

Cambridge University Press

978-1-108-04967-2 - The Animal Kingdom: Volume 14: The Class Insecta 1

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Excerpt

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THE  
ANIMAL KINGDOM.

THIRD CLASS OF ARTICULATED ANIMALS,  
AND PROVIDED WITH ARTICULATED FEET.

THE INSECTS (INSECTA)

have articulated feet, a dorsal vessel, which holds the situation of every vestige of heart, but without any branch for circulation;\* respire through two principal tracheæ, which

\* Anatomists are greatly divided with regard to this organ. Many consider it as a genuine heart; others (and such is the opinion of M. Cuvier, and one which appears to us to have been fully confirmed by the satisfactory researches of M. Marcel de Serres, entirely deny this position. According to the last mentioned author, the function of this vessel is the secretion of fat, which is afterwards elaborated in the adipose tissue which envelopes it. Lyonet says that it encloses a gummy substance of an orange colour. Some very recent observations appear to establish the existence of a few small vessels; but, besides that this circulation would be very partial, the insects must always differ greatly in this respect from the crustacea, in as much as the blood does not return to the heart. M. Straus, in reviewing a memoir of M. de Herold on the subject in the "Bulletin Universel," has given us his own opinion, founded on his own researches, on the *Melolontha*. "The dorsal vessel," he says, "is the true heart of the insect, being, as in the superior animals, the locomotive organ of the blood, which, instead of being contained in vessels, is spread through the general cavity of the body. This heart occupies the entire

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extend parallel to each other through the whole length of the body. At intervals they have centres, from which pro-

length of the back part of the abdomen, and terminates anteriorly by a single artery not ramified, which transports the blood into the head, where it pours it out and from whence it returns into the abdomen, from the very effects of its accumulation in the head, to re-enter the heart. To this the entire sanguine circulation of the insects is reduced, which have thus a single artery without branches, and no veins. The *alæ* of the heart are not muscular, as Herold pretends: they are simple fibrous ligaments which keep the dorsal vessel in its place. The heart, that is to say, the abdominal portion of the vessel, is divided into eight chambers internally (*Melolontha vulgaris*), separated from each other by two convergent valvules, which permit the blood to proceed from behind, in front of one chamber, into the other as far as the artery which conducts it to the head, but which opposes its retrograde motion. Each chamber is provided laterally, in its anterior part, with two apertures, formed like transverse clefts, which communicate with the abdominal cavity, and through which the blood contained in this cavity can enter the heart. Each of these apertures is provided internally with a small valvule in the form of a semi-circle, which is attached on the aperture during the movement of the systole." From this short description it is easy to conceive, that when the posterior chamber is dilated, the blood contained in the abdominal cavity penetrates thither by the two apertures of which we have spoken, and which are named *auriculo-ventricular*. When the chamber contracts, the blood which it contains, not being able to return into the abdominal cavity, pushes the interventricular valvule, passes into the second chamber, which dilates to receive it, and which receives at the same time a certain quantity of blood by the proper auriculo-ventricular apertures. During the movement of the systole of this second chamber, the blood passes in the same manner into the third, which equally receives some by the lateral apertures; and it is thus that the blood is pushed from one chamber into the other as far as the artery. It is these successive contractions of the chambers of the heart, that one discovers through the skin of the caterpillar.

The heart of the decapode crustacea, of squillæ, limulæ, spiders, &c., also presents, according to the information which I have received from this profound observer, similar valvules. It is enclosed in a kind of sac or pericardium, which, according to him, stands in place of the auricle. These

ceed a number of branches which correspond to the external apertures, or *stigmata*, for the entrance of air.\*

divisions or chambers of the dorsal vessel, are what Lyonet denominates wings; and he has also seen the dorsal vessel prolonged as far as the head, and terminated there in the same manner; but he did not observe the apertures and valvules of which M. Straus has spoken. The definition of the dorsal vessel, given by this naturalist, whatever be the interior composition of this organ, proves evidently that it is not a genuine heart. These observations, moreover, do not teach us what the nature of the fluid is, nor how it is spread through the other parts of the body, so as to minister to their nutrition; at all events, it is certain, according to the observations of Lyonet, that all the parts of the body, communicate with the corpus adiposum by means of fibrillæ. The tracheæ throw out branches which extend even into the extremities of the different appendages of the body. It is possible that the action of the air may determine the ascension of the nutritive juices into the interstices, forming a sort of capillary tubes.

\* The number of segments of the myriapodes being undetermined, that of their stigmata is so likewise, and it often exceeds twenty. In the hexapode insects it is often eighteen, nine on each side. This calculation, however, is rather founded on the larva than the perfect state of the animal. The caterpillars, the larvæ of the coleoptera, and those of a great number of other insects, have one pair of stigmata on the first segment, or that to which is attached the first pair of feet; the second and third have none, because, as I presume, the development of the wings, which takes place in these rings, renders useless in this place the presence of respiratory apertures. The fourth ring, and the seven following, are each provided with a pair; but in the coleoptera in a perfect state, besides the two anterior stigmata concealed in the cavity of the prothorax or corslet, and which are not discernible, we find two others situated between the origin of the elytra and that of the wings: these belong to the mesothorax. There are none at the metathorax, unless we consider the two of the first abdominal segment as supplementary ones of the thorax, like what takes place in the hymenoptera with pedicled abdomen, and the diptera, where these two stigmata, with the semi segment on which they depend, form a part of the thorax. Thus, in general, all the hexapode insects have eight pairs of stigmata to the abdomen; but the last two are frequently obliterated. In the crickets, the truxales, and the libellulæ, the sides of the metathorax are each provided with a stigma—those which

They all have two antennæ, and a head distinct. The nervous system of the majority of insects (the hexapodes) is generally composed of a brain formed of two opposite ganglia, united at their bases, giving but eight pairs of nerves, and two solitary nerves, and twelve ganglia,\* all inferior. The first two are situated near the junction of the head with the thorax, and longitudinally contiguous; the anterior gives out nerves to the under lip, and to the parts adjacent. The second and the two following are proper to each of the first three segments, or those which in the hexapode insects compose the thorax. The other ganglia belong to the abdomen, so that the last, or twelfth, corresponds to its seventh ring, followed immediately by those which compose the several organs. Each of these ganglia give out nerves to the parts of their respective segments. The two last, very closely approaching each other, also give out nerves to the last rings of the body. The frontal region has three particular ganglia, designated by Lyonet under the name of *frontals*, and the first of which produces, posteriorly, a thick nerve with swellings: this is the longest of all the nerves, and he names it *recurrent*. The first ordinary ganglion, or the *sub-œsopha-*

M. Marcel de Serres names *trémaeres*. In these last mentioned insects as well as in the others with naked wings, or without elytra, the first two thoracic stigmata are placed above, between the prothorax and mesothorax. With the exception of the libellulæ, the thorax proper exhibits no distinct stigmata. I say the thorax proper, because, as we have remarked above, the two first of the abdomen are referred by many to the posterior extremity of the thorax. The metathorax of the pentatomata and scutellaria exhibits one pair of stigmata underneath. In the aptera, the second segment, or mesothorax, has none; but the following segment, or metathorax, has two pairs, one anterior, and which, being situated near the articulation of this segment with the preceding, may be deemed to belong to this last, and the other smaller, and placed very near that of the first abdominal segment.

\* Divers lamellicorneous coleoptera in the perfect state form an exception.

## CLASS INSECTA.

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*gian*, germinates, according to this author, four pairs of nerves, and the following, two pairs each ; so that, reckoning the eight pairs of the brain, the ten spinal bridles, which may be considered as so many pairs of nerves, we have in all forty-five pairs, independently of the two solitary nerves, or from a dozen to fourteen more than are in the human body. The two nervous cords, which, by their union, form the ganglia, are tubular, and composed of two tunics, the exterior of which presents tracheæ. A medullary substance fills the central canal. The excellent work of M. Herold on the anatomy of the caterpillar of the large cabbage butterfly, studied in its progressive growth, to its transformation into the chrysalis, shews us that the nervous system and that of the digestive organs undergo remarkable changes; that the nervous cords are in their origin longer and more separated, an observation which favours the opinion of one of the greatest zootomists of our age, Dr. Serres, on the origin and development of the nervous system. We have explained in the generalities common to the three classes of articulated animals with articulated feet, the various sentiments of physiologists on the seat of the senses of hearing and of smell. We shall confine ourselves to adding, that, with regard to the first, the small nervous ganglia situated on the forehead, of which we have spoken, seem to confirm the opinion of those, such as Scarpa, who place the seat of this sense near the origin of the antennæ. In some lepidoptera, I have observed two small holes situated near the eyes, and which, perhaps, are auditory conduits. If, in many insects, especially those which have filiform or setaceous and long antennæ, these organs answer the purpose of tact, it appears difficult to give a reason for the extraordinary development which they acquire in certain families, and more particularly in the males, if we do not admit that they are then the seat of smell. Perhaps, also, in relation to taste, the palpi play in some cases, as

when they are very much dilated at their extremity, the principal part. The tongue may also have something to do with this function.

A preparatory or buccal apparatus, the intestinal canal, the biliary vessels, also named *hepatic*, those which are called *salivary*, but which are less general, those free or floating vessels which have received the denomination of excremental, the epiploon, or corpus adiposum, and probably also the dorsal vessel, may be said to constitute the digestive system. It is singularly modified according to the diversity of aliments. or it forms a great number of peculiar types, which we shall describe in treating of the families of this class. We shall at present only say a word respecting the buccal apparatus, and the principal divisions of the intestinal canal, beginning with the last. In those insects, such as the carnassial coleoptera, in which it is more complicated, we may distinguish in it the pharynx, the *æsofagus*, the crop, the gizzard, the stomach, or chylific ventricle, and some intestines, which are divided into the slender intestine, the thick intestine, or *cæcum*, and the rectum. In the insects in which the tongue, properly so called, is attached to the anterior or internal face of the lip, or where it is not disengaged, the pharynx is situated on this same face, which is generally the case. We shall also add, that, with respect to the biliary vessels, a naturalist to whom we are indebted for the first valuable observations on the respiratory organs of the mygale, M. Gäde, professor of natural history at Liege, does not consider these vessels as secretory, according to the common opinion; but his notion does not seem to be sufficiently well founded, and the observations of M. Leon Dufour even appear to destroy it.\*

\* This last mentioned naturalist, whom I shall often have occasion to quote, has explained in the most minute manner every thing which has

A few insects, and always without wings, such as the *myriapodes* or *millepedes*, approximate to many crustacea either in the quantity of rings of the body and of their feet, or in some traits of analogy in the conformation of the parts of the mouth; but all the others have constantly but six feet; and their body, the number of segments in which never exceeds a dozen, is always divided into three principal portions, the *head*, the *trunk*, and the *abdomen*. Among these last, some have no wings, and preserve during life the form which they had when born, merely growing and changing their skin.\* In this respect they have some relation to the animals of the preceding classes. The other insects with six feet are almost all winged; but the wings, and frequently even the feet, do not appear at first, and are not developed until after a series of changes, more or less remarkable, called *metamorphoses*, and which we shall shortly describe.

The head † is the seat of the antennæ, the eyes, and the mouth. The composition and form of the antennæ vary much more than in the crustacea, and are often more developed in the males than in the females.

The eyes are either complicated or smooth: the former, according to the researches of Baron Cuvier, Marcel de Serres, and others, are formed, first, of a cornea divided into a mul-

reference to the digestive system of insects, in a series of excellent memoirs, which have contributed to enrich the annals of natural sciences. M. Victor Audouin has given a well-executed recapitulation of them in his article INSECTS, in the “Dictionnaire Classique d’Histoire Naturelle.”

\* These are what I name *homotenes*, (alike to the end,) or the *ametobolia* of Dr. Leach.

† Its surface is divided into many regions, which are named the *nose*, the *forehead*, the *vertex* or *top*, and the cheeks. The French term used for the nose (*chaperon*) being equivocal, M. Latreille, has changed it to *epistoma* or sub-mouth; this part serves for the insertion of the *labrum* or upper lip.

N.B. *Nose* is the term given by Mr. Kirby —Ed.

titude of small facets, by so much the more convex as the insect is more carnassial, clothed at its external face with a substance not very fluid, opaque, variously coloured, but in general black, or of a sombre violet; secondly, of a choroid, fixed both in its extent and by its edges to the cornea, covered with a black varnish, exhibiting a multitude of air-vessels proceeding from tolerably thick trunks of tracheæ situated in the head, and whose branches form around the eye a circular trachea. This is wanting, as well as the choroid, in divers lucifugous insects. Thirdly, of nerves, which originate from a thick trunk, proceeding immediately from the brain, expanding afterwards into the form of an inverted cone, the base of which is on the side of the cornea, while its radii or threads, traversing the choroid and the covering of the cornea, end each of them at one of its facets. There is neither crystalline nor vitreous humour.

Many insects besides the compound, or complicated eyes, have simple ones, or such as have the cornea altogether of a piece. These are usually three in number, and disposed in a triangular form on the top of the head. In most of the apterous insects, and of the larva of those which are winged, they supply the place of other eyes, and are often united in a group. If we may judge by those of the arachnida, they must serve the purposes of vision.

The mouth of insects with six feet is in general composed of six principal pieces, four of which are lateral, disposed in pairs, and move transversely. The other two, opposite to each other, in a contrary direction to that of the preceding, fill the vacancies comprised between them. One is situated above the upper pair, and the other below the lower. In the *grinding* insects, or such as feed on solid substances, the four lateral pieces perform the office of jaws, and the other two are considered as lips: but, as we have already observed, the two upper jaws have been distinguished by the peculiar



denomination of *mandibles*; the two others alone have preserved that of jaws. They have, moreover, one or two articulated threads, which are called *palpi* or *antennulæ*, a character which, in this class, the mandibles never exhibit. Their extremity is often terminated by two divisions or lobes, the exterior of which is named, in the orthoptera (in French), *galète* (*galea*, Fabr.). We have already mentioned that the upper lip is termed *labrum*; the other, or the lip properly so called (*labium*) is composed of two parts. The more solid and under part is the chin (*mentum*); the upper, which very frequently has two palpi, is the tongue (*lingua*).\*

In the sucking insects, or those which take nothing but fluid aliment, these divers organs of manducation present themselves under two sorts of general modifications. In the first the mandibles and jaws are replaced by small laminæ, formed like blades or lancets, composing, by their union, a sort of sucker, which is received into a sheath, the substitute for a lip, either cylindrical or conical, and articulated in the

\* See what we have said on this subject, in the generalities which precede the particular account of each class. The lower lip appears to us to be but a particular modification of the second jaws of the decapode crustacea combined with their tongue. The changes which these parts gradually undergo in the crustacea, the arachnida and the myriapoda, would lead us to believe it; on this hypothesis, the six thoracic feet would be the analogues of the jaw-feet, and this has been already recognized in relation to the crustacea of the genus *apus*. Then the first five segments of the abdomen in the hexapod insects, would represent those to which, in the decapode crustacea, are attached the feet, properly so called, or the third and fourth following ones of the amphipod and isopod crustacea. All the researches which have been published on the thorax of insects, though otherwise very useful and laudable, will necessarily undergo essential alterations, when naturalists come to compare this part of the body in the three classes of articulated animals with articulated feet. Nomenclature is very far from being fixed in this particular.

form of a beak (*rostrum*), or membranous or fleshy, unarticulated, and terminated by two lips (the *proboscis*). The labrum is triangular, vaulted, and covers the base of the sucker. In the second kind of organization, the labrum and mandibles are almost obliterated and extremely small. The lip is no longer a free body, and is distinguished only by the presence of two palpi, of which it is the support. The jaws have acquired an extraordinary length, and transformed into two tubular threads, which, uniting at their edges, form a sort of proboscis, which rolls into a spiral form, and is usually named *tongue*; but which, to avoid all equivocation, it would be preferable to call *spiral proboscis* or *tongue (spirignatha)*.\* Its interior exhibits three canals, the middle one of which is the conduit of the nutritive juices. At the basis of each of these threads is a palpus, usually very small, and but little apparent.

The myriapodes, or millipedes, are the only insects whose mouth shews a different type of organization, which I shall describe when I come to treat of them.

The trunk† of insects, or that intermediate part of their body to which the feet are attached, is generally designated by the Latin name of *thorax*, which has been rendered into

\* Kirby calls it *antlia*.—ED.

† This denomination is here synonymous with that of *thorax*. I am of opinion, however, that to avoid all embarrassment, we should apply the first term only to the apterous insects of Linnæus, which have more than six feet, and in which these organs are attached to segments proper to them; that is, in which the head is distinct from the trunk. With regard to the crustacea in which these parts of the body are confounded, the *thorax* should take the name of *thoracida*, and that of *cephalothorax* in the arachnida; animals which exhibit the same character, but in which the trunk or *thorax* is more simple, and provided with less numerous appendages. The entomostracea even approximate, in this respect, to these latter animals; but as they belong to another class, the term *thoracida* should be preserved for them—that of *thorax* should be exclusively reserved for the hexapod insects.