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living animals, — who has set himself in opposition to the geological views of *Cuvier*, *Buckland*, and *Conybeare*,—who has criticised *Leach*, *MacLeay*, *Samouelle*; and, on a former occasion, myself. And when, moreover, I trace in your pages, under the signature of D. D., the eccentric opinions contained in the “*Philosophy of Zoology*,” and the “*History of British Animals*,” I feel persuaded that all these are but diversified productions of *one pen*. The Dichotomous system, some how or other, is always brought in, as in the present case; for the Reviewer says, “we shall come to the Dichotomous system, which *must be true*, for by the affinities of two beings, the links in the chain of creation are moulded.” True it is that affinities are so marked, but we have seen that these links, which *must* differ in structure, are not what the writer defines to be *affinities*; and that, consequently, if he is correct, there is no chain of creation.

I have alluded to my suspicions as to the author of this review, that our younger students should not be alarmed by perceiving, under a variety of anonymous shapes and signatures, so much stress laid upon “the Dichotomous system;” and thus be frightened from adopting, or examining, any other. I may be wrong in this supposition, but it is strengthened by so many collateral circumstances, that nothing but a public denial on the part of Dr. Fleming will remove this impression. If this is given, I will cheerfully and sincerely acknowledge I have done him temporary injustice;—but his silence must be looked upon as an affirmative.

P. S.—I have neither time nor inclination to notice *the authors* of the other review: its falsehood is best refuted by the volume itself.

January 20, 1835.

W. S.

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ART. II.—*A few Words on the Transformation of Insects.*

By EDWARD NEWMAN. *Read at the Linnæan Society, April 1, 1834.*<sup>a</sup>

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“*In nova fert animus mutatas dicere formas.*”

THE metamorphosis of insects has, in all ages, attracted admiration. What can be more wonderful than that an

<sup>a</sup> In order to account for the appearance of this article in the *Entomological Magazine*, after its having been read at the Linnæan Society, it seems necessary

unsightly and voracious worm should pass through a shrouded and death-like sleep, and wake at last a glorious butterfly, to bask in sun-shine, bathe in realms of liquid air, and quaff the heaven-distilled nectar of beauteous flowers! Well might such a miracle be made a poet's theme! Well might those philosophers, on whose minds there dawned, albeit dimly, the great truth of an after life;—well might they imagine their toilsome existence typified in the caterpillar, their descent to the quiet grave in the tomb-like repose of the chrysalis, and the hereafter they sighed for, in the spirit-like resurrection of the happy butterfly;—and, seizing with avidity the idea, well might they designate these aërial creatures by the name of “souls.”

Wonderful indeed is this transformation from one form to another, and wonderful it ever must remain; yet science has offered us an explanation, which, while it fills us with admiration, strips the subject of that paradoxical seeming which led some of our predecessors to suppose that one animal was actually converted into another; science has shown us that the butterfly pre-exists not only in the chrysalis but in the crawling caterpillar.

It is a very general and a very convenient opinion, that an insect is a being having a quadruple existence; that at birth it is an egg; which hatching produces a larva or caterpillar; this becomes a pupa, and finally an imago; from the imago eggs again proceed, and thus the round of existence is complete. This is confessedly a convenient idea, but the possibility of its application is so partial, that definitions drawn from it must be incomplete,—methods founded on it wholly artificial.

When an organized being first exists, it does not, as far as human observation has reached, bear any resemblance to its parent. When an organized being has reached perfection, it precisely resembles its parent. The degrees or steps by which a being mounts to this perfection and similarity to its parent, constitute that which in an insect is termed metamorphosis.

In every organized being there is a tendency in every part of its substance to become unfitted for its functions, and therefore useless. There is in every organized being a tendency to

to state, that the Publishing Committee of that Society thought it unsuitable for publication in the Transactions, and returned it to the author accordingly.—ED.

throw off, discard, or get rid of all parts of its substance which have become useless. Finally, there is a tendency to form or create fresh portions of substance, to supply the place and perform the functions of those portions thus thrown off. In this three-fold disposition is to be found a solution of all those mysterious changes we behold in animals and vegetables. Generally this change of substance is most readily detected in the exterior covering; but in man, the most perfect animal, the only undeniable proof of it is to be found internally even in the bones. Numberless experiments prove that the substance of bones is continually undergoing change; portions are constantly being absorbed, other portions as continually secreted. By these processes certain portions of matter escape to fulfil other ends, while other portions of matter, introduced as nutriment into the stomach or lungs, are mixed with the blood, and rush to supply the place of that abstracted. Matter cannot perish; each created article must endure for ever. Neither is matter afresh created. The mass of matter remains unalterably the same; but to this disposition of matter to change its relative position, thus operating in the substance of organized beings, are to be attributed the shedding of hair in quadrupeds, the moulting of birds, the sloughing of snakes, the extraordinary changes of Amphibia, and the metamorphosis of Insects.

It has just been observed that the bones of man bear more ample testimony to this constant tendency to exchange of substance, than any of his less solid parts; the same may perhaps be said of all vertebrates, although some of them testify it so abundantly in other ways. Now the skeleton, or external covering of annulates, performs, in a great degree, the same part in the animal functions as the skeleton of the vertebrates; the two are not identical but analogous,—they are substitutes for each other.

In all Condylpodes this tendency to exchange of substance induces a full, complete, and often repeated ecdysis, or change of skin. We find the crab and the butterfly undergoing this ecdysis in an equal degree, both as to extent and number of times, but with how different a result!—the crab remains a crab, but it is a crawling grub becomes a butterfly!

Condylpodes divide into four great groups, three of which are again subdivisible into two each. The easiest and most

convenient character for the primary division of annulates is the number of legs.

HEXAPODA have, in their final state, six articulated legs. They have no power to reproduce a leg, if accidentally lost. Two distinct tribes are included in this group:—

TRIBE I.—TETRAPTERA, or *winged insects*.

II.—APTERA, or *wingless insects*.

OCTOPODA have, in all their states, eight articulated legs. They have power to reproduce a leg, if accidentally lost. Two distinct tribes are included in this group:—

TRIBE III.—ARACHNOIDA, or *spiders*.

IV.—ACAROIDA, or *acari*.

ANISOPODA have, in all their states, the number of the legs varying from that of the *Octopoda* to that of the *Myriapoda*. They have power to reproduce a leg, if accidentally lost. Two distinct tribes are included in this group:—

TRIBE V.—MALACOSTRACA, or *crabs, lobsters*, and similar shellfish, with simple legs.

VI.—ENTOMOSTRACA, *aquatic animals*, somewhat similar, but having legs with branchial appendages.

MYRIAPODA have an indefinite number of legs in their final state; generally more than twenty, but only six in their first state. They have the power to reproduce a leg, if accidentally lost. One tribe only is included in this group:—

TRIBE VII.—MYRIAPODA, or *centipedes*.

Of these seven tribes, the *Tetraptera* offer the most obvious characters in their metamorphosis for farther subdivision. It may be remarked as a singular fact, without applying it to any theory, that the perfect *Aptera* frequently represent the imperfect *Myriapoda*, likewise the perfect *Myriapoda* represent the imperfect *Tetraptera*. The *Tetraptera*, like the *Condylopoda*, constitute four perfectly distinct groups, three of which are, in like manner, double groups, and the fourth is most heterogeneous in its contents, but from carrying the organs of sense, &c. to greater perfection, superior to the others.

AMORPHA, in which the penultimate state is provided neither with mouth nor organs of locomotion; consequently it neither eats nor moves, neither does it bear any resemblance to the perfect state. This group contains:—

CLASS I.—LEPIDOPTERA.

II.—DIPTERA.

NECROMORPHA, in which the penultimate state is provided with mouth and organs of locomotion, detached from the body, but so enveloped in a case that it can employ neither. The resemblance, therefore, to the perfect insect is very considerable, excepting in the total want of motion. This group contains:—

CLASS III.—HYMENOPTERA.

IV.—COLEOPTERA.

ISOMORPHA, in which all the stages are active and voracious, and of similar form. This group contains:—

CLASS V.—ORTHOPTERA.

VI.—HEMIPTERA.

ANISOMORPHA, in which appears the Amorphous, Necromorphous, and Isomorphous characters, together with a typical and distinct character. This group is equivalent to:—

CLASS VII.—NEUROPTERA.

The Amorphous insects are divisible into two distinct groups; one of which is by far more decidedly and essentially amorphous than the other; and, strange as the assertion may appear, the possession of this character in the extreme is nothing more than an approach to the Necromorphous group, which does not in any degree possess the character. The two groups of Amorphous insects are not limited to the classes *Lepidoptera* and *Diptera*, but are separated by the fact of their possessing, in the penultimate or quiescent state, the last skin of the ante-penultimate, or previous state; thus,

1. AMORPHA ADERMATA, which do not retain the skin of the previous state on entering the quiescent state; which possess a slight power of *motion*, but not of *locomotion*; which exhibit the site of the wings, legs, antennæ, eyes, &c. *Papilio*, Lin.; *Sphinx*, Lin.; *Phalæna*, Lin.; *Tipula*, *Tababus*, *Asilus*, *Bombilius*, &c., are the leading groups of *Amorpha Adermata*. *Culex* has a

locomotive pupa, and forms, therefore, an aberrant order of this section.

2. AMORPHA DERMATA, which, on assuming the quiescent state, retain the last cuticle of the previous state, which do not exhibit the least trace of the site of the wings, legs, antennæ, or eyes. The sections contain the great orders, for which the genera, *Syrphus*, *Cestrus*, *Musca*, &c. serve as types.

The insects of the last section, possessing, as they certainly do, the extreme character of the *Amorpha*, nevertheless, as has previously been stated, testify a very evident approach to the neighbouring *Necromorpha*; for, when the skull or covering of the quiescent insect is broken, a perfectly Necromorphous form is disclosed; and thus, though nothing could appear more different than the exterior appearance of the two, yet this examination proves that the real difference exists only in the circumstance that one group retains the covering of the previous state longer than the other group. If we select two well-known insects, the flesh-fly (*Musca vomitoria*), and the honey-bee (*Apis mellifica*), we shall find little or no difficulty in tracing the similarity. The grubs or maggots from which these insects proceed are not dissimilar; but the grub of the fly merely ceases to feed, becomes quiescent, and hardens externally, while that of the bee ceases to eat, is walled in its cell by the workers, lines its cell with silk, casts its covering, and becomes quiescent, every limb being distinct, detached, and perfect, but enveloped in a delicately soft and smooth skin, and perfectly motionless. This is the true Necromorphous character. Now the fly, on the contrary, is Amorphous; but if a few days before the perfect insect appears, the hard and apparently inorganic case which covers it is gently opened, we find within a form precisely resembling the Necromorphous form of the bee just described:—thus it appears clear that the so-called pupæ of the bee and the fly are neither substantially nor numerically the same state. Every ecdysis is certainly a transformation; and therefore, calling the imago, as it certainly is, the ultimate state, then the so-called pupa of the bee is the penultimate; and the so-called pupa of the fly the antepenultimate. The difference is thus explained:—the fly, on assuming the perfect state, casts two skins, the bee only one.

In turning to the other section of the *Amorpha*, the *Amorpha Adermata*, the butterflies, moths, and gnats, we find, on examining them in the quiescent state, abundant evidence that we have before us not only organized but animated beings; in these, the grubs, before becoming quiescent, cast their covering in the same manner as the bee; but still unlike that insect, retain two distinct coverings, thus resembling the *Amorpha Dermata*. Both these coverings are cast at the same time; the interior, fine, semi-transparent, and delicately soft, must have been observed by all who have paid any attention to the rearing of *Lepidoptera*. Now the whole of the *Necromorpha*, as far as has yet been ascertained, finally undergo a *single*, and the whole of the *Amorpha*, on the other hand, a *double* ecdysis.

The *Isomorpha*, of which the common cricket is an excellent example, have no quiescent state; neither can we find that they possess any state precisely equivalent to that portion of the lives of the two great groups which we have been comparing. Their whole existence between the egg and the imago, consists of a gradual series of approaches to perfection, and during this interval, copulation certainly, and not improbably reproduction, often takes place. No character is yet known by which the penultimate, antepenultimate, and prior states can be determined.

In the heterogeneous group, *Anisomorpha*, a group in metamorphosis, as in all other characters, equally related to the other three, we find a typical and distinct section in the dragon-flies (*Libellula*, Lin.) These, like the *Isomorpha*, have no quiescent state: their preparatory state is aquatic, active and voracious: when arrived at the period for assuming the imago, they leave the water, and fixing their feet firmly to a slender stick or blade of grass, emerge from a double skin, and fly away. The exterior skin is hard, corneous, and brittle; the interior, soft, fine, and pliable. Even the magnificent wings leave behind them a covering, which, unfolded with great care, will be found to retain an impression of their complicated meshes. The May-fly (*Ephemera*), one of the Anisomorphous insects, has a metamorphosis still more striking, and one that has been deemed anomalous and unaccountable. In the antepenultimate skin it leaves the water, and attaches itself by the legs like the dragon-fly. Its antepenultimate skin then opens

on the back ; the insect emerges and flies away, leaving that one skin only : that beautifully delicate skin which the dragon-fly quits simultaneously with the harder one, being still retained by the May-fly. Here then we have the strange fact of an insect's flying before it reaches the imago ; that is, flying in its penultimate state. In twenty or thirty minutes at the farthest it settles again, casts its skin, and becomes a perfect imago.

It thus appears, that, although until the final ecdysis, no insect arrives at perfection ; yet before that period, even in the state immediately preceding, it may feed, run, and even fly ; or may swim, crawl, barely move, or be without motion, without apparent life, or without apparent organization. It appears that the apparently lifeless or quiescent state may be entered without ecdysis ; that ecdysis itself may be either single or double ; that the states called pupa, in various tribes, are neither substantially nor numerically the same. That comparing those few insects herein noticed, the fly, the bee, the cricket, the dragon-fly, and the May-fly, all of which represent great orders, we shall find it perfectly impossible to apply, if we aim at precision, any other than a numerical denomination to their intermediate states ; and finally, therefore, that insects, like higher animals, have but three eras of existence, the foetal, the adolescent, and the adult.

As to the number of times ecdysis takes place in the life of an insect, little can be said at present, owing to the carelessness and imperfection of our researches ; and on this account it will be found safer to count downwards from the imago, than upwards from the eggs. Although the contrary has been asserted, and perhaps generally believed, it yet remains to be proved that the grubs of *Diptera* and aculeate *Hymenoptera*, undergo any ecdysis until full grown. The order *Tenthredinites*, on the contrary, and the *Lepidoptera*, change very frequently, with some exceptions ; for example, the caterpillar of the great *Sphinx Ligustri* sheds its skin but once.

These various facts, so simple, so obvious, so plain, so completely within the reach of the most cursory observer, proclaim that each variation in the number or manner of ecdysis is but another mode of metamorphosis ; proclaim that metamorphosis, hough in annulates, a complete and oft-repeated ecdysis, is but

another instance of that constant loss and reparation of substance which is incident to all organized beings; proclaim the existence of a general uniformity of plan, with which the widest differences, the greatest discrepancies, are not only compatible, but are essential to perfect harmony, are the surest and safest guides to natural arrangement, and serve, like the key-stones of arches, to unite objects before devoid of continuity; proclaim finally the greatness of Him whose will shapes the whole into perfection.

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ART. III.—*Essay on Parasitic Hymenoptera.*

By A. H. HALIDAY, M. A.

(Continued from Vol. II., page 468).

*Of the Ichneumones Adsciti.*

GEN. VI. LEIOPHRON. (*Appendix.*)

Subgen. I.—PYGOSTOLUS<sup>a</sup>.

*Palpi labiales 4-articulati, articulo penultimo minutissimo: abdomen subsessile; segmento 1<sup>mo</sup>. perbrevis; ano verticaliter fisso: aculeus linearis deflexus: alarum anticarum areola radialis apicem alæ attingens; antica disci remota.*

Leiophron (*partim*) *N. ab Ess. Act. Acad. IX. 303.*  
Gen. VI.

————— *Monogr. 43.* Gen. VII.

†Sp. 1. *L. P. falcatus.* Fem. *Testaceus, macula verticis, metathorace, abdominis basi et alarum stigmatibus fuscis.*  
(Long. vix. 2 lin.)

*Leiophron falcatus.* *N. ab Ess. Monogr. 44. Sp. 1.*

Ab *L. stictico* differre videtur statura plus duplo minore, alarum stigmatibus fuscis, segmento 1<sup>mo</sup>. abdominis ante tubercula nonnihil producto: siletur etiam punctum fuscum marginis antici thoracis: reliqua ad amussim conveniunt.

*Habitat Germaniam.*

*Adnot.—Leiophron clavipes N. ab Ess. Monogr. 45. Sp. 2, nobis pariter invisus ad proprium subgenus relegandus videtur.*

<sup>a</sup> *Pygostolus*, a πυξ et στελλω, propter fissuram ani.