be sought the reason for his complete repudiation of Naegeli's principle of perfection.

It is an incontrovertible fact that in the organic world there exists an ascending scale from the imperfect to the perfect. Every organism is indeed perfect in its own sphere and from its own point of view. But perfection with reference to things of earth is a very relative concept; many an organism which is perfect in itself, appears very imperfect when compared with others. If, then, there is a gradation of animals and plants from the lower to the higher, it is the task of the theory of Descent to explain

this gradual perfection. The crude and aimless activity of Darwinian selection, which necessarily operates through "chance," can never explain this perfection, which remains, as far as selection is concerned, one of the greatest enigmas of nature. Far from solving the enigma, selection but makes it obscurer.

If, then, one refuses to recognize a directing creative Intelligence, whose direction produces this perfection, nothing remains but Naegeli's principle of perfection. The outer world with its influences can certainly not produce perfection, hence this power must lie within the organism itself. But when one has once brought himself to accept an immanent principle of development, it surely cannot be difficult to take the next step and ascribe to it the tendency towards perfection.

That Eimer does not take this step, is, to my mind, a mistake, which must be attributed to his one-sidedness, which, in turn, results from the fact that he generalizes too arbitrarily his observations on butterflies and the conclusions which he draws from them. Animals and plants certainly possess many characteristics which cannot be explained by means of his theory alone. The conclusion will probably be finally arrived at, that nature is inexhaustible and many-sided, even in the lines on which it proceeds to attain this or that end.

One thing, however, of primary importance is evident from the investigations of Eimer, namely the proof that the same lines of development may be entered upon from entirely different starting-points, and that the number of

these lines is limited. This fact is of importance because it enjoins more caution in arguing from uniformity of development to family-relation, than has been usually employed since the days of Darwin. The method commonly employed is undoubtedly very convenient, but is somewhat liable to be misleading. Hence, if one wishes to establish the genealogical relationship of forms, nothing remains but to set out on the laborious path of studying the development of both; and even then it remains questionable whether the truth will be arrived at. However, he who concludes to relationship from a comparison of developed forms, is much less likely to arrive at the truth.

In one point Eimer concedes too much to Darwinism, in the matter of the famous fundamental principle of biogenesis, according to which an organism is said to repeat in its individual development the whole series of its progenitors. Although he does not enter upon a discussion of the principle, it is evident from one passage that he accepts it. One is inclined to think that his careful observations and experiments should have convinced him of the contrary. It appears to me, at least, that the abundant materials of his observations bear evidence radically opposed to the principle. During late years, the antagonism to it has been on the increase, and the day is not very distant when it shall have passed into history. It would certainly be a laudable undertaking to enter upon a thorough investigation of the actual basis of the principle.