level in latitude 45° and under normal conditions, 0.089873 ± 0.0000027.

In 1891 Prof. Morley published* a series of determinations of the volumetric composition of water. The results of these determinations were extremely concordant and there can be no reasonable doubt that the same ratio would be obtained again by the same method. When, however, this ratio is combined with the ratio of the densities given above, the resulting value for the atomic weight of oxygen does not agree with that which Prof. Morley has obtained by the direct weighing of oxygen and hydrogen and of the water formed by their union. Scott has recently determined† the volumetric ratio and finds the value 2.00285. This ratio, when combined with the ratio of densities as found either by Lord Rayleigh or by Prof. Morley, gives the same value for the atomic weight as that found by the gravimetric method. Prof. Morley has, therefore, determined the volumetric ratio by another method. In a series of ten experiments he determined the density of electrolytic gas obtained from a solution of caustic potash. He also determined the excess of hydrogen present in the gas. From the results obtained, and, taking into account the change in pressure occasioned when one volume of oxygen is mixed with two volumes of hydrogen and the mixture is made to occupy three volumes, the value 2.00269 for the volumetric ratio was calculated.

It seems to be established, therefore, that the values obtained by Prof. Morley with the eudiometer were not correct as representing the volumetric ratio and that the density of a gas in a tube is different from that in a globe, the effect on the density being different for a light gas from that for a heavy one.

The gravimetric composition of water was determined in a series of twelve experiments. In these the oxygen was weighed in large globes, the hydrogen (three and one-half grams), in palladium, and the two gases were burned in an apparatus so devised that the water formed was also weighed. In this way each experiment gave two independent determinations of the atomic weight of oxygen.

* Amer. Journ. of Science, *41*, 220.

† Phil. Trans. *184*, A, 543 (1893).

The results were:

From the ratio of hydrogen and oxygen,	15.8792
From the ratio of hydrogen and water,	15.8785

These values agree to the third decimal with the value calculated from the volumetric composition and the ratio of densities as given above.

The final results of Prof. Morley's determinations are:

	Grams.
Weight of one liter of oxygen, latitude 45°,	1.42900
Weight of one liter of hydrogen, latitude 45°,	0.089873
Atomic weight of oxygen, chemical method,	15.879
Atomic weight of oxygen, physical methods,	15.879
Molecular weight of water, chemical method,	17.879

In conclusion a summary of previous determinations of the constants in question is given. Omitting the earlier determinations, which were manifestly inaccurate, and the results of one more recent experimenter, whose work appears to have been affected by some source of constant error, the mean of all the other determinations of six different observers gives the value 15.879 for the atomic weight of oxygen.

It is impossible, in a brief sketch of this kind, to convey any adequate idea of the pains which was taken at every step to secure the greatest possible accuracy in the work, nor of the genius which has been displayed in devising complicated apparatus adapted for the determinations to be made. The work is classical and must, hereafter, be consulted by every one who wishes to do the best work in this field.

W. A. Noyes.

EIMER'S EVOLUTION OF BUTTERFLIES.*

Prof. Eimer, of Tübingen, is an enthusiastic opponent of Darwin's theory of Natural Selection, and has a theory of his own to replace it. The theory of Eimer has been defended by him on various occasions, his main exposition being given in his work on the origin of species published in 1888. His investigations on butterflies (thus far of the genus Papilio *auct.* only) are intended to afford proof of his theory in a

* Die Artbildung und Verwandtschaft bei den Schmetterlingen. II. Theil. von Dr. G. H. Theodor Eimer unter Mitwirkung von K. Fickert. Text 8vo. Pp. viii, 153. Atlas Folio Tafeln v.–viii. Jena, Gustav Fischer. 1895.

special case. His standpoint is indicated in his preface, in which he says:

"My butterflies demonstrate, as said above, the impotence of natural selection over a wide territory; their formation of species occurs evidently without any influence of Darwinian selection, and, therefore, disproves Darwinism completely. * * * * *There is no origin of species by natural selection*, but only a preservation of species already existing. The assumption that natural selection can bring forth new species rests upon a gross defect of reasoning (Denkfehler). Natural selection cannot cause new species to arise, either by the formation of new characteristics or by the division of existing chains of organisms into species. My butterflies show, in complete contradiction to the Darwinian doctrine, that new characters arise by development in a few predetermined directions (*Orthogenesis*) or by organic growth (*Organophysis*) from physiological causes. They show that it is essentially a still stand (*Genepistase*) at determinate stages of development, which separates a chain of organisms into species, together with certain other causes, such as the preventing of impregnation (*Kyesamechanie*) and development by jumps (*Halamatogenesis*)." *

He also claims that he presents only facts—no suppositions or hypotheses:

If Prof. Eimer's claims are correct, his researches mark one of the great epochs of biological discovery. It is, therefore, desirable to determine with precision the nature and value of the evidence which he presents.

The study of his work on butterflies (including both the present second part and also the first, published in 1889) shows that the facts of actual observation are solely the markings and geographical distribution of species of the genus Papilio *auctorum*. From these observations our author has deduced a systematic arrangement of several groups of species, so as to present them in what he believes to be their true phylogenetic relationships. From the standpoint of the systematic entomologist Eimer's work is certainly both interesting and valuable, since the figures and descriptions are very painstaking, and his groups are natural ones, and we may even go further and admit that his grouping of the species is in the main correct. Herewith we come, not without some surprise after the assurances of the preface, to the end of Eimer's positive facts. The remainder of his book is constructed of interpretations of the facts, and these interpretations cannot be designated otherwise than as a series of unproven assumptions and hypotheses. We may indicate the reasons for this characterization by a few illustrations of his reasoning. Thus he states (pt. i, p. 2) that in all animals longitudinal stripes are primary markings, longitudinal rows of spots secondary, and transverse markings tertiary. By this rule he is able to decide easily which living species of Papilio are nearest the ancestral forms. Surely such a universal rule needs to be demonstrated, not proclaimed *ex-cathedra*. His laws of the genesis of species are deduced thus: In a series of species of Papilio there may be ancestral forms with much black and descendent forms with little (Antiphates group), or just the other way the descendants blacker than the ancestors (Leosthenes-Ajax group) yet all the species concerned are living and no *proof* is offered that this or that form is ancestral, we are simply told that it is so. Again he finds a series of species, which differ from one another by the width of certain dark bands, each species taking its place according to the width of the bands. Such a series is his proof of *halmatogenesis*, and he entirely passes by the possibility that there may have been intermediate forms with the simple denial of their existence. Now it is certainly possible that the species of Papilio arise by discontinuous variation, to use Bateson's felicitious term, but between what seems possible in the present state of our knowledge, and absolute certainty there is a vast abyss, across which Prof. Eimer airily makes his way with the bare affirmation 'my butterflies prove halmatogenesis.' Not a word throws any light on the question how do they prove it?

Prof. Eimer lays stress upon the direction of the assumed development of a series of forms, and from the fact that a series of species may exhibit progressive increase in a certain character, he infers that the progress is a predetermined development. He overlooks this simple consideration *that no matter how evolution is caused it must be in some direction, and the mere observation of that direction cannot prove that there was a predetermining tendency to the ances-*

* Slightly abbreviated. The italics are the author's.

tral form to develop in that direction. Again a difficulty is encountered when we examine another of our author's fundamental principles, the inheritance of acquired characteristics, because the *assertion* of this principle is made and yet no demonstration of its truth is offered—it is at best a bold hypothesis.

Another peculiarity of the author's position is his serious misapprehension of Darwin's theory, which he mistakes repeatedly. He rejects Darwinism because it does not explain the origin of variations. Darwin, of course, did not attempt to more than suggest certain explanations, and his theory of natural selection does not depend on the origin of variations, but on the demonstrated fact that innumerable variations do occur and numerous variations have been transmitted. Prof. Eimer claims that his book should be 'read *and studied*,' in return we claim that before he again writes against Darwin, he should thoroughly master Darwin's chief work, the '*Variation of Animals and Plants.*' Until he has done that his attacks must remain unheeded, for they are only against a straw substitute for Darwinism.

Professor Eimer's book is a valuable contribution to descriptive entomology, and sets before entomologists a high standard of description and illustration of species. It is also an unsuccessful attempt to substitute for Darwinism a new theory of evolution, based wholly upon hypothetical assumptions, for no one of which is substantial proof offered, and so far from agreeing to the author's claim that his theory is a series of facts, we must, on the contrary, say that it is a collection of arbitrary assertions. He condemns Weismann very emphatically for speculating, and yet shows himself, perhaps, the more speculative of the two.

C. S. Minot.

The Structure and Life of Birds. By F. W. Headley, M. A., F. Z. S. London, Macmillan & Co. 1895. 8vo. Pp. xx. 412. 78 illustrations. $2.00.

This book "attempts to give good evidence of the development of birds from reptilian ancestors, to show that modifications in their anatomy have accompanied their advance to a more vigorous life, and, after explaining, as far as possible their physiology, to make clear the main principles of their noble accomplishment, flight, the visible proof and expression of their high vitality. After this it deals, principally, with the subjects of color and song, instinct and reason, migration and the principles of classification, and, lastly, gives some hints as to the best methods of studying birds."

Mr. Headley's aim is confessedly an ambitious one, and since he has shot so well he must not take it amiss if he is told that his pen has not carried quite true throughout its entire flight. It is difficult to compress so many subjects as are contained in the 'Structure and Life of Birds' into the compass of four hundred pages, and we can not expect to have every point touched on fully and clearly explained. Still, making due allowance for this and for the popular audience to which the book is largely addressed, there is a certain amount of looseness, or inexactness, of statement that might have been avoided. For example, uncinate processes are not 'common to all birds,' since they are absent in the Screamers, a fact which might have been explained in half a dozen words. Neither is the supplementary toe of the Dorking Fowl a dermal bone, but a case of duplication of a digit, the perpetuation by careful breeding of an abnormality now and then seen among animals, even in man. This looseness of diction is well shown by the constant reference to bones filled with marrow as *solid* bones; and the statement that the coracoid and clavicles are firmly fixed to the breast bone, when this is rarely the case; and those birds in which the clavicle is most securely fastened to the sternum are by no means among our best birds of flight. The statement that all the bones of the Swallow are filled with marrow is a little indefinite, and if intended as generalization, misleading, since the humerus may be pneumatic, even among Swallows.

However, pneumaticity is a very inconstant character and is not even of generic value. The connection between the reduced phalanges of the Swift and its alleged inability to rise from the ground is not clear to the average mind, and it is rather startling to be told that the Rook may be told from the Crow by the absence of feathers on the beak.

It would also have been well to have avoided positive statements concerning facts or theories still in debate, especially such an one as that the skull is no doubt partially made up of vertebræ, or that the pisiform is an ossified tendon. Neither do we *know* that an insect gets a mosaic picture of an object, while, had Mr. Headley heard the question of the sense of smell in *Cathartes* discussed, he might not be so certain that vultures do not scent carrion from afar, although neither that nor the contrary is yet proven. In discussing flight too much stress is laid on the importance of the clavicle. As the author states, the bone is rudimentary in parrots which fly exceedingly well, while any one who has dissected humming-birds will be morally sure, from its shape and insignificant proportions, that these birds could dispense with the bone. We are told that the wing serves as a parachute to sustain the bird between the strokes of the wing and, but for this, the drop would be greater than it is. A more obvious explanation would seem that there is not sufficient time for gravity to overcome the inertia of onward movement, for it is very evident that unless a bird is falling more rapidly than the wing is being raised, the wing can afford no support. Many other things might be said—did space allow—concerning the chapter on flight, but it will suffice to remark that there is as yet no proof that the muscles of birds exert any unusual power; on the contrary, birds which like the larger petrels have mastered the problem of sailing flight, not only have small wing muscles, but have very little strength in them, and it was pleasing to obtain from Prof. Moseley's notes corroborative evidence of the inability of the Cape Pigeon (*Daption*) to rise from the water after a hearty meal.

A word or two on another point. Why does Mr. Headley confuse the reader by calling both the leg of a man and the wing of a bird the homologue of the arm, when a better and clearer expression would be that the fore limb is the homotype of the hind?

But in spite of blemishes, some of which have been cited to warn the reader to be on his guard, and to use a pinch of salt now and then, the 'Structure and Life of Birds' is a most interesting book and a welcome addition to ornithological literature. Many of the errors may be ascribed to the fact that the author is so brimful of his subject that, writing as he does *calamo currente*, his ideas outstrip his pen and are incorrectly recorded. The style is bright, clear and readable, the illustrations illustrate and are not thrown in, while the numerous bibliographical references are not only a boon to the reader who would like to know how he may best extend his knowledge, but to him who would like to know on whose authority some of the statements are made. The book is evidently based on much observation and experiment, supplemented by a vast amount of reading, and it will give the general reader, and many a one who considers himself an ornithologist, a good idea of many of the facts and problems concerning birds. The reader will learn why the perching bird does not fall from the bough, even when asleep, will find full details of the wonderful air sacs with which the body is permeated, and much information as to how a bird breathes and how his blood circulates. He will gather that the colors of feathers are due to a variety of causes, and learn that they correspond to the scales of snakes as well as much of their growth and mode of shedding and renewal.

The chapter on flight is particularly full and interesting and this difficult matter is well treated, and it is to be hoped that the concluding chapter may stimulate some, at least, of its readers to address themselves to some of the many branches of ornithology which lie ready to their hand. Lastly, but by no means least, the book is well indexed.

F. A. LUCAS.

The Beginnings of Writing. By WALTER JAMES HOFFMAN, M. D. With an introduction by PROF. FREDERICK STARR. New York, D. Appleton & Co. 1895. Pp. xiv+209.

In this latest volume of the 'Anthropological Series' Dr. Hoffman has attempted to present in brief and popular form the results up to date of the researches into the origin of the art of writing.

The development of the use of conventional signs is traced from pictographs through symbols, mnemonic signs, etc., to alphabets, and

the result is a work not only of interest to the lay reader, but of considerable scientific merit and usefulness. The difficulty of selection from the mass of material, much of it of doubtful interpretation, to say the least, which the author had at his disposal must not be underestimated and to say, as we may, that he has accomplished his task with judgment is no mean praise.

The first four chapters of the book are taken up with a discussion of pictography, both descriptive and interpretative, and here, as was to be expected from the previous work of the author in the picture-writing of the North American Indians, he shows himself thoroughly at home. One of the main faults of the book may be mentioned here, and that is the almost overwhelming prominence given to American remains and records in nearly every question under discussion, a fault easy to understand when the volume of research and even relative importance of the pictographic remains of the aborigines of this and other countries is considered, and yet the idea of proportion which the general reader would obtain from the book must inevitably be a wrong one.

Of pictographs on stone those of the 'Algonkian type' are the most numerous and widely distributed, corresponding to the great area occupied by tribes of the linguistic family of that name. They appear to be mainly representations of animals or concrete objects and probably served as hunting or other records. The author points out that in nearly every instance these Algonkian petroglyphs have been placed upon rocks low down along the shore of water courses, whereas many of the pictographs of other types are placed upon high and conspicuous cliffs, in which case the drawings are apt to be colored.

In Mexico and Central America, petroglyphs are comparatively rare, while in South America investigation is at present not far enough advanced to present examples of much importance.

In the chapter on pictographs on materials other than stone, the art is traced through carvings and drawings on ivory, bone and shell, in which the Alaska Innuits especially excel, through birch bark records to the use of maguey paper by the Mexicans and papyrus by the Egyptians. The Mexican pictographs show a very high degree of development in which the artists had passed the stage of mere concrete object drawing, and show signs of a beginning system midway between the pictographic and the phonetic. This system which has been called the 'ikonomatic' is one in which "the object employed to represent a complex word or character, each furnishes its first syllable, or more, to suggest the sound required for the complex character and may have no other relation to the general result." Colors were largely used and may have had a phonetic value, though often were nothing more than the natural color of the object depicted.

Dr. Hoffman denies that any evident parallel exists between the pictographs of the Western hemisphere and those of the East. The Egyptian had become entirely phonetic and partly alphabetic, while the Chinese and other systems were of a well developed syllabic order; the American aborigines, on the other hand, had not yet risen above the stage when a study of the origin of their pictographs is possible, and therein lie their peculiar interest and value.

The chapters on symbolic signs and gesture signs and attitudes are especially good and well arranged, while those on the growth of conventional signs and comparisons give interesting examples of primitive designations from which space prevents our quoting.

The book closes with a discussion of the growth of the alphabet through the various stages of graphic development; the transition stages where the alphabetic character has served as a pictorial representation of an object and as a syllable being proved, as indicated above, by reference to the systems in use among the early Mexicans and the Mayas of Yucatan.

Ikonomatic or rebus writing was extensively used by the Mexicans, while the Mayas went a step further and employed purely phonetic signs as well as ideographic characters.

In conclusion it may be said that Dr. Hoffman has raised very markedly the standard of the hitherto somewhat disappointing series in which his book appears, a standard which it is to be hoped the succeeding issues will sustain.

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