Dott. ERCOLE GIACOMINI. — Contributo alle conoscenze sull' organizzazione interna e sullo sviluppo della « Eristalis tenax, L. » — *Osservazioni e annotazioni.*

I.

Preliminari.

Le osservazioni e gli scritti pubblicati sull'*Eristalis tenax*, L., dittero appartenente alla famiglia dei Sirfidi, sono già assai numerose, ed io, riferendo qui alcuni risultati di una serie di ricerche da me intraprese sull'organizzazione e sullo sviluppo di questo sirfide, non ho altro intendimento che di recare un piccolo contributo ad una più esatta conoscenza della sua interna struttura e degli intimi processi che accompagnano la sua trasformazione dallo stato di larva a quello d'insetto perfetto od imago.

Essendo, ora, ben lungi da me l'idea di rendere a questo scritto l'aria di uno scritto monografico sull'*Eristalis*, ciò che sarebbe troppo ardua cosa e richiederebbe d'altra parte un lungo studio, e volendo, perciò, rimanere nei limiti di semplici osservazioni e annotazioni, tralascio, per adesso, di riportare un'estesa bibliografia. Ricorderò soltanto che i costumi dell'*Eristalis* vennero mirabilmente esposti da Réaumur nella sua opera « Des Mouches a deux ailes qui ont l'air d'Abeille, et de celles qui ont l'air de Guèpes et de Frelons ». Come è noto, Réaumur chiamò l'insetto perfetto col nome di moscha apiforme « mouche abeilleforme » e le sue larve con quello di vermi a coda di ratto « vers à queue de rat ».

Oltre alle osservazioni sopra a singoli organi od a singoli sistemi ed apparati organici, così dell'insetto perfetto come della sua larva, registrate anche in parecchi lavori che non riflettono

Contribution to the body of knowledge about the internal structure and the development of 'Eristalis tenax, L.' - observations & notes

[* I have noted that my original translation of 'intracellulare', the last word on p217, was wrong and have corrected it. I think there may be one or two other examples that need checking, as on p176 I've just noticed.]

[I have kept strictly to the pagination of the original with the translation]

( ) denotes bracketed original text

[denotes translator's insertion or notes]

Preliminaries

The observations & published writings on E.t. ... are already quite numerous, and I, reporting here on some results of a series of researches undertaken by me on the e. of d. of this Syrphid have the sole intention of making a ~~little~~ small contribution to a more exact knowledge of its internal structure and of the hidden processes that go along with its transformation from ~~the~~ larva to ^finished insect or imago

Since at this time I am far from thinking of ~~making~~ giving this writing the semblance of a monograph on E., which would be ~~too~~ demanding and ~~anyway~~ ^anyway require long study and because I want on that account to remain within the limits of simple observations and notes, I leave out for now any reference to an extensive bibliography. I shall call to mind only that the habits of E. have been excellently described by R. in his work 'Flies with two wings that look like bees, and those that look like wasps and hornets'. As noted R. called the fully formed insect a bee-like fly and its larvae ~~with~~ ~~worms~~ rat-tailed worms

Besides the above observations on particular organs or on particular systems and organic arrangements, both ~~of the~~ in the fully formed insect and in the larva, referred to also in several works which don't refer solely to E.,

we have valuable records, ~~among~~ which ~~are~~ include studies dealing exclusively with ~~the structure~~ of the larva and imago of E.t.

B. in 1879 in one of his notes . . . gave a very accurate and careful description . . . This important note has remained one of the ~~full~~ fullest studies on the larva of E. t. even though, made as it was at a time when microscope technique was undeveloped, it leaves unresolved various questions on the detailed structure of the organs under consideration.

~~Twenty~~ 5 years ago, in 1895, Buckton wrote a book entitled 'The Natural History of E.t., in which he dealt only with the anatomy of the larva and imago. Truth to say I must straightaway aver that in this book, even though very rich in ~~illustrations~~ plates, both the description and the illustrations of various organs and organic apparatus are hardly exact, as was plain to me from my research and as I shall show later. Buckton did not know of the work of Batelli ~~and~~ not, I believe, the fine research by Künckel on the organisation of the V., a genus akin to E. and belonging to the same family of S. According to the description and the illustrations ~~given~~ furnished by B., certain arrangements of the organs ~~of~~ in E. differ quite a lot from those of the V. which K. showed, whereas they should have been, as they in fact are, if not absolutely, at least fairly similar. Furthermore B. doesn't deal very much with the detailed structure of the organs, so the histological information he offers is sparse.

Recently (last year) in Studies from the ~~Zoology~~ Institute of Zoology of Vienna an interesting publication by Wahl appeared 'on the Trachea System and the Imago discs of E.t.', in which A. Studies the tracheal System especially, allotting it a detailed description, extremely precise, and examines the imago discs of the thorax and head, assigning great importance to their position and relationship as well as the origin of the hypodermis.

For the same reason that I have kept short my references to the bibliography directly concerned with E.t, I am not going to dwell on previous studies on the internal organisation and the processes of metamorphosis of the Diptera as a Whole and of the Muscidi in particular (which manifests closer relationships with E.), confining myself to appropriate comparisons and references in the course of showing the results of my research. But I ~~can't~~ mustn't fail to say that since the work of Weisma etc., to name the more important of the larvae of other muscidae, in these recent times also detailed studies have been made, with more appropriate means, more suited as suggested by modern microscope technique: Thus in 1898 Pantel wrote a monograph on the larva, parasite, of T. H.; in 1899 W. illustrated te larva of Platey. pl.; still today very many queries are being addressed about the structure, the morphological and physiological significance of some larva organs, about the post-embryonic development, the very complex processes, ~~far~~ from clear, occurring during the pupal stage.

In this huge field the road marked by W., who was the first to trace the ~~from~~ histological transformations of the organs, and to look for the origin of the tissues of D., even though followed in succession by a swarm of worthy researchers, has not yet been explored fully, and at this time on our part fresh studies have been made with good results but ~~not~~ too divergent in certain really essential features, by B., studies on the phenomena occurring in the nymph stage of metabolic insects, and by S. studies on the phenomena occurring during the postembryonic development of C.e.

Moreover since a notable discrepancy still exists between the opinions expressed by various authors relating to the profound changes that occur in the nymph, to the purpose of, to the decline and disappearance of larval organs, to the regeneration and new formation of organs belonging to the imago, it ~~will perhaps be~~ this group of observations which we have been making on the E.t. will perhaps be ~~not~~ far from ~~all~~ a waste of time. Faced with queries that through their difficulty have led to very contrary opinions, we think the additional work, with new investigations on other species belonging to another group of D., ~~can~~ new ~~proof~~ evidence in favour of or confirming this or that opinion won't be useless, so much the more because, as Van R noted, the S. seem to occupy, in certain processes of their development, a mid-position between C. and M.

In the present research I was impelled by the opportunity in the spring just past and in this summer to collect a huge number of larvae and many samples of the imago of E. t., the species of E. most common in our region, and by the desire to make use of the abundant material available to me.

Among the samples of the fully formed insect I found very few males. Females had either already laid eggs or, fertilised, were about to lay. Some laid eggs in the lab. shut in a glass jar or in a cage. After 24-30 hours the embryonic development was complete and small larvae emerged from the eggs which were transferred to aquariums. They began moving immediately in the water in search of food. I tried several times to raise the little larvae in the lab. but in spite of all my attempts I didn't manage to keep them until they matured, nor to establish precisely how long the length of their life as larvae of E. But without doubt their larval life is very much shorter than that of V.

Larvae gathered and taken into the lab. as soon as they were near maturity easily developed into pupae. Some lost all movement before emerging from the water and finding a suitable place; it was sufficient in that case to place them in the dry for them to be able to complete their metamorphosis. The nymph stage lasts about 14 days on average, but it can be much less and even as little as 9 days, as I established in some cases. So the length of the nymph stage is also far and away much shorter than that of V.

The larva of E., as has been noted, is characterised by a tail bearing markings, formed by a long chitinous respiratory canal, extendable and retractable, which contains two tracheal branches and has at the tip two marked openings: these are constituted by the last two segments so extraordinarily lengthened as to exceed, when the tail completely unfolds, two or three times the length of the larva's body.

A similar arrangement is found in other larvae of S. such as H., which lives in water, but is not found in the larvae of S., Ch., genera related to E., even though they live in almost identical conditions — so adaptation to life in water is insufficient on its own to explain the extreme elongation of the segments that go to make up the form of the respiratory tube. There remains however the fact that a tendency exists for such elongation of the two last segments, since in all the S. larvae, as also in those parasites of the V. (Künc), in the larvae of M (Pow) the stigma at the back are carried by a more or less clear tube, formed by these segments, which becomes even more evident at the moment when the larva gathers itself up to pass into the pupa stage.

On the back between the first or second segment the larva has two forward stigma, retractable, very evident because of their solid dark chitin plate, and having the form of two tubes cut like the mouthpiece of a flute with the oblique side facing forward

The forward stigma as we shall see are closed: they do not exist in the very young larva, appear only on the seventh or eighth day and their appearance marks the second larva stage, as in the M. and the V. (Künc). Also on the back behind the front stigma, on the covering of the third segment of the larva can be seen two little circular areas can be seen, slightly raised, brown yellowish or dark in colour which represent the two little operculums through which, on the second day of the nymphal stage, there appear the two horns bearing stigma, characteristic of the pupa of E. and of the S. in general. Underneath, the larva has 7 pairs of false feet or 8 when

with stricter criteria, there are counted a pair of tubercles on the skin situated on the second segment, behind the inlet of the mouth opening, similar to those on the abdomen and similarly furnished with small stiff hooks. The second (or first) pair of feet always appear lower than the others.

The head, pseudocephalon, retractable, is furnished with a pair of antennae, each terminating in two sensitive tubercles. The mouth opening, situated underneath, is confined above by an upper lip, a continuation of the bottom of the two antennae, and by a lower lip which curves between the two layers or valves of the atrium of the head.

Before proceeding further I should say that since my research is not yet finished, I shall not make a methodical description of all the systems and organic arrangements, but will speak concisely or briefly only on what I have up till now observed and what seems to me not yet made known by others about the internal organisation of the larva and imago; then preliminaries with respect to the histological side; and it is worth correcting whatever has been mistakenly described by others about E. Please pardon me however if I don't maintain a correct proportion in the treatment of various parts.

In this first of my descriptions, which I regret I can't accompany with explanatory illustrations, I shall be concerned only with some facts examined during the pupa phase, waiting with everything about the nymphal stage for a later communication, in so far as my observations in that respect will be more complete.

Technical note - It's always difficult to fix and preserve whole larvae and pupae well. The fixing liquids I use for small larvae & for nymphs, besides the Frenzel liquid, also solutions of acetic sublimate, alcoholic or not, applied warm at a temperature of about 50°C

varying the immersion time. In order to avoid too strong a contraction of the small larvae, following the suggestion by P., I anesthetised them first with a physiological solution of chlorinated sodium chloride, although this process doesn't always either avoid a damaging compulsion*(?). For killing and fixing larvae that are already old or mature I resorted to boiling solutions of sublimate, taking in addition the precaution to leave them immersed the shortest time possible, two or three minutes, in order not to harm do too much harm to the tissues with the prolonged action of a high temperature. Furthermore this period of time is sufficient not just to kill the larva but to coagulate the albuminoids of the tissues and the nutritive liquid, and the larva fixed like this can be divided laterally into two halves for keeping immersed for some time in the cold sublimate. I had Recourse also to the injection of sublimate into the visceral cavity of live larvae, immersing them then in the fixing liquid. To take the pupa on the second or third day of the nymphal stage, I kept the nymphs immersed first beforehand in boiling water for half a minute or a minute at the most and carefully removing the puparium I put them in the fixing liquid. After the second day, with great care the puparium can be easily removed from the pupa without harming the live pupa. Some pupae I took removed as best I could from the puparium on the first or second day without previously immersing them in boiling water, and I fixed the pupa cold once free from the its casing.

For the study of the minute structure of the internal organs I did this always with the living animal (larva, pupa or fully formed insect) and fixed them either in Sublimate or in Flemming liquid or Hermann liquid. For colouring the fixed matter in sublimate I used either emallume? alone or more frequently and with better results double colour emallume and eosin; I used some aniline colours as well, for example, tionina. To colour the sections obtained from pieces fixed in osmium liquids I made use of saffranine or gentian violet (Bizzozero method).

I took great advantage of examination outdoors.

It almost goes without saying that I have always followed the method of serial sections.

Observations o Notes on the larva

Digestive system

The d.g. of E. larva, with its great length, allows the different parts to be easily recognised.

* Coartazione = coercion, compulsion?? What zoologically? Constriction contraction?

Anterior intestine — The mouth and pharynx with their covering and muscles have been described in great detail by B. and recently by W. These two (writers) make a more precise distinction between the parts of the head and the initial part of the intestine after having assigned to the entire invaginated part of the head the name (already in use) of vescicola cefalica, and subdivide it into atrium of the head, or cefalic atrium, and frontal sack. The c.a. is the part beginning the intestine at the front and leads into the pharynx from which it passes to the œsophagus. The frontal sack is the deep invagination (hollowing?) of the dorsal wall of the c.a., which the frontal invaginated region represents. The common conduit for the salivary glands opens at the edge, or threshold, between the c.a. and the pharynx: this edge corresponds to the edge of the definitive mouth of the imago.

The hypodermis and cuticle of the c.a. are a direct continuation of the integumentum and give rise to two mouth valves or layers corresponding to the jaws described by K. in the Vaflies. Passing from the point of passing into the pharynx the atrium narrows, although but the hypodermis and the cuticle of this part continue into the hyp are continuous with the hypodermis and the inside of the pharynx itself. The mandibles (or jaws, as others call them) located lateral-dorsally, quite developed, and a nexus of special chitinous pronged bristles (the pharyngeal 'sifters' of Batelli) beautifully placed in 9 rows longitudinally from the ventral side, make up the covering of the pharynx. Myself, following in a caudal direction transverse serial sections of the head, I discovered managed to see a sensitive organ, not referred to at any rate not with any precision either by B. or W., like the one observed by P. in the larva of Th. and called by him an epipharyngeal organ. A little after the two antennæ have joined in a common base, which will form the upper lip, and when, proceeding further backwards, the atrium of the head is about to begin, there appears between the forward extremities of the two valves a dark cuticular platelet shaped like a truncated cone that bears two small sensitive tubercles with each of which a bulb or piriform ganglia of nerves is connected. Two

slender muscles, situated laterally to the ganglia* of nerves are used to move this part about, probably the seat of taste.

Pantel refers to another sensitive organ in the larva of Thr., called by him 'hypopharyngeal organ', situated directly in front of the orifice of the excretory canal of the salivary glands. As for myself, though I noticed the cuticle of this area thickened into a special platelet, I didn't manage to see any nerve ganglia there. On the other hand Wandolleck saw distinctly the hypopharyngeal organ in the larva of Pl. pl. without being able to speak of any epipharyngeal organ with equal certainty, particularly in regard to its structure.

On the underside in front of the entry to the pharynx, between the two valves, closing in between these, the lower lip protrudes, which has thickened cuticle on its highest part, cornea, and on each side supports a tuft of cuticular bristles, quite delicate, light, transparent, which in their appearance are distinct from the ordinary hairs and sparse chitinous papillæ on the covering of the larva. It might be supposed that this is a sensitive organ corresponding to the hypopharyngeal organ, but to back up this hypothesis the existence of ganglion cells connected to this organ would have to be shown, and my research does not support this.

At the point of passing between the œ.g. and the pharynx, two discs originate from the hypodermis by means of a corresponding peduncle. This pair of discs is underneath, first seen by K. in the V., then by Vahl (Wahl?) in E. sp. and their existence I can confirm. In this section, below the hypodermis I constantly found four big cells, two of which are situated among the peduncles and one on the outer side of each peduncle. The connections, the nature and significance of these four large cells escape me for the moments completely.

'imaginale' in It. not in dictionaries not even in the form 'immaginale'. So related tech. to 'imago'?

Œsophagus — After the pharynx comes the œ., which begins at the posterior dorsal extremity of this and is marked by its slenderness, so that it appears as a thin line connecting the pharynx with the proventricle.

* I am not sure of the correct form of this word in zoology. In It. ganglio = one / gangli = more than one. The same goes for 'epitelio' It. I have used 'epitelia' as the Eng. form — out of ignorance. Perhaps Eng. is epithelium sing. / epithelia plur.? So be careful at such points not to assume I know what I'm talking about.

14.1 While it wasn't given to Batelli to discover muscle fibre in the oesophagus, I on my part found that it has an outside wall of muscle consisting of fine striated uninuclear muscle cells that are specially distinct and appear in the sections running according to the longitudinal axis of the organ. Internally the oesophagus is covered with flat epitelial (closely packed) cells, on top of which lies a very thin intima of cuticle. In its passage through the nervous girdle of nerves the oe. does not change its own structure; on the contrary, narrowing somewhat, it offers its muscle fibres to better view.

Proventricle – As we have known for a long time through Weismann's research, the p. behaves in a rather particular way in the M. Similar behaviour is found in the S. and in E., where besides an exaggeration of these conditions is found. The oe. of E. larva penetrates the entire length of the p., as in the M. The description given to us by W. of the p. in the larva of the M. can still be said to be the most exact in comparison with the descriptions given successively by other observers. Above both a section longitudinally cut and a transverse one the E. proventricle shows clearly its structure and the three layers or tunics, placed one above the other, of which it is composed. The oe. penetrates the proventricle, without changing its structure, for the whole of its length, finishing near the beginning of the mid-intestine. Here, assuming quite another look, the oe. wall turns on itself to form the middle layer of the proventricle and, modified in this way, to go to the anterior extremity, here, with a different structure, it folds again to become the layer outside. This turns back* continues along with the wall of the middle intestine. The middle layer is closely backed up against the inside wall of the oe.) and these two layers are guarded by their layer of muscle. Between the middle layer and the outside one, which are guarded with their epitelia layer,

* This ed. be is continuous with

there is enclosed a narrow space like a cleft. The whole layout can be easily understood when it is looked at as a whole, even in a fresh state with a larva only just appearing in the proventricle or with an embryo at the end of its development.

On account of what I have said above it is histologically of interest to give consideration to the middle layer and the outside layer. In older larvae and those nearly mature the lamina or middle tunic has a thin layer of muscle and a basal membrane on which the epithelium lies made up of large clear cells, rather peculiar on account of their particular properties: very high, cylindrical-prismatic in shape on a polygon transverse section, but narrow at their proximal extremity and enlarged at their distal extremity. These cells are furnished with a distinct membrane and with doubled cuticle edges around their free extremity. Their dimensions are 165-170 μ in length and 75-90 μ in width maximum. The cytoplasm of such cells shows trabecles(?) that branch out and run along the major axis of the cell body and expand into a dense delicate network beneath the cuticle. A very delicate network appears in the spaces between the biggest trabecles: a few fine granules can be seen in the mesh of the network of protoplasm, more and more obvious when examined fresh in a sodium chloride solution. The nucleus of the clear cells, quite big in size (40 μ), spherical vesicular, easily alterable in its form, is placed near the middle or goes as far as the upper third of the cell body, has a coloured (loose?) network with long meshes and a big nucleus. The cells of which we are speaking take up colouring substances only with great difficulty and they are as if immune to them - they deserve on that account their name of clear cells. These cells diminish and get smaller get smaller at the two ends of the middle layer (lamina media), that is to say towards the reflexion point on the outside layer and towards the reflexion point on the inside layer or œsophagus.

clear/light?

lasso?

towards

We come now to the outside layer or tunic of the proventricle.

This has a thin muscle layer and an epithelial layer made of dark cells which contrast in their nature with the clear cells. These are in fact quite short compared to the previous ones, (place) low/(form) short, square or rectangular in shape, in perpendicular sections on their surface, and therefore with more width than height, and they measure 55 μ in height, 65-75 μ in breadth. Their cytoplasm is dense, it colours strongly and rapidly, which makes it very fitting that they are called dark cells; they have big dense trabecles straight from the bottom to the free edge of the cell, at the edges a thin border of cuticle, underneath which the whole cytoplasm appears delicately striped; along the length of the trabecles and scattered more abundantly in the body of the cell, are fine granules of metaplasm strongly coloured. The roundish or oval nucleus (30 x 20 μ) has a rich and dense coloured network with distinct nucleus. The height of the dark cells gets less towards the two ends of the proventricle.

Both on the surface of this epithelial layer and in the narrow space of the proventricle, contained between the outside layer and the middle layer, a granulous substance collects and a certain quantity of small granular spheres, the product of secretions from the dark cells: with careful examination it's not difficult to see the little spheres leaving the cell body through the cuticle edge, to which they stay attached for a certain time by means of a slender pedunde. It is on the other hand extremely difficult to see the secretion of the clear cells outside the body of the cell that produces it. From my study of the proventricles in a fresh state, just removed from live larvae I have ascertained that in the case of the living the space or proventricle cavity contains the substance secreted in which the little spheres we we have been speaking about stand out. In the proventricle of young larvae the two types of cell, clear and dark, differ hardly at all in size: the dark ones are cylindrical and almost as large as the clear, which have a less reticulated cytoplasm than the older cells.

At the spot where the middle layer reflexes on the outside layer, at the level

(19th ~~electric~~ light had a fuse as part of its structure?

therefore of the entrance to the oesophagus in the proventricle, ~~##~~ small cells are harboured which all together make a ring round the oesophagus. These are the cells that form the so-called imaginal ring in the anterior intestine (~~Kow~~) (Kow.) as in the Muscidi.

At the point at which the outside layer of proventricle* runs with the wall of the chylificic stomach the intestinal tract undergoes a circular narrowing and a slightly raised fold in the wall projects like a fuse above in a light. A little later you meet the outlet of the blind stomachs.

It's ~~diff~~ hard to establish the physiological significance of the particular arrangement of the proventricle, indicated by some with the name of oesophagus valve. Kow.) who studied it in the M., assumed ~~admitted~~ that it might serve ~~as~~ to hinder the passage of excessively ~~big~~ large masses of food into the chylific stomach. A similar arrangement can be found ~~in~~ even in larvae of other insect orders. Wan. has very briefly described it in the larva of Plat. Pantel ~~doesn't~~ finds no proventricle in the larva of Thrixion, a strange thing, but large clear cells in the oesophagus wall, greatly developed in the dorsal region, close to the point where the oe. is about to continue with the chylific stomach. This finding of Pantel's shows that the proventricle is formed dependent on the oesophagus, thanks to the invagination of its wall. Pantel attributes a mechanical purpose to the the entirety of te clear cells, meant to increase the ~~working~~ sucking function performed by the pharynx.

In respect of the function of the proventricle, having regard to the histological characteristics and to the fact that products of secretion are found in the ~~proventricular~~ proventricular space, I for my part, more than Wandolleck, am inclined to support the ~~ancient~~ old hypothesis of Weismann's

* again this cd-be 'is continuous with'. I dont know whether this means two layers are continuous or one layer becomes the other without a break.

that attributes the job of secreting some substance, perhaps some enzyme, to the two particular epitelia, the one with dark cells, the other with clear. When poured into the ch. stomach it works on the alimentary particles that have been ingested. The clear cells and dark cells remind me though distantly of the two sorts of secreting cells in the pancreas of vertebrates; the dark are the ordinary pancreatic cells and the clear the cells of the islands of Langerhans; but putting this distant recollection into words is far from a pretext for making comparisons and drawing rash conclusions; I just want to confirm the secretion activity in cells of these very special cells described in the proventricle. Nor can it be said, as some have said, that against this can be set the presence of an edge of cuticle on the free side of the cells in question. For other cells are provided with this and of in their case the elaboration and emission of a secretion is not at all in doubt.

I add finally that the proventricle has relatively large dimensions (in the mature larva 2 mm. in length & 1 mm. in breadth) which perhaps contribute to its glandular function, and that alimentary particles or other substances ingested by the larva are never found in the proventricle space.

Mid-intestine or ch. stomach —

It is very long and wide in comparison with the other parts of the intestinal tract: it has a thin muscular wall, formed by an internal layer of circular muscular fibres and an external longitudinal muscle trellised muscle, of the type described by Wiallanes. The epitelial coating shows its own histological marks: the epitelial cells, higher and larger in some cases (height 55 μ, width max. 45-55 μ), lower and smaller in others, have a narrowed base tip in the shape of a polygon in transverse section and a distal tip widened to a cupola shape, with their nucleus usually placed towards the narrow part and containing

(nucleolo)

a. voluminous nuclear corpuscle, a network of cytoplasm that can be coloured at the base quite well, areolar in appearance at the top of the cell and less colourable. The cellular body is bounded by a cuticle edge about 2 μ in width in the free part, homogeneous on the ~~side~~ edge lateral edges of this part of the cell, obviously formed by thin rods* in a manner that simulates the an edge of vibratile lashes, on the upper side. This sort of character of epitelia cells shows with greater clarity near the ~~parts~~ cephalic area of the middle intestine. In the heavily extended parts of the chylific stomach the cells flatten, preserving almost unchanged their edge of ~~sticks~~ rods. It must be noted besides that the striated edge is not continuous on all the cells of the middle intestine; it is held by some that the edge of ~~sticks~~ rods, seen in other ~~larvae~~ Diptera larvae and in larvae of insects of other orders, ~~is~~ consists of immobile vibratile lashes or they have become immobile because, if you go by how Vignon refers to them, the lashes would really be mobile in the middle intestine of young larvae of Chironomus. In the larvae of E. which have only just come out of the egg the ~~sticks~~ rods on the free edge of the cell of the middle intestine can be observed with the clearest evidence and to behold, in spite of prolonged careful monitoring, I never saw any sign of movement from them. For the present, precise data are lacking to make a sure judgement on the question and we are of the opinion that it remains very much an open question whether the ~~sticks~~ rods* on the edge of the cells of the chylifer stomach are to be considered effectively as vibratile lashes that are modified and immobile; we are of the opinion rather that it is a matter of a disposition related to the function of secretion and absorption in the epitelia cells.

~~Several~~ Some cells of the middle intestine, especially in the posterior area, contain fatty droplets, showing up well in pieces treated with osmic liquids.

* 'bastone' is a stick in It. 'bastoncello' a small stick or rod. I haven't found any technical term but the Zingarelli dictionary refers to cells of the retina that react to stimuli. This seems to be the point of dispute on this page - whether the 'bastoncelli' react or not to stimuli. So I have chosen 'rods'

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Near these cells with the signs of an absorption function the epithelium of the middle intestine has others that on the other hand show the signs of a secretory function. And in fact cells can be seen with their distal extremity swollen with granular contents, thinning their edge so as to make it invisible, and emitting, through a process similar to that described by Van Gehuchten, little spheres of their contents that fall into the intestinal cavity.*

The epithelial layer in the cephalic area of the chylific stomach can sometimes be seen distinctly raised in little folds (circumscribing cavities (crypts) on the stele of which the internal muscular layer penetrates. Towards the caudal (tail) end of the middle intestine the epit. cells become high, narrow and cylindrical.

At the point of passing from the middle i. to the posterior i. the four malpighian tubes open into the i. cavity. At this point there is an epithelian fold that acts as a valve (pylorus). Here the cells retain an embryonic character forming the so-called imaginal ring of the posterior i.

Intestino posteriore — Without making a distinction between parts in this I want to say that the post. i., just after it begins, narrows somewhat, then opens out for a certain distance and then gets smaller in size again before opening into the anal ampulla. The muscular wall, extremely developed, is made almost throughout its length of circular muscular fibres, to which are added some longitudinal external fibres on the last bit, where the musculature is even more powerful. The epithelial coating of the p. i. is composed of a layer of moderately high, fairly wide cells, with a cuticle edge with a double circle, underneath which the protoplasm is heavily striped. The boundaries between the cells cannot be seen but in sections† we see the epit. layer

* 'lume' in It. is normally 'light' but here it must be anatomically a 'cavity' or 'hollow part'

† nelle sezioni - in section is: 'when the cell is cut through and examined' I take it as meaning.

raised in folds each corresponding to a cell, while the cavities in the folds reveal the line between one cell and another. The ~~large~~ nucleus, a large one, lies in the rising part of the cell. It can't be completely ruled out ~~that~~ given the nature of the ep. that it is capable of performing the function of absorption. Where the p. i. is more narrow, its cavity, being almost entirely taken up by the folds of e., ~~it~~ in transverse section ~~it~~ assumes the shape of a very irregular scalloped edge*

Glandular appendices in the intestine

Salivary glands – The s.g. are represented by two secretory tubes that join to make a single secretory canal opening ventrally, corresponding to the point of passing from the atrium of the head and the pharynx: a thin lamella of cuticle protects the ~~orifice~~ outlet orifice of the excretory canal, in the way that Pantel noticed in the larva of Thrixion. Each glandular tube is covered with an a secretory epithelia. Its cells have homogeneous protoplasm with fine granules that are easily coloured, and a nucleus with large nucleole. The limits between the bodies of the cells are not at all distinct. They seem to be united at the base, they usually project with the distal end towards the hollow of the gland, so that the surrounding epithelia looks wavy. The excretory canal, as has been already remarked by others, is furnished on its inside surface with a chitinous filament twisting in a spiral that develops a coating of irregular rods towards the outlet.

Blind glands (gastric and stomach glands) – The blind glands, ~~two~~ 4 in number, open into the middle intestine at the same level separately, a little below the proventricle. They are very long glandular tubes, white in colour, running in ~~a wavy~~ waves on the inside of the visceral cavity and proceeding forward. They have their muscular walls formed ~~with~~ of a single layer of delicate fibres. The secretory epithelium that lines them inside is formed of cells that differ from those of the epithelium of the ~~stomach~~ ch. stomach in several characteristics.

* Not at all clear what this means in English or Italian. 'cantina' can means a framework for supporting a structure or a design for scalloping. I suppose the interior shape of the cavity in section might look scalloped.

As to their shape. it can be said to vary considerably since the cells are not all of the same size: indeed some are relatively small and cylindrical in shape, others with much bigger dimensions are much more developed in width than height. The small ones are intercalated with the large and the latter; projecting above the smaller ones, occupy with their mass a good part of the glandular cavity. The small ones measure about 45 μ in height and 20 μ in width, while the large attain a maximum of 145 μ in width and 60–70 μ in height. These large cells, with a wide sustaining base and the free part swollen into a dome that is not very convex, usually have protoplasm that looks reticulated, clearer at the base, denser in the remainder of the cell, surrounded by a very thin edge of cuticle. Where the protoplasm is denser it appears to be so vacuoled as to be a complex with thin little channels running through it and branching out, clearly defined. The nuclei of such cells are round and quite large, 30–40 μ in diameter, with one or two nucleoles and large nodal points on the coloured net made up of thick filaments. In spite of the uniformly intense colouring that the protoplasm assumes in prepared (specimens), there stand out metaplasmatic granules that are even more strongly coloured.

Even though it may be difficult to establish the exact nature of the substance secreted by the blind stomachs, it can't be denied that they have properties able to exercise a digestive action.

Malpighian tubes — The M.t. (also called the tubes or canals for bearing urine) physiologically considered are excretory organs and would be described elsewhere together with analogous organs but from the point of view of anatomy and origin they are put together with the intestine from which they derive. Hence it is on morphological grounds that we speak of them here. Four in number they open independently (first manner of Schindler's in the D.) at the point

of passing between the middle intestine and the posterior ~~i~~, just like the valve bead is (pylorus). They colour yellowish or dark.

I am not going to linger in speaking of their form and their relations, which have already been carefully studied by B. I recall only that two of these go forwards while the other two go backwards; that the two anterior ones are longer and have their ~~ends~~ blind ends shaped like an oval ampulla with a thin wall which functions as a reservoir of excreted matter, milky white in colour and containing calcareous salts. In the neighbourhood of their insertion into the intestine the 4 tubes of Malpl. as pairs → get closer to each other, that is the tubes of the anterior pair and the tubes of the posterior pair, but without actually joining into a common trunk. The two anterior tubes open, each with a distinct orifice at the same level but opposite to the outlet of the two posterior tubes, in the manner that Kunckel d'H. described in the V., while Batelli* describes the anal tubes in a way that makes the anterior of one side ~~with the~~ closer ~~with~~ to the posterior of the same side — which in fact is not the case.

I omit to speak of their histological structure both because others have spoken of it at quite some length and because I shall have an opportunity to make some references to it in the internal organisation of the fully-formed insect.

Anal glands (intestine branchiae, Wahl's "Darmkiemen" ~~by Wahl~~)

I have continued to call them anal glands for two principal reasons: 1. because I believe they have an excretory function as well as a respiratory job; 2. because I believe they must be regarded as homologous to the rectal glands of the ~~the~~ Vol. larvae, described by Kun. d'H. ~~in~~ in fig. 3 of chap. VIII.

In correspondence with the anal aperture the integument, introflexing, forms an anal ampulla in the ~~form of~~ shape of a bell capable of

* could be 'sketches' or 'describes'

~~the intest. posterior~~

~~being~~ extraflexion together with the anal glands ~~it comes out halfway~~ along (~~or it comes out by means of these~~) ~~with a narrow cleft directed~~ in an arrow direction = in a sagittal direction?

The post. int. comes out dorsally by means of these with a narrow cleft ~~directed in an arrow direction~~ directed like an arrow and on the sides the anal glands open, deriving from invaginations of the ectoderm covering this area. The anal glands are shaped like a† little vessel of finger form with a blind bottom. There are 18 or 20 placed in pairs, half on each side. They are extraflexed together ~~at~~ with the anal ampulla and moved by the larva with a continuous oscillation from front to back, while each of them can in turn fold back on itself ~~as~~ like a finger. Each pair has a ~~part or~~ common part or base and a ~~common~~ tracheal trunk, which forks to ~~give~~ make a branch for each gland, on which it ~~subdivides~~ breaks down into many ~~small in great number~~ subdivisions. The otricoles (little vessels of finger shape) – and ~~it~~ it should be noted that I ~~consider~~ consider them now in the introflexed state – are coated internally with large epit. cells ~~of~~ somewhat low, 45-55 μ, but yet very broad, as much as 100 μ, whose cytoplasm appears striated, with a thick edge of cuticle on the free end of the cell body. The nuclei of these cells is also large, 25-35 μ, round or oval, with a ~~fine~~ dense coloured network and one or two nucleoles: sometimes in the nucleus, rather than a coloured network, a ball with jewel* filaments on coloured swollen granules ~~can appear~~ is apparent. At the tops of the otricoles the epit. cells are a little smaller and more granulous. The membrane that forms the wall of the glands and on which the epit. cells rest is extremely thin, at certain points almost imperceptible. The tracheal branches are inserted here and there, at different heights of the ~~all~~ otricle, into this membrane and dispatch very fine capillaries, in respect of which I couldn't say whether they penetrate into the epit. cells. The hollow of the otricles when introflexed contains often a special excretion product and the ampulla anal ampulla fills with certain little membranes protruding in a bunch outside the anal aperture. These are continuous with the excretion product of the otricles non-stop and seem ~~to~~ made of the very same product. It appears besides that these ~~membranes~~ little membranes with a cuticle appearance might constitute so many tubes resulting from the prolongation of the cuticle intima of the otricles

† otricoli – little vessels formed from goatskin originally – vase shaped therefore.

* moniliformi – 'monile' is Lat. for an ornament worn round the neck. The granules make the filaments making ~~the~~ up the ball shine? Yes, a guess only.

in the anal ampulla. While the anal glands are introflexed, the top of some of them stays invaginated for a longer or shorter stretch two or three fold even, like the finger of a glove, on the remainder of the otricle, in a manner such that in section (and these cut transversely these parts of the gland) two or three and even four epit. layers can be seen, circular and concentric one upon another. The sections, which fall along the longitudinal axis of the invaginated top of the gland, show clearly how the tracheas, in respect of the otricle, become internal and the epit. becomes external at the moment of extroversion, and how then the otricle when turned inside out fills with blood (haemolymph). In the sections under microscopic examination of sections of pieces that have been variously fixed a certain quantity of blood coagulated with blood corpuscles (amoebic?*) and fatty droplets is always revealed in the invaginated apex.

On every glandular otricle not far from its top or directly on its top one or two muscular fibres are inserted which with their other end are attached to the dorsal wall of the body of the larva and serve as retractile muscles in the introflexion of the otricles. Equally similarly retractile muscles are inserted on the dorsal convex face of the anal ampulla on the sides of the post. int., as also on the post. int. itself when it is about to open into the anal ampulla. On the edges of the anal amp.a and on the base of the otricles muscles are inserted which in my view by their contraction must help in the extraflexion of the whole thing. Since in the action of extraflexion the otricles turn completely inside out we have a tubular appendix with a blind bottom in every extraflex otricle turned inside out. This tubular appendix is lined externally with an epitelial layer and internally contains tracheal branches, blood (which fills it and helps by its pressure to turn it outwards) and retractory muscles. I have seen in very many larvae the top of the otricles coloured black when turned outwards, drops of a brown oily-looking substance having accumulated in them.

These glands seen for the first time by Reaumur, then

* It. amebociti – which I can't find even in the Zingarelli dictionary.
Amaba then?

described by Chun, by Batelli, and ~~in diff~~ interpreted in different ways, have been recently carefully studied by Wahl in relation to the tracheal system especially and labelled by intestinal branches by him.

Buckton refers only to 11 anal flabelli, saying nothing of their Structure, and thinks they are the first signs* of the rectal glands of the fully formed insect. In regard to this I shall ~~soon~~ quickly say that following the internal processes of the nymph I have ascertained that they decompose completely and therefore that they play ~~no~~ no part at all in the formation of the rectal glands in the imago.

Relying especially on their richness in tracheas, Wahl holds that they are endowed with a respiratory function which would ensue particularly when the provision of oxygen through the respiration of the stigmi was insufficient. I have often seen the anal glands turned ~~in~~ out ~~from~~ from time to time even in larvae kept in the best conditions in acquariums in which the water was renewed several times a day.

Usually the extroversion of the glands co-incides with a relative state of inactivity in the larva. The glands of larvae newly hatched are already well-formed and begin to be extroverted after only a few days.

I do not deny that the anal glands also function as respiratory organs, since their abundance of tracheas speaks effectively in favour of this, and, I would add, the influx of haemolymph into the out turned utricles (as in [redacted] blood filled branchiae); but when I think ~~of the~~ that in the structure of the large cells which the epitelia is composed of, lining the utricles, the signs are not lacking of a secretory activity, that in the larvae of Vol., a species close to E., similar anal glands exist not capable of being turned outwards, which as Künckel says would seem to secrete a protective substance, I hesitate to take away from the anal utricles of the larva of E. a job of secretion or excretion, even if I don't know exactly which, ~~but which~~ ~~would~~ →

* abbozzi - are 'a preliminary sketch' or biologically 'the primitive nucleus at the embryonic stage'

but which could very well co-exist with the respiratory function, to which these organs must be secondarily adapted in consequence of the larva's life in water. My interpretation therefore seems to confirm the opinion of Chun already expressed ever since 1875 on the anal glands of E.

Having mentioned the different parts of which the digestive apparatus is the outcome and the its glandular appendixes, it's now the right moment to show up some of the worse mistakes which Buckton committed.

We have seen that there are two salivary glands, joined together in a common excretory channel, opening ventrally at the moment of crossing from the atrium of the head to the pharynx. Well then, for B. the salivary ducts are actually only six (you don't say so!) issuing in the oesophagus. Indeed in the chapter III fig. 4 B. sketches the pharynx of the larva of E.t. and a bit of the oesophagus with six tubes, three on the part 'g', which open into this and which he labels as salivary ducts; in the explanation for fig. 4 he writes: 'Part of the . . .' [See English] of the original text]

In fig. 6 of chap. VI representing part of the viscera of a young larva of E. arbust., in front of the pharynx is shown a thin streake mark is drawn, the significance of which is not shown clear, and immediately after the oesophagus the chylific stomach is shown, called by B. proventricle as well [English] very short. Following it is a narrow tract in which the Mal. tubes are made to open, joined together two by two in a common trunk. Then the salivary glands are missing, the proventricle properly called, which we on our part have described, the blind stomach glands, without our calling attention to the fact that the chylific stomach is not as short as it appears to B. and the Mal. tubes open separately, as among them only the two anterior brought closer together and the two posterior,

quoted verbatim in the text (proventricle or chylestomach distended)

but they do not really behave in the way B. desires. So many hallowed mistakes and such imprecision, even with a certain luxury of illustration in a book, demand to be corrected.

In my view he committed another mistake when he records and draws in figs. 1 & 2 of Chap. II, special red ducts of doubtful significance (vasi) vessels? which could be seen underneath the integumentum and which are then found scattered among the viscera when the larva is ~~dissected~~ ~~dead~~ dissected. I have never seen similar ducts in live larvæ, nor even in ~~dead~~ larvæ that have been dead for one or two days, and I fear that in fact B. saw them in examining dead larvæ, describing and showing as special (vasi) ducts, pieces of the Malph. tubes that post mortem become red and shine through the skin or are found in the viscera like ducts of a vivid carmine red colour.

We referred already to B's having noted only 11 flabellivæ analis (anal glands) whereas there are at least 18.

Circulatory system (the dorsal vessel or heart)

The dorsal vessel or heart was deeply studied in larvae of the Muscidi (W. V. L.) and of other Diptera, but still often poses the greatest difficulty on account of its extraordinary delicateness. Recently Pantel made a minute analysis of the v. d. in the larva of Thrix. and W. also was extremely busy on it in the larva of Plat. plan. P. subdivided the v. d. into four areas: a) the post. trunk or ventricle (Lowne) which has together with it very large pericardial cells, capable of expansion and contraction b) the middle trunk which has small pericardial cells capable of expansion and contraction c) the anterior trunk or aorta (G., L.) without any satellite cells and capable of lengthening and shortening, fixed at its anterior end by means of the supporting ring (W.) d) the trunk or prolongation above the oesophagus, that goes from the ring to the pharynx in the form of an upside down shower with the lateral margins joined to the imaginal discs of that part.

For W. the circulatory system of the larva of Pl. plan. consists of four sizeable parts that can be precisely defined: 1a. an *infabulbous channel enclosed on all sides 2a a shower part originally open only laterally, then below as well) 3a the aorta which in its turn consists of two parts: the free part going upwards and the horizontal part, which on its upper side has small pericardial cells and is supported by bundles of muscles; & 4a the ample posterior part which has a pair of large valves and has large pericardial cells.

In the larva of the S. the dorsal vessel was studied by Viallanes in order to sort out the structure in particular.

* 'infra' must mean either 'below' or 'between' and 'bulbare' spherical or global in shape. Word not even in Zingarelli

In live larva of E. advanced in age the dorsal vessel stands out rather clearly between the two tracheal principal tracheal trunks mainly through its contrasting colour. Quite large at the back towards its cul-de-sac, it gradually narrows until the suspensory ring. However, in the live larva the dorsal vessel is not visible at the anterior, either because it becomes so thin or because it gets further away and deeper from the integumentum. In the case of the dorsal vessel of the E., following tracking it in serial section, one manages to distinguish, as in the case of the muscidi, a posterior part with large pericardial cells, a middle part with small pericardial cells, and an anterior part, aorta, with no satellite cells that first runs horizontally then goes downwards backed up against the dorsal side of the proventricle and the oesophagus, until it reaches a point near the brain, where it is surrounded by the suspensory ring of cells.

Before referring to the way it finishes the aorta or anterior part of the dorsal vessel finishes, it's best to describe the suspensory ring.

This is situated in an oblique direction cephalo-caudal and dorso-ventral, and is formed of large cells crowded together, among them, epitelial in look, for the most part parallelopedic in shape, with a fine nucleus rich in cromatina. Both on the anterior and the posterior end of it the presence of a large number of very small cells can be seen very thickly compressed together to make a solid cord at each end of the ring contained between the large cells making up the organ. A funiculus of ligament breaks away from the ventral face of the aorta, crosses the posterior mass of small cells and moving from there in a cando-ventral direction is lost on the wall of the proventricle. Two other funiculi breaking away which break away laterally on the posterior mass of small cells go forwards. The suspensory ring is then connected to the tracheal anterior tracheal junction and to two tracheal branches leading for the cerebral hemispheres.

I note incidentally at this point that it is not true, as Kün. d'Ht thinks, that the suspensory ring

is destined to disappear, because it remains little changed during the nymphal stage and persists afterwards in the image.

Having noted the position, structure, and relations of the suspensory ring we can now speak of ~~its behaviour to be~~ how the dorsal vessel behaves in front. The aorta passes through the S.r. and finishes more quickly ventrally than dorsally, that is to say its opening in front is oblique in the sense of the direction of the S.r. Once past the ~~a~~ posterior end of this ring the ventral wall of the aorta is sprinkled with ~~a~~ small nuclei and shortly afterwards finishes by disappearing. On the dorsal side however it is thin and prolonged, ~~thin~~ in the shape of a shower open lower down, until the anterior end of the S.r. and the anterior tracheal junction, reaching ~~above~~ beyond the cerebral junction. But to go beyond the arrangements that are met in advance on the series of cuts would require a very particular and minute description which I think I will have to spare myself from since it is too long and difficult without the aid of explanatory illustrations. I content myself with confirming that from this point onwards I don't find any longer, proceeding forward, a ~~more~~ wall of muscle on the dorsal vessel, even one very reduced in size, rather just provisions made by the reciprocal relationships of ligament membranes with the brain, with the tracheal trunks, with the imaginal discs of the area and with the muscles of the pharynx. These provisions do physiologically lead the current of blood in a certain settled direction and help of course to give it a bigger boost than the ~~pharyngal~~ muscles of the pharynx can (infrabulbous channel of Wandolleck). Morphologically however, it doesn't appear to me that they should be considered, contrary to what Pantel and Wandolleck desire, (namely) that the channel of the pharyngeal bulb reaches them, as the anterior continuation of the dorsal vessel.

On the wall of the three parts really belonging to the dorsal vessel the nuclei are large with their own characteristics; in the middle ~~area~~ and posterior areas they are situated laterally in a symmetrical way, but ~~not at all~~ never ~~standing~~ ? projecting out in the hollow of the vessel like as Pantel represents ~~for it~~ for the larva of Thrixion. As for the wing muscles which

hold the posterior and middle parts in position, they are not smooth as Künckel d'Herc. says states for the Volucelle, but, rather, clearly striated, and they are not attached sideways to the principal tracheal trunks, but being backed up to this they go beyond them and really are inserted on the lateral wall of the body in the tendons and or muscle walls which offer insertion to the lateral muscles of this (= corpo body), And that provides a check in the sense that Pantel and Wand. said in the case of the lateral insertions of the wing muscles, viz Thrix. and Plat. plan. respectively, against Weismann, who in the case of the larvae of Muscidi allowed these muscles to insert and terminate at the tracheal trunks.

What is 'this'?

Towards the middle the sarcolemma of the wing muscle fibres is visible going to make up their tendons. After it is extend has broadened out and made several branches it is inserted with these on the sides of the dorsal vessel in the middle area, and on the sides and beneath it on the posterior area or ventricle. Among the ramifications of the tendons the pericardial cells are included†. The cul de sac of the heart, placed a little in front of the junction posterior tracheal junction, is anchored by means of thin ligaments to the dorsal wall of the body.

× or between

On the subject of the delicate structure of the dorsal vessel it is known that its wall is formed of striated muscle substance. It was a matter of debate whether the dorsal vessel was to be regarded as a unique single hollow muscle fibre (Ch.) or (Weismann) or instead as whether it resulted instead from the union of more muscle cells in a particular manner arranged and disposed in a particular way, as others more reasonably correctly have maintained, among them Viallanes principally, who studied the minute structure of the heart of S., because the almost perfectly symmetrical disposition of the nuclei is heavily in favour of this theory, even leaving unsaid the fact that

† stanno compresi - this may be little more than 'there are'. Probably better so.

* riscontro - can be 'a comparison' or 'check'. The latter here I think because he agrees with Pantel and Wandolleck and disagrees with Weismann?

Viallanes managed to see the line of the joint above and below of the muscle cells composing the heart.

Tracheal system (organs of respiration)

Réaumur was already busy on the t.s. of the larva of E. t. Among modern observers after Batelli and Kolbe, Wahl gives us a thorough and full description in his note published last year "On the Th. S. and the Imago discs of larva of E.t." in which he pursues histological research on the structure of the trachea and of the stigmi, on the centres of regeneration and renewal of the tracheal epitelia. Anyone who wants a full knowledge of the tracheal system of E. I would send back to the note by Wahl: saying that. through my own research I was convinced of the correctness of what this thorough observer refers to in this part concerning this part. I will add just one or two notes that Wahl was not able to make and I shall do it for the sake of greater clarity while I record the general lines of the t.s. of the larva of E., sticking to Wahl's description and to my own observations.

This system has two principal longitudinal trunks, situated dorsally, that start at the front with two closed stigmatic horns placed between the first and second segments, and extend through the whole body and continue in the respiratory tube of the tail of the larva, at the end of which they issue through two stigmatic openings. Since here only the posterior stigmi are open, the larva belongs to the metapneustic type. Batelli thought that the anterior stigmi were open, but Palmen had already said they were closed; Wahl

asserts as much and I confirm it. The two main straight trunks, swollen in the middle part, become thinner and bowed to S at their anterior and posterior ends and continue backwards in two large tracheal branches of the respiratory canal. ~~The two branches,~~ When the tail is retracted, these two branches are folded back for the most part in the posterior end of the visceral cavity, at the base of the tail. The prolongations of, anterior and posterior, of the main trunks, which go to the anterior and posterior stigmi respectively, should be considered, according to Wahl, as the first and last pair of the tracheal stigmatic branches, while the main trunks would represent a long anastomose between these branches. The two main tracheal trunks are joined through two junctions, one anterior, the other posterior. From Very many branches come out of the two main tr. trunks, distinguished by Wahl as segmented and non-segmented, branches. ~~which~~ They go to the different organs of the larva.

Buckton is silent on the tr. s. but he speaks mistakenly of a muscular tunic of the main tr. trunks by which the very same (trunks) would repeat their capacity considerably to expand and contract. At this time neither I nor anybody else sees muscle fibre on the tr. walls, and I don't think anyone has ever discovered, not even in other larvae or in other insects in the imago state, muscle fibres that make up the structure of the tr.

The anterior stigmi are related to the superior imaginal discs in the first segment, from which the two stigmata-forms horns of the pupa also derive. They are ~~not~~ retractable and protractile and in the mature larva they are about 1 mm. long. The hypodermis folds in at their base.

I mention at this point that the anterior stigmi are absent completely in the young larvae and appear only on the seventh or eighth day, which I managed to establish by following the growth of larvae born from eggs laid in the lab. by females of E.t. The appearance of the anterior stigmi

Therefore
would characterise a second larval stage in the E., as it does in the Vol. and Musc.

When they first appear
While the anterior stigmi ~~at the start of their appearance~~ are very delicate, with a light brown colour, gradually ~~they become thicker~~ their chitinous armature becomes thicker and they become dark and strong, so that only with the greatest difficulty can they be sectioned by microtome. Each stigma anteriore is cut in a flute mouthpiece there where it is scalloped (to use Batelli's expression), with the face oblique and the scallop turned backwards. As a whole the anterior face is helicoid, kidney-shaped, umbilicate in the middle. As for their structure it can already be said that they are closed: they have moreover dispositions that make ~~osmosis~~ possible. Wahl makes a drawing - skipping over them - however - of certain reliefs or cupola-shaped tubercles, placed all around the anterior face of the stigma, except ~~that~~ in the short cropped bit, that confers on the stigma as a whole the kidney-shaped configuration. On my part, using young larvae at the moment when the stigmi appear, I was able distinctly to count 16 ~~reliefs~~ rounded prominences or cupola-shaped tubercles (to be named stigmatic ~~cells~~ chambers) covered on their convex surface with a very thin membrane *anista, permeable by gases, framed by a thicker edge that forms the tubercle base. These aforesaid tubercles or stigmatic chambers as can be considered as so many small secondary stigmi, supported by the corneous plate of the main stigma. On the edge of each secondary stigma a very small bud can be seen, from the middle of it a short growth† rises containing a microscopic orifice, which we shall learn the significance of later on. Since the chamber of each relief cupola-shaped °relief is full of air, the surface of the cupolas looks shining under microscope observation with reflected light [perhaps just: "the surface shines with reflected light under the microscope"] It is known through the research of the preceding observers and of Wahl that the tracheal trunk loses its spiral ~~fibr~~ or ** tenidio filament and substitutes for it a felting of chitinous filaments that are branching and variously anastomised, coming out of the chitinous armature. I have seen at this time on E. sections

prominences

prominence

°° Perhaps this mention of 'scalloped' in connection with the flute mouthpiece shape helps to explain p148 note?

** tenidio - no ideas on this. It describes filament. Not in Zingarelli. Adj. Also see top of p 163

° rilievo - a raised part? a prominence, I think

† processo = anatomical. I use 'growth'.

* anista - goes with the membrane. Not in Zingarelli even, but aniso- in compounds means diverse, unequal, dissimilar. But the -t-? se.

that fall in the right direction that the felt, which has a spongy look, does not invade the chambers of the secondary stigmi but leaves them completely free.

see p. 162 At the point where the tracheal stigmatic trunk is about to lose the tenidio, it becomes surrounded by a series of large cells in the shape of a corona. (These cells are situated between the hypodermis that surrounds the tracheal tube and the peripodal membrane of the upper imaginal disc of the first segment.) They were seen before by Batelli but not fully understood, and described by Wahl as well. The above-mentioned large cells are glandular, are piriform in shape, with a cuticle membrance that is distinct though thin, large vesicular nuclei with one or two nucleoles, and homogeneous looking cytoplasm, coloured yellowish in the fresh state. Finally they have the peculiar characteristic of possessing a long excretory canal, intercellular, circling many times in the interior of the cell body. The ~~excretory canal~~ intercellular excretory canal comes out of the thinned end of the cell, goes a long way from it and is covered with a layer of cytoplasm, which becomes thinner, surrounded with the cuticle membrane.

Such a canal was at first held to be a filament so that in speaking of them Batelli called them *nemacistiform, almost comparing them to urticacious cells. Wahl then established their true nature as a filament, and my research confirms Wahl completely.

Such cells as these are found, as we shall say shortly, also related to together with the posterior stigmi.

It is in section that one manages especially to appreciate the hollow of the canal, the cuticle wall of which is strongly coloured by haematoxylon or by †hemallum. When I examined these cells in pupae one or two days old under strong magnification – they remain quite well preserved in these – ~~it~~ I happened to see the cytoplasm arranged radially around the hollow of the canal, as if it[1] was crossed by extremely thin straight canals running towards it[2] and with outlets into it[2]. Anyway, in the larva specimens the cytoplasm shows

1 This 'it' is different from 'it'2. It' is the cytoplasm, I think
It 2 is the body of the canal, I think.

* ? zoology babble?
† a colouring agent?

fine striations in the neighbourhood of the excretory canal and pependicular to the canal.

As Wilh was hindered both by the great thickness and by the intense pigmentation of the chitinous armature of the main stigma, he could not follow the course of the excretory canal of the glandular cells attached to the anterior stigmi. As for me I took advantage of larvae of the 7th or 8th day for such observations. Their anterior stigmi, having just emerged, were still only faintly pigmented and therefore fairly transparent. I had the good fortune to be able at leisure to trace the course of the excretory canal of the glandular cells and to determine the finish and the point of outlet. Thus the canal of each glandular cell rises in a very twisting spiral along the wall of the stigmatic tube, at first positioned under the introflexed hypodermis, then between the hypodermis and the chitinous plate of the stigma and finally into the thick part of the plate; after it has reached the contour of the anterior face of the main stigma, it opens up at the base of a secondary stigma, on its outside margin, in correspondence with that bud noted above and exactly at the top of the short growth † and from the middle of the bud it rises. From the disposition described, therefore, it can be inferred that there is a single excretory canal corresponding to each secondary stigma and perhaps a single glandular cell and that, apart from the existence of unions between the excretory canals of adjacent cells, which I didn't happen to observe, the glandular cells are equal in number to the secondary stigmi

Compressing my fresh lab. specimens to advantage I helped at the emergence from the excretory orifice of very refractive droplets of an oily-looking substance. The spontaneous question arises now of the job deputed to the large and peculiar stigmatic cells. When you reflect on their relations, on the look of the substance secreted by these same cells, there is no doubt at all that of their function they are meant to fulfil: to secrete, that is, an oily substance that spreads over the surface of the stigmi and prevents water from adhering to them and wetting them.

○ 'Assistere' usually means 'to be present'; but here 'comprimendo' = compressing creates difficulty. So I think 'Compressing my specimens ... I helped the emergence of ...'

* It. segregata – now means in It. as in English 'segregated'. But Zingarelli says in 1884 it was used to mean 'secreted'. So I take this as the 1895 usage. Mod. It. would be 'secernere' from 'secernere'.

† See note p. 162

But this is perhaps not their only and major function, since if it was, similar cells connected to the stigmi ought to be encountered also in other acquatic larvae; but as fas as I know that is not true. Consequently it is perhaps to be presumed that the substance secreted by the particular cells has poisonous properties such as to act on bacteria or other microorganisms that certainly teem in the contaminated waters and in those places in general where the larvae of E. lead their lives. However it may be, we would not be far from the truth in concluding that it is a matter of a protective function.

We now move on to refer to the posterior stigmi. These are the ones on the tip of the tail or respiratory canal that were had already been described by Réaumur and were then studied by Batelli and recently by Wahl. That canal consists of three parts continuous with each other, with the capability in the case of the final two of invaginating ('sliding'?) one inside the other and both of them in the third, like the tubes of a telescope. As for us, we are not entering into the details of its structure seeing that they can be found in the works of Batelli and Wahl. Nevertheless we note that the last part differs from the first two both because it lacks muscles and because its cuticle lacking bristles forms circular pads, separated by furrows which disappear at the terminal end where longitudinal striations can instead be seen. This part which is already pigmented in larvae hatching from the eggs is the one that has the stigmi (Batelli's stigmatic swelling or chitinous armature of the stigmatic canal) at its apex, which is somewhat enlarged, strongly chitinised and black. The two large tracheal branches running through the tail and going to the stigmi lose the tenidio* at the moment of entering the end part of the final portion and each one immediately enlarges into a stigmatic chamber, opening to the outside through one or two orifices. Wahl speaks of two orifices, Batelli of one only; I in my turn have seen now one now two orifices. Kräckel d'H. shows two orifices in the younger larvae, one in the mature larvae of Vol. The deduction to draw from such diversity of findings is

* see page 162 for absence of ideas on the meaning of this zoology babble.

: probably there exist two orifices in the young larvae for each chamber which either persist separately or merge gradually into a single one. The orifices have a small cornea plate with delicate carvings. On the edge of the said cornea plate there are 8 (not 5 or 6 as Buckton says) bristles or downy hairs, growing from as many dimples.

Wahl justly notes that here the stigmatic ~~cavities~~ chambers, contrary to what happens in the stigmi of many other larvae of D. (and in the ~~stigmi~~ anterior stigmi of the larva of D. itself) are not filled with a chitinous pad. In my view however such a condition is only secondary in E., since by examining serial* sagittal or transverse cuts of tails of very young larvae, I found that during a certain time each chamber is full, though partially, with the centre of it remaining free, with a delicate network or pad of chitinous filaments ~~which~~ branching and ~~are~~ anastomatised among themselves, which afterwards slowly disappears. I ~~found~~ established this as well: that besides this as in newly hatched larvae the stigmi are closed by a thin membrane, ~~similar~~ in a way similar to what is seen in anterior stigmi, with the difference that in this case it is a matter of a permanent condition, in the other of a temporary one. In fact later the stigmi open and the stigmatic chambers completely empty of chitinous filaments. ~~But it is~~ It follows therefore that the larvae of E. should be described as apneustic at first and then they become metapneustic. In any case it is worthwhile pointing out that the greater simplicity of the posterior stigmi compared with the anterior ones, and that the former, in contrast with the latter, are open permanently.

In the case of the posterior stigmi as well special glandular cells are connected with them (similar to those adjacent to the anterior stigmi). The glandular cells are placed among the retractable muscles of the tail. In effect, the retraction of the tail and the respiratory canal is brought about through the action of 6 retractile muscles which ~~on one side~~ are inserted on one side on the ~~wall~~ somatic wall of the last segment of the body and on the other side at the point of crossing between the second and third portion of the tail. At the present moment in the neighbourhood of this point, among the muscular fibres

* sections that divide the body into two identical equal parts

there are resulting characteristic cells, of a quite conspicuous size, such that they can be seen even with the naked eye or with a simple magnifying lens when they are isolated together with the muscle fibres, among which they stand out on account of their yellowish colour. The form of the huge cells isolated cells is of a bottle or of a pear as in the glandular cells of the anterior stigmi, which they resemble too in their general appearance, except for the greater size (170–200 μ in length, and 70–80 μ max. breadth) and the greater length of the excretory canal that coils with more loops in the interior of the cellular body.

Their large spherical nucleus, usually containing two big nucleoles, does not reveal in the live state that rich chromatic network that only appears properly in prepared specimens after fixing and colouring. Under pressure from the muscles their form varies easily. The excretory canal in the interior of the cellular body begins with a small ball in the shape of a club, resulting* from small loops crowded closely together, and emerges issues from the pointed end of the cell surrounded by a thin protoplasm envelope, then extends to the stigmatic apex of the respiratory canal. The excretory canals are first somewhat widened level with the stigmatic chambers, then issue between the stigmatic openings and the downy bristles. The extracellular route of the excretory canal was not pursued by Batelli. He was the first to see these cells and referred to their glandular significance (likening them to the glandular cells with intracellular excretory canal described by Leydig in the integument of Insects). But their route was correctly determined by Wahl, as my own new research confirms. In larvae of advanced age it is only as a result of repeated observations that you manage to discover the excretory canals running along the respiratory canal but they easily get lost from view in the when close to and in relation to the stigmatic swelling through the strong pigmentation and the size of the chitinous armature. In young larvae on the other hand they are quite easy to follow when the pigmentation is less intense and the chitinous armature

* 'resulting the from' should be 'risultante da'—. But 'resulting in' does not make sense for 'risultante di'. So I prefer the former, rather like 'arising from'

smaller. Finally, in order to define more precisely the route of the above mentioned canals in mature larvae I sectioned their tails with the *microtome pursued both transversally and longitudinally in series. At the present time I cut a series of transverse sections at the level of the cuts across the glandular cells these cells can be seen compressed between the retractile muscles showing the ~~hollow with the clearest proof, quite 5μ in width~~, with the clearest proof their excretory canal's hollow, quite 5μ in wide, sectioned in a number of ways because of its convoluted intracellular path. Then the bodies of the cells are prolonged *caudally ~~in the tail~~ and their prolongations are arranged in two furrows resulting from the two trachea being backed up to each other. Towards the tail extremity the excretory canals ~~from be~~ twist laterally in a very lengthy spiral to arrange themselves, one from one side, one from the ~~other~~ respectively on the outside of the stigmatic tracheal trunks, interposing themselves among the hypodermic cells that here become somewhat higher and cylindrical (chitinogene matrix). Finally before issuing ~~to the~~ externally the canals undergo enlargement during which [if time] / or in the course of which [if place] they appear with a double wall.

On the significance of the glandular giant cells, on which we discoursed at ~~her~~ some length, there is now no room to raise any further doubt. And the opinion of Viallanes goes for an absolute ~~Buxton~~. After making it an object of special study, though without managing to recognise the route of what he mistakenly labelled a solid filament (the excretory canal), he claimed he had found a single elastic apparatus, a new type of elastic tissue. Viallanes' opinion, ~~although~~ in spite of having been already confounded by Gazagnaire, was of course accepted by Buckton, who ~~after~~ then offers an illustration in his book (~~fig~~. chap. VIII, fig. 9) in no way conforming to the true facts.

* in the tail

The moment has arrived now to ask: What is the function of these unicellular glands of the posterior stigmi?

As Wahl also thinks, as I have observed above about the glandular cells of the anterior stigmi, it seems certain that their job is to spread their oily secretion on the posterior stigmi and in this way prevent water sticking to them and by means of them entering the trachea; but in my opinion it is to be believed that in all likelihood they also have another important job, namely to protect the stigmi from invasion by micro-organisms by means of their bactericidal action. But Wahl holds besides that the secretion from the above-mentioned cells serves also to hold the larva suspended in the water by the apex of the tail. Wahl however did not see that the glandular cells of the anterior stigmi issue at the surface of these and he could not, even therefore make the objection that: if what he supposes is admitted the larva should remain suspended on the skin of the water more by the anterior than the posterior tip. It could really be said that the former is heavier than the latter, but it should not be forgotten that in compensation there is a greater surface for adhesion in the two stigmi on the anterior end. There are also at least four times the number of unicellular glands (inasmuch as at the front there are certainly 32, whereas at the back 8 at the most). So in my view Wahl exaggerates a fair bit on the job of the posterior glands cells. The larva's suspension by the apex of the tail on the water surface owes more to the special nature of the downy hairs than to the substance secreted. It would be however be of more and more interest to pin down the significance of the cells that we have up till now been concerned with, to investigate whether similar unicellular glands exist in the larvae of other S. which live in the water or do differently, as Vol., Helophilus, Microdon etc.

Even if the tail is shrivelled up and dried, it does not spontaneously drop off, as Réaumur believed; in the passage to the pupal state, nor furthermore does it, always, any use to keep the pupa suspended, as Loew thought, and facilitate the transformation in this way.

Body or fatty tissue

[I use 'fatty' here but later submit to a.t. adipose tissue]

It can be said that the body or f.t. is what tires the mind of those who study it most for both on its own account and all the questions which directly refer to it during the nymph processes or indirectly link up to it. Though the f.t. has been researched by many up till now, it always maintained a rather enigmatic presence both in relation to its nature and according to its job and its behaviour during the nymph stage.

It is only through the work of recent investigations and especially thanks to the research that Berlese extended to insects belonging to various orders of metabolics that we have begun to get clearer ideas on the morphology of the f.t., on the modifications the f.t. encounters undergoes during the transformation of the animal from the larva state to the imago state, as well as many queries relating to it.

But notwithstanding the clearer light brought to bear, we are still a long way off from seeing a wide consensus of opinion among the different researchers, a complete agreement among opinions, to demonstrate which it is sufficient to recall that the results of the research by Berlese are in part and on essential points opposed by those of the research by Supino on the Call. cyph. So the desire for more observation, instead of dwindling, is more and more to be heard. But I can't for now enter on such difficult questions both because it would not be either the place or the opportune moment and besides because our own studies of E. are not completed at this time.

Such studies need to be very accurate because in this species the nymph stage is completed quite quickly so and the various processes succeed one another can be followed only with rather greater difficulty. I confine myself on that account to giving here only the briefest reference to the f.t. of the larva, reserving a fuller treatment to the time when I can treat the changes to it in the nymph stage as well.

The fatty body in the mature larva of E. has a pale yellow colour tending slightly towards pink. It is located as in the larva of Muscidi, in two symmetrical strips which start from at the anterior end on the sides of the pharynx and run dorsally as far as the posterior extremity of the body.

Each of these is subdivided into two strips, one located on the inside, the other on the outside of the respective main tracheal trunk which conducts them its own branches to them (tracheae of the fatty body) and the two stripes of each strap join up at the two ends: the internal stripe is narrow (scarcely 1 mm.) and compact, regularly nastriform [ribbon shaped] with no fringes, the outside wider (1.5-2 mm.) with edges or fringes, more or less broad, that go among the viscera. The f.t. is made up of large cells (Bedese's trophocytes) more or less spheroid or polyhedrons, which even though loosely held together in elegant necklaces or coronets still easily flatten their surface at points of mutual contact.

The f.t. is not always as developed as in the mature larva, and in the very young larva is composed of relatively small cells only lightly loaded with fat. In larvae that are newly hatched the f. cells are quite small, not exceeding 7 or 8 μ in diameter. At an early stage the same cells become round or oval and more or less lengthened, measuring from 10-15 μ, with only some vacuoles (fat droplets) relatively large: their nucleus of 5 μ contains a rather big very distinct nucleole. Gradually with the growth of the larva the fat cells become larger and larger, so that in the larva close to maturity

they attain conspicuous dimensions of 120-130-145 mm. in diameter; their ~~nucleus also~~ vesicular, round or oval nucleus also greatly increases in volume so as to measure some 30 μ.

Taking one of these cells now for closer study in preparations of f.t. fixed in Sublimate, ~~and~~ we shall see that the cytoplasm is surrounded ~~by~~ on the surface by a thin membrane and appears so richly scattered with vacuoles as to look really like a net: the ~~ab~~ aforesaid vacuoles radiate from the centre towards the periphery, gradually decreasing in volume, but leaving on the periphery under the membrane a little cortical layer of protoplasm that is finely granulous and without vacuoles (almost an exoplasm). Meantime in the cytoplasmatic trabecules of the f. cells of mature larvae there gather sparse small albumenoid bodies, in the form of deutoplasmatic granules which are easily coloured by eosin. The nucleus is located usually near the cell's centre and around it there is a layer of cytoplasm free of vacuoles: the nucleus is of quite rich in nuclear juice fluid with a chromatic network formed of large filaments, and always contains a large nucleole which can also be double. I would add that I have very rarely ~~for~~ come across fat cells containing two nuclei. [I am not clear whether he means this positively or negatively. Translator's note]

Such is the appearance, in a few words, of the fat cells fixed with Sublimate and coloured with 'emallume' and eosin.

If we now ~~have a look~~ turn to an examination of thin sections of f.t. fixed with Flemming liquid or Hermann's, coloured with gentian violet following the iodochromic method of Bizzozero, which conserves the fat drops ~~blacked~~ blackened with osmic acid, we see that those cell vacuoles are not really empty but contain fat droplets that stand out sharply black against the grey cytoplasmatic trabecles.

Mixed up with the large drops there are other small ones and others extremely fine. The large drops can even be ~~about~~ 20 μ big.

When the mature larva is about to pass to the nymph state the fat cells assume a more regularly spherical shape,

and increase still more in volume to attain a diameter of 185 and 195 μ, greatest in the anterior area of the body. ~~In the body the~~ however the cytoplasmatic cortical layer disappears because it does not remain homogeneous but is invaded by small vacuoles and is loaded besides with granulations and inclusions that can be coloured with eosin.

Here we wish to break off the description on the f.t. of E., not omitting of course to say, and this as confirmation (if there was still such a need) of what Berlese was the first to cast doubt on and subsequently proved by him, by Supino and by others, ~~as~~ that it is not the case that the fat cells are attacked and destroyed during the nymph stage by leucocytes (phagocytes) ~~and that~~ and ~~they~~ that the fat cells of E. are not actually penetrated by leucocytes not actually destroyed ~~by means of these during~~ at their hands during the nymph stage.

In the E. the f.t. of the larva does not, indeed, turn into the imago tissue, and ~~If~~ Contrary to what Künckel d'Her. declares and shows in fig. 12 of Chap. XVIII about the Volucelle (V. Zonaria) I have not found a special fat tissue ~~in the rat-tailed larva~~ with little cells in the rat-tailed larva, surrounding the posterior part of the digestive canal and the traces of the genital apparatus, fat tissue that according to ~~Künkel~~ Künckel passes integrally without undergoing modification into the body of the adult insect, where it surrounds the genital organs.

At this time I have ~~certainly~~ verified a certain difference in size between the fat cells of the cephalic area and those of the caudal area, as had already been noted anyway by others in the Muscidi, but not as difference of structure, much less a destiny so different. It is possible that things happen differently in the Volucelle from in E. but that would be no small marvel for sure since it is a matter of two genera that are very close.

Excretory organs

The e. o. are ~~shown~~ represented by the Malpighian tubes,

correct in English?
or 'species'?

of which
~~and of them~~ we have already spoken, ~~of the~~ by the pericardial cells and by the enocytes.

Pericardial Cells - We hold that they are excretory cells, with Cuenot and Kowalevsky. Tracing them ~~the m~~ through the nymph stage it is easy to be persuaded that they pass with little modification into the fully formed insect. In E. they have nothing to do with fat. and they are not young fat cells as Lowne claims for the Calliphora.

I only take note of them because they offered me very little to record. I referred to their position and their links in speaking of the dorsal vessel, and I said they are included among the branches of the tendons of the wing muscles. These per. cells in two or three rows opposite each other form as a whole two strips on the sides of the heart, corresponding to its posterior and middle portions. They are large (40μ) in relation to the posterior portion, on which they extend as far as the ventral side of the heart, small however (8-15μ) in relation to the middle portion. They have a roundish shape, oval or ~~helicoid~~ ellipsoidal, and are light yellowish in colour. A thin distinct membrane encircles their cytoplasm, which in the larva is uniformly granulous.

As to the nucleus of the per. cells I must emphasize a difference which seems to exist between E. and V. Whilst for my part in E., except for some rare exceptions of duplication, I have seen a single nucleus on every occasion (and the same goes for the nymph and imago) in each of the pericardial cells, Künckel d. Her. (Chap. XVIII fig 13 and 14 § Vol. Zonaria) on the contrary has constantly seen double nuclei in the pericardial cells of Volucella, which he on the contrary calls large cells with two nuclei.

This difference, which I cannot explain because I lack direct observations of Vol., reminds me of the other position in evidence by Pantel, who claimed that in the larva of Thrixion the nucleus of the ~~cells~~ peric. cells was typically single in contrast with what is ordinarily confirmed

in Muscidi, in which the nucleus of the peric. cells was double.

Enocyte Enocytes – I think its opportune at this point to precede with some very brief recollections before referring to the enocytes of the larva of E. The enocytes are large cellular elements, of ectoderm origin according to Weehler Heymons, Kowalevsky which are believed to have the job of excretory organs. So Pantel for Thrixion, Berlese for the larvae and the young nymphs of Melophagus ovinus, and for the Formiche, K. for the Bee claim that these cells have the job of excreting urinous substances. Indicated for the first time by Wielowiejski they got the name they now bear from him. Thence they were studied, as has been noted, in various Insects. As in the larvae in general and particularly in the young ones as a result of their origin in the neighbourhood of the Stigmi they were located metamerically, it was possible to call them as a whole metameric organ, as Pantel did.

With this as a preface, we can say that the enocytes in the larva of E. t. are also conspicuous cells that are symmetrically and metamerically located in groups along the sides of the body in the abdominal region topographically confined to the neighbourhood of the *primitive nucleus of the stigmi of the aforesaid region, beneath the hypodermis, between this and the lateral wall muscles; at times lined up in a row beneath the hypodermis and backed up to this; at other times clustered together and at some distance from the hypodermis. I followed the enocytes from front to back, in Serial transverse sections of larva near to maturity and noticed that while at first 6-8-10 were encountered per group in each segment, they then became more numerous, reaching

*'abbozzi' in It. Zingarelli gives 'primitive nucleus of organism in the embryonic state'. See note on p153 and p184 and p186

their maximum number in relation to the last two segments of the body (setting aside the tail).

As far as shape is concerned they vary somewhat, roundish, oval, piriform and *tapered. As for structure they are furnished with a thin delicate membrane, have cytoplasm uniformly and finely granulous, with some characteristic spaces, of which we shall say something shortly, a round or oval nucleus, sometimes double. They usually lie just touching, rarely seeming to be united into one continuous body. On the contrary they sometimes appear far separated from one another and it therefore supposes that they have rather unstable connexions (not however established by me with any precision) and are perhaps endowed with tracheal capillaries. As for their dimensions we note that the enocytes measure up to 45–50 μ in the mature larva of E. Their nucleus measures about 25 μ. The enocytes are much smaller in the young larva, from 10–15 μ maximum, with a nucleus of 5 μ, and they are even smaller in newly hatched larvae.

Such cellular elements behave in a particular manner in the presence of colourings used in preparations. So for example with when double colourations with emallum and eosin they always have a characteristic purple tint, which serves very well to show up amidst other elements. But what structurally sets them apart is the look of the nucleus – which possesses ordinarily a large nucleole – is rich in fundamental substance and shows on the contrary little reticulation with thin chromatic filaments. There are besides present in their cytoplasm some small characteristic spaces, which we are going to call vacuoles, clearly delimited, variable in shape, round, *tapering, elongated, often also with the look of little circular canals or semi-circular canals around the nucleus, such that one would say that their cytoplasm is traversed by special intracellular canals, the significance of which could well relate to the excretory function of the elements in question.

If you take the dimensions which are also the time increasing, and a more marked appearance of those peculiar vacuoles mentioned above,

* affusati – not in Zingarelli. Affusolato = tapered. See also p. 181

in the cytoplasm

I did not discover changes of the enocytes of E. (they are certainly found in other insects) nor in their nucleus either in larvae of different ages nor even in pupae right to the last stages of the nymph. Likewise I have to say also that the assay enocytes do not have any phagocyte effect, as some wrongly claim as in the face of the wholly justified view of others.

Finally on the enocytes I would add that during the nymph stage they are confined until the lateral muscles degenerate begin to degenerate and at that point once free they move towards the interior and mingle with the fat cells, retaining while at the same time retaining always their usual characteristics. But I must elaborate on that elsewhere.

Nervous System – Sense Organs

I am not going to dwell on observations on the central and secondary nervous system of E. because I propose to make it an object of special study chiefly in regard to its minute structure, although there have been previous researches and Viallanes has already illustrated the structure of the optical ganglia of our larva. Another fruitful line of study will be to follow the minute changes that the central nervous system undergoes during the change into the imago state. Although the anatomical differences that lead from the ventral ganglia* chain of the larva to that of the fully formed insect in E. and in S. in general, are known. Whilst in the larva the ganglia chain is gathered together in a mass, called also the ventral medula, in the adult, as well as the subœsophagal ganglio, there is it is represented by a large

* Note that my use of the word 'ganglia' 'ganglio' is rather arbitrary in English: 'gangliee' very

Italian adjective 'gangliare' sing. plur. 'gangliari'
noun 'ganglio' sing. plur. 'gangli'

thoracic* ganglia mass, by a small first abdominal ganglio and by a second large abdominal ganglio situated at the level of the genital organs. Well then, Künckel d. Her. has shown that in the Vol. (as also in other Dipt.) the transformation occurs upon the elongation of the* ganglia mass of the larva and thanks to the separation of the* gangli during the nymph stage. It must equally happen in E. and it must be interesting moreover to follow step by step the minute histological modifications that take place in such a transformation.

I would also like to make a particular histological study of the sense organs of the larva, but I shall say here that aside from the hairs and the tactile papillae such sense organs are found in the larva of E., specifically a pair of antennae, an epipharyngeal organ, and perhaps a hypopharyngeal organ. I made brief reference before to these at the beginning, referring to the mouth and the cephalic atrium! I shall now go back to these for a bit.

Antennae:

Regarding the antennae I must not fail to say That their existence passed Buckton by, which is very odd given the adequate ease with they can be seen. On page 21 of his book he says that the larva of E. is without antennae! If he had taken a look at figs. 2 and 3 of chap. XVI of Künckel d'Her.'s work, he would have noticed that a pair of antennae exists in the larvae of Vol., a species akin to E. In the past these were known as tentacles or anterior appendices and afterwards called antennae by MacLeay. Künckel regarded them as such and Buckton would have begun through this awareness to do some research on the antennae in E. Besides B. would have avoided his own mistake if he had known of the work of Batelli, who illustrated and described the antennae of the larva of E.,

* see note on p. 177

and the work of Viallanes, who describes just these organs in E.

The antennae in the larvae of the Muscidi and the D. Diptera* ciclorafi in general were accorded various interpretations. Weismann indeed attributed to each of these organs in the larvae of the Muscidi the significance of antennae and of mascellar palpus; they were thought to function like an eye in Calliphora eryth. by Lowne and were called "eye-like organs" placed at the ends of each maxilla. Bowerbanck studied the structure of the antennae in E. and concluded that they could not be used as hearing organs. Viallanes described them also in E. and gave them the name of antennae-form organs.

Wandolleck in recent times made a comparative study of the arrangement of the antennae in the Dipt. ciclorafi and outlined the a. of E. as well without being able to describe the minute structure however.

Pantel has studied the a. of the L. of Thrixion fully and last year Wand. even recorded many observations on the detailed structure of the a. of the L. of Platycephala.

As Wando has shown in his comparative study the a. vary greatly in form in the Dipt. ciclorafi, so that in some species they are sessile, in others pedunculate.

In E. they occur in this last form. They are in fact two delicate appendages, when they are viewed together they look like a V open at the front since they diverge from each other out of a common base, above and in front of what can be called the upper lip of the mouth orifice (of the cephalic atrium) of the larva. It is difficult to say whether those (parts) that serve as supports for the tactile papillae in the shape of peduncles should be considered as † articulations of the a. or not. Wandolleck

† articolo - can be translated as an articulation. See also next page.

* ciclorafi - not in Zingarelli. Raphidiae? + ciclo-?

regarded these (the papilli tattili) as the only true and proper antennae, we think the whole appendage can be considered as a. Every a. is then composed of a base articulation* which joins up with that of the other a., of an articulation* in the form of a keg which on its distant face supports two little tubercles or rather two sensitive papillae of cylindrical form, close to each other, one medio-dorsal, the other latero-ventral. The first of these papillae is distinct from the second in having a little body surmounting it that is conical, clear, transparent, very refractive†. The first has a height of 55 μ with a base of 35 μ, the second a height of 35 μ with a base also of 35 μ. The conical little body measures about 15 μ. In correspondence with the articulation* in the form of a keg there are two ganglia or nerve bulbs, ovoid and tapered, joined respectively one to the dorsal papilla the other to the ventral. Each ganglio is prolonged continues to the far distal tip in order to connect with the respective papilla and at the proximal tip continues in a distinct nerve. The ganglia nerve belonging to the dorsal papilla goes, in the manner shown by Wandolleck in other species, to the supraesophagal ganglio, while the nerve to do with the ventral papilla goes to the subaesophagal ganglio; it is therefore appropriate to conclude that the two sensitive papillae have two different functions. After examining the a. fresh in a solution of Sod. chloride or after fixing them in sublimate and enclosing them in glycerine, it is possible to appreciate their structure, which then shows more clearly from serial coloured sections coloured with emall. and eosin. Meanwhile however the presence of thin prolongations in the shape of delicate rods° is revealed in each sensitive papilla, These rods reach these from the respective nerve bulbs and make it [the papilla?] look striated longitudinally. The cuticle of the little cylinders or papillae becomes thicker notably on their circular surround and here seems divided in two layers, one of them ontside and thin (epiostracum), the other inside and thick (endostracum), producing in this respect an arrangement similar to that described by Pantel for the a. of Thrixion. The cuticle however appears extremely thin at the distal (far) base

° See p. 146

* See previous page

† I am not clear whether this refers to light or liability to break

of every little cylinder or conical papilla. The little body which surmounts the dorsal papilla has very transparent cuticle, refractive* and containing a homogeneous substance in which the rods are immersed.

By studying some sections it can be established that in the far part of the ganglì or nerve bulbs there are sensitive cylindrical or tapered cells that send out a prolongation to the respective papilla in the form of a rod with a tip that is rounded to a cone and very refractive*. In the dorsal papilla some of the rods are immersed in the substance contained in the little body which surmounts the papilla, others come beneath the cuticle of the periphery of the distal face of this papilla. In the ventral papilla the rods all reach underneath the thin cuticle of its distal face. In the prossimal† portion of the ganglì are found some large nerve cells and many cellular elements with a little nucleus, some of them crammed together, of which the form, the nature and connections of which I failed to evaluate.

If it is almost impossible to pin down the function of the a., the two sensitive papillae, it can nevertheless be said that the dorsal only being surmounted by a special little body and being related to a nerve going to the superesophal ganglio, must enjoy a function different from that of the other papilla, the ventral one, which lacks the little body and communicates with a nerve reaching the subesophagal ganglio. Wandolleck, of course only by way of hypothesis, supposes that the dorsal serves a touch function, the ventral a smell function. For my part however I think that other than the tactile function, the a. can serve for smelling. That the larvae of E. have the ability to perceive odours was suggested to me by the following fact. I kept some eggs of E. in a glass basin, from which the small larvae hatched and started to roam, spreading over the whole basin. I put some little pieces of putrefying meat into it which spread a strong smell around and immediately afterwards I saw the small larvae making for these pieces of meat and diving into them. This seemed to me to demonstrate by proof that the larvae

* See previous page
o see p 176
† prossimale not in the ordinary dict. So Zingarelli gives 'prossimale' as Anat. only.

were attracted to the food by the strong smell emanating from it and perceived by them.

Epipharyngeal Organ

I said already, ensuing on the serial sections of the head, that I happened to show up a sensitive organ, similar to the one observed by Pantel in the larva of Thrixion and called by him ep. o. This organ is placed dorsally and on the median on the anterior edge of the cephalic atrium. After having recognised the topography I was able to isolate it and study its appearance also in a fresh state.* By observing with a separate magnifying lens you can see the orifice of the cephalic atrium of the larva placed on its back. It appears then as a dark cuticle platelet, somewhat raised in the middle, where it supports two tubercles or papillae, placed in two separate inlets. In transverse sections of the head the platelet, its dark colour owing to the thickened and pigmented cuticle, is seen as triangular or a snapped off cone at the apex of which are two little tubercles next to one another, each contained in its respective dimple and separated from each other only by the cuticle ridge running between the two dimples. On the sections even better than on the untreated specimen* two little ganglia or nerve bulbs of club shape show up distinctly. Each of these is distally linked with the respective papilla and proximally continues in a separate nerve. Each ganglia results† [or 'arises from'] from some nerve cells and sensitive spindle-shaped cells connected by means of a special prolongation with the papilla of the same side. The papilla is cylindrical-conical shaped 50μ high and 30μ wide, and shows in its interior the prolongations of the sensitive cells: it has thickened cuticle on the circular surround, but extremely thin on the its distal tip, from which extremely delicate rods emerge visible only with fairly large magnification. The ep. o. moves of its own accord through two slender muscles placed laterally to the nerve ganglia. As for the physiological job of the ep. o., seeing its topography, it would not be unfounded hypothesis to say that it fulfils a taste function.

† See p. 167. I can't visualise it. It might be 'results from, arises from' OR 'results in' 'the opposite direction'!

* Bul fresco - not happy with this phrase. Does he refer to specimens untreated with chemicals? Or to specimens uncut not sectioned? or to live specimens? or just fresh specimens?

Basing what he said on the description of the epipharynx of adult Vol. that Kunckel and Gazagnaire gave, Pantel supposes that the ep.o. of the larva becomes the epipharynx of the imago: evidently however a supposition like that, although it may have verisimilitude, requires the tracing of the organ through the nymph stage in order to establish whether in fact it transforms into the actual epipharynx.

Wandolleck also describes the ep. or. in the larva of Plat. plan. but with some uncertainty about the structure.

I would not be able to assert that a hypopharyngeal o. exists in the larva of E. since I have not up till now been able to discern it clearly. Pantel discovered it in the larva of Phrixion and Wandolleck confirmed the existence in Plat.

Batelli refers to two pigmentary patches, regarded by him as eyes, placed beneath the a. in the larva of E., and given life by two nerves which derive from the supercesophagal ganglia. Although I have researched it, I haven't managed to find ocular patches like these and so I think the organs to which Batelli refers, somewhat vaguely, could correspond to what I have described as an ep. o.

But that the larvae of E., like those of the Muscidi, are undoubtedly very sensitive to light, is already clear from the experiences of Pouchet. Having myself raised larvae of E. in the lab, I have seen how they flee the light, hiding themselves away in the

darker places and always remaining hidden beneath or among pieces of softened meat, which they were feeding on.

And with which organs then do they perceive the light, if there are no organs that can be considered as eyes on the surface of their body? With the significance given to the antennae by Lowne, which he calls 'eye-like organs', the reply would be ready and easy, and equally if the job of visual organ was going to be attributed to the epi. o. by anyone. But if as we have done, you deny that either the antenna or the epi. o. serve in the sensation of light, the question creates puzzles and however nevertheless the reply becomes very difficult to make. It can be supposed & with Ponchet and Viallanes that the optical ganglia govern luminous light sensation (not true vision true and proper) which and they are already highly differentiated in their different parts and would be capable though situated deeply of receiving light sensations through the integument, the muscles and the fat body.

Genital Organs

The internal g.o. we have always found the internal genital organs very poorly developed in the larvae of E. even when mature and we would prefer to deal with these when speaking about the nymph, in which we could follow the their different evolving phases.

Immaginal Discs

We intend to dwell a little only on the immaginal discs of the head, the thorax and the abdomen of the larva E.t.

I would be moving too far away from my subject if, wanting merely to refer to them,

I were now to set to in going over the historical data on the meaning and origin of those small masses, hidden under the skin of the larva and destined to ~~become~~ turn ~~into~~ later into ~~constituent~~ parts constituting the integument and the appendices of the imago. It ~~would~~ will not be nevertheless off the point to note that, seen already by Swammerdam, by Lyonet, by Léon Dufour, and which he called them [the small masses] corps ganglionoides, by Scheiber, which he considered as ganglia, they became only in our own times ~~close to us with~~ interpreted with precision, and in any case are discussed still ~~until~~ today for their origin.

~~It was Weismann's concern~~ Weismann applied to them the name of imm. discs and his was the great merit of having recognised their true significance in his classic work on the development of the Dipt. ~~Weis~~ He erred in believing that they originated always from trachea and from nerves, but that must not be thought of as a big mistake, because, as I said, the argument about their derivation of the imm. discs has been going on at length up till our time.

~~Künckel~~ In his fine research on the Vol. Künckel d'Her showed that all the imm. discs, called histoblasts by him, are found joined by pedicles ~~through~~ of a pedicle with the hypodermis, from which they originate through a process of invagination. But Gamin returned to the opinion of Weismann.

Wiallanes studies the i.d. as well as in E., illustrating especially their histological composition. In the case of the Muscidi Kowalevsky stated that the i.d. do not derive from the cellular wall of the tracheae but join up with the wall and with the nerves when they are already fine and* roughed out. Later Van Rees gets into the argument in a special manner, reaching the conclusion that while some of the i.d. (all the lower i.d. and those of the wings) derive from the hypodermis with which they are joined through a pedunclc, others (those of the 'balancers' [= posterior wings of the D]. and the superior i.d.) have an origin which was described by Weismann, namely from the epitelia of the tracheae.

Lowne in the case of the Call. eryth. admitted, without however giving special proof of it, the ectodermis origin of the i.d. and admitted besides that the lower i.d. of the pro- and mesothorax join up with the nerves, all the remaining ones with the tracheae.

With the purpose of defining more or more the origin of the i.d. Pratt recently made investigations on the Melophagus ov., demonstrating (as already supposed by Weismann) that they start to form already during the embryonic development and those of the head and thorax derive from thickening of the ectoderm, and these later go deeper into the inside. The i.d. for the abdominal hypodermis (like those for the internal organs) find their derivation during the life of the larva.

Last year Wahl took for study the i.d. of the thorax and of the head of the larva of E.t. and with preparations overall managed to demonstrate that effectively all the i.d. of these regions are found, as Künckel d'Her maintained in the Volucellæ, in connection with the hypodermis.

* 'fine and roughed out' sound contrasting epithets. The It. sentence suggests that their dev. is complete. But 'abbozzati' suggests only just begun. See note p. 175 and p 153

E. offers excellent material for study in this regard and it can really be said, with Van Rees, that together with Volucelle it has in this respect a state midway between Corethra and Musca.

Following up the serial sections of larvae of E. near to maturity I have managed to see, both for the i. d. or histoblasts of the head and those of the thorax, their connection with the hypodermis and I can fully confirm the relevant results obtained by Wahl, agreeing fully with Künckel d'Hc. who since 1875 maintained that in the case of the Vol. all the histoblasts derived from the ectoderm.

Künckel distinguished 4 pairs of histoblasts in the region of the head of Vol. which surround the mouth parts of the larva. Three pairs make up the dorsal region since two discs form the lip, two the epistoma, the face and the antennae, and two the epicranium, the occipit and the eyes.

The fourth pair of histoblasts, situated ventrally, is what on their own compose the lower lip: this corresponds to the ventral i. d. of the head, seen also by Wahl in E. and which I referred to at the beginning of my text, speaking about the mouth and pharynx. I confirm the existence of this pair of ventral histoblasts, not mentioned by Weismann, Viallanes or Van Rees. The ventral i. d. are connected to the hypodermis of the cephalic atrium, and indeed each of them is inserted with a peduncle corresponding to the ventral posterior end of the cephalic atrium, laterally and a little forward of the orifice of the excretory canal of the salivary glands.

It would be quite difficult to give a precise idea of the situation and relations of the three pairs of dorsal histoblasts of the region of the head without recourse to an illustration. I will just say that all these are connected with the cephalic sack, which derives by invagination of the frontal region of the head and is therefore part of the cephalic vesicola. In front the frontal sack is joined dorsally and laterally with the cephalic atrium, at the back it continues

with two peduncles, one per side, up to the histoblasts or ocular vesicules. In opposition to Künckel, Wahl denies ~~that~~ the existence of a pair of i.d. destined to form the upper lip, a pair of discs never seen by anyone else yet. Following up my series of ~~se~~ transverse sections of larvae near maturity I was persuaded that along the frontal sac ~~&~~ there really are three pairs of histoblasts: the first or anterior is that of the upper lip; the second or middle, of the antennae; and the third or posterior of the *compost eyes. I now maintain that the anterior part of the pair indicated by Wahl as i.d. of the antennae corresponds exactly to the discs of the ~~lip~~ upper lip. The i.d. of the antennae are further back on the sides of the muscle mass of the pharynx, they are more developed and they correspond to the posterior part. To be more precise I will state that in my view what Wahl indicates in fig 12 of Chap V and in fig.5 of the text with 'ant' represents the i.d. of the upper lip, and what is indicated with 'ant' in fig. 8 of the text corresponds to the true and proper histoblasts of the antennae, cut off however at the less developed piece section.

It is no great ~~difficulty~~ to trace in the sections the hypodermic connections for all the histoblasts of the thorax, for the three upper and the three lower. The upper histoblasts of the prothorax, from which the stigma bearing horns ~~also derive~~ of the pupa also derive. are directly joined with the invaginated hypodermis ~~in~~ corresponding with the anterior stigmi. The upper histoblasts of the meso- and of the metathorax however ~~are~~ joined with the hypodermis thanks to a respective peduncle. The lower i.d. unite to the hypodermis by means of a wide & unequal common peduncle, as occurs in the Muscidi; those lower ones of the mesothorax & each possess a long peduncle which goes sideways up to the hypodermis, and another peduncle which unites with the one for the lower histoblasts of the prothorax. Finally each lower disc of the metathorax has a peduncle pointing ventro ventrally and medially, we can admit however with Wahl that all the histoblasts of the thorax ~~also~~ also arise, ~~also~~ out of invagination of the hypodermis. In E. the

* I have just followed the Italian 'composti'. cd. mean 'false' also.

pedunclos are so apparent that they also show a space, a hollow which continues is continuous with the temporary or peripodal space, defined by the exodermic layers and the peripodal or temporary membrane of the histoblasts. Every histoblast receives tracheae and nerves but is genetically quite independent of these, as Künchel d'Herc. had so wisely affirmed in the case of the Vol. The mesoderm, in the form of small cellular elements, for the most part oval or tapering and more or less leaning against each other, is then found adjacent to the histoblasts, on the side of the exodermic polistratified layer.

Wahl does not deal with the i.d. of the abdomen except for a brief mention of the* outlines of the abdominal stigmae. Following up serial sections of this region in E. larvae I have been able to track the abdominal histoblasts as well.

Through Gamin's research it has already been noted that four small cellular islands, two for each half of the segment, can be seen in every abdominal segment of the Muscidi, on the second day of the pupa state. These islands are destined to provide the integument of this region. This is renewed during the nymph stage and not conserved as Weismann believed — he had not seen these focus points of renovation. Viallanes also observed and described made observations and a description of these cellular islands — under the name of embryonic thickenings of the epitelia — without however saying that they are already found in the mature larva. But they were found by Van Rees in the mature larva of Musca vomitoria, as productions that sometimes almost rivalled surpassed in size the large surrounding hypodermic cells.

In the mature larva of E., going by what I have observed, four invaginations of the hypodermis are very easily seen on each segment of the abdomen, one dorsal and one ventral for each half of zoonite. These invaginations, from 75-80 μ deep up to 190 μ deep, are in every respect similar to small i.d.

* abbozzi - traces? See previous pp 186, 175, 153

joined for sure to a wide pedunole at the hypodermis of the abdomen. But there can also be distinguished an exodermic layer, a peripodal membrane and a peripodal or temporary space. The ventral abdominal histoblasts are placed on each side laterally to the false feet. The last two ventral abdominal histoblasts are on the sides of the opening of the anal ampulla, and I cannot however rule out in the case of E. that the last abdominal segment (setting aside the tail) possesses such histoblasts, and that these are concentrated in the two pairs of histoblasts in the genital armature. These exist in our larva as many abdominal histoblasts in the last segment of the body (always setting aside the tail) as the histoblasts of the external genital organs.

The abdominal histoblasts are still more invaginated on the second day of the pupal state, during which state they behave in a particular way.

Pratt saw the i.d. of the abdomen in Melofagus ovinus and from the comparison of them with those of the thorax he allowed himself to be persuaded that the ventral histoblasts of the abdomen are strictly homologous to those representing the outlines of the feet of the thorax. He arrived at the conclusion that the abdominal ventral ones can be thought of as rudiments of *arte outlines. Certainly the hypothesis is more than a bit hazardous, with the abdominal histoblasts behaving differently from those of the thorax, but it is undeniable that the disposition and form of the abdominal histoblasts, most of all such as appear in E., strongly suggest this hypothesis. Not that I wish to be seduced by this hypothesis but just that mentally I run over and over the memory of those rudimentary abdominal members that appear transitorily in the embryo of many Insects† and I wonder whether it is absolutely out of the question to research still more closely how these members develop, whether or not they have any connection with the ventral i.d. of the abdomen. Only after a study like this could we speak with fewer doubts of the homologies between the ventral i.d. of the thorax and the i.d.

wings?

† I don't know why Bubble always gives insects a capital letter, as if they were God.

* I am amazed and incredulous. But what else can it mean? There are not other Fr. words like 'arte' with which it could be confused. It must be a misprint for 'ali' = 'wings'

of the abdomen of the Muscidi, in Melaphagus and in E. If that is very difficult to establish, the other hypothesis becomes naturally even more risky. It was faced by Platt and according to it the existence of dorsal i.d. in the single segment of the abdomen would mean there existed in the line of the antecedents of the D. cicloraphi forms whose body possessed wing-shaping processes of the integument in its dorsal posterior part.

Besides the i.d. of which we have just now spoken, hypodermis thickenings, i.d., are found on the side of the abdomen. There are two for every segment corresponding to the future stigmi. Each stigmatic i.d. is placed beneath a cuticle prominence towards which it rises more or less. The cuticle at this point shows obvious stratification and because of this characteristic it differs from the surrounding cuticle. The stigmatic i. prominence has overall the shape of a cup, is umbilicated in the middle and in the centre of the umbilica sits the very small aperture of the stigma. Its cuticle is turned inwards and almost completely obliterates it, continuing in the inside of the thin tracheal stigmatic little trunk crossing the i.d. The stigmatic tracheal little trunk joins a somewhat larger trunk which in its turn joins the principal tracheal trunk. The epitelia of every stigmatic little trunk continues with the hypodermis of the respective disc.

Finally it remains to speak of the genital i.d. We saw already in speaking of the anal glands that the integument turned inwards in correspondence with the anal aperture to form an anal ampulla in the shape of a bell in the middle of which the posterior intestine opens with a narrow cleft directed in an arrow direction, while the glands issue on the sides. It can be distinctly observed when following (along the cephalo-caudal direction) the series of transverse sections of this region (in a mature larva) ~~that the anterior end of the anal ampulla just before the union with the posterior intestine~~ that two pairs of i.d. originating from the hypodermis from the anterior end of the anal ampulla ~~of this~~ just before the union with the posterior intestine. These are certainly the

histoblasts destined to form the genital armature. These two pairs of histoblasts are situated ventrally at the terminal intestine and are opposite each other, the one a little in front of the other that is to say that one of them is anterior and ventral, the other, more developed, is posterior and dorsal. Each pair originates by means of a single median pedunclе and the two pedunclеs come in succession from front to back, first one then the other. The two histoblasts of each pair stay close to each other on the sides of the sagittal plane*: The dorsal two appear look like two little swollen sacs, the ventral two, flattened like two spatulas. According to Künckel d'Herc. the outlines of the pieces of genital armature are inserted between the anal segment and the penultimate segment, like parts of a new formation. Such a hypothesis is perhaps not easily demonstrable though it is enjoyable to record that the genital histoblasts are not the four histoblasts abdominal histoblasts concentrated in the ultimate segment according to how it was described above. Künckel does not mention the abdominal I. d. for the Vol., as described by us in the E.

In the month of August during the correction of the proofs† of This writing we succeeded in getting 15 larvae to full maturity that hatched on the same day from eggs laid in the lab. by a female of E.t. and we have observed that the duration of the larva life varies greatly even for individuals hatched at the same time from eggs from the same female and kept afterwards under the very same conditions. In fact we got the first pupae after 16 days of larva life and the last ones after 23 days; so with a maximum variation of 7 days, on each of which we collected one, two or three pupae. Taking an average between the two extremes, minimum and maximum, of this variation it can be stated that the duration of larval life for E.t. is on average about 19 or 20 days.

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† Note this word 'bozze' for proofs or early drafts. Connected with 'abbozzi' for some sort of rough outline in the larva or pupa of an imago feature to come? See p353

* no idea what this means! The lie of the body as a whole is 'sagittal'? like an arrow? Is this zoological babble?

Part II Observations and Notes on the Imago

In this second part I shall be very much briefer since, without treating all the systems and apparatus of organs methodically, I shall communicate for now few and fragmentary notes with the intention of explaining only what I have observed up till now that is noteworthy and which appears to me not to have been made known already by others, particularly regarding the structure of some organs, or ~~may~~ what it is worthwhile correcting ~~when~~ that ~~came~~ was mistakenly ~~from others~~ described by others on the subject of certain organic dispositions of the imago of E.t.

While the larva lives for the most part in polluted water, in sewers, in ponds, feeding on animal substances that are decomposing, the winged insect of elegant form, of beautiful colour, of swift flight, lives instead among the flowers of the Compositae, feeding on pollen, and ~~in its~~ as a whole shows characteristics that make it distantly resemble the bee, whence its name of apiform fly 'mouche abeilleforme' given it by Réaumur, and the name of wild bee, which our peasants often call it.

The great disparity of life and alimentation between the larva and the imago corresponds to a very great difference ~~of~~ in organisation between the two forms, most of all in respect of the digestive system.

The Digestive System

Dutrochet illustrated earlier the changes that the digestive system

of the E.t. undergoes in the passage from the larva state to that of fully formed insect. He noted that the middle ventricle shortens greatly, the ventricular glands vanish, the Malpighian sacs (believed by him to be connected to the salivary glands) diminish until there is no trace in the fully formed insect. Dufour drew the digestive apparatus of the E. in a perfect state. Buckton even gave figures of this apparatus of the imago in his book, without however reproducing the arrangements as they are really met with. It's a marvel that Given that the internal organisation of E. in the fully formed insect state is very similar to that of the Vol., which was so beautifully illustrated by Künckel in his work, it is a wonder that Buckton after studying and portraying systems and organic apparatus of the imago of E. took so little notice of the research of Kü. by giving us a description of the digestive apparatus so far from the truth and seeing and drawing dispositions that do not in fact exist.

Though modified, the intestine of the imago allows us to distinguish the the principal regions already pointed out in the larva.

Anterior intestine — Includes the mouth, the pharynx, the oesophagus, the ingluvie or container (sucking stomach) and the proventricle.

The mouth and pharynx with their various pieces constitute the whole of the trumpet or proboscis which is articulated with that prominent part of the head called the peristoma. Leaving aside the other mouth parts, we note the epipharynx and hypopharynx which by means of a membrane are articulated with the pharynx, from which the oesophagus follows on.

Oesophagus — The oe. is a thin tract that after running through the base of the trumpet, goes towards the brain, passes through the oesophagal nerve girdle and arrives at the thorax through the occipital hole* There it joins the proventricle. Its wall is thin, provided externally with striated circular muscle fibres (which form a muscular tunic with/in anastomatised bundles), and internally covered with a flattened epitelia, raised

difficult to decide which?

* could also be 'forum'. You decide.

in folds and with a cuticle intima. From this intima arise numerous hairs or chitinous spines meant to prevent the regurgitation of pollen grains during the contractions of the inglurie.

Proventricle

While a clear separation can be established between the oes. and the pro. through the difference of calibre, the pro. passes imperceptibly into the middle intestine, from which it is with difficulty distinguished. This is the opposite of what happens in the larva, where the pro. is very clearly defined, owing to its strangulation, even from the chylific stomach.

Though very short, the prov. of the imago as a whole is shaped similarly to that of the larva. So it is composed in the same way of three tunics or concentric layers. The inside one is represented by the wall of the oesophagus which traverses it, the middle and the external one by the reflexion of this wall. The oesophagus dilates somewhat in proximity to the pro., produces from its ventral side a peduncle or collar of the inglurie, thins its cuticle intima, loses its spines and immediately afterwards penetrates the pro. and runs the whole length of it, keeping retaining its structure. The wall of the oesophagus joins the posterior end of the prov. and folds back, changing its histological characteristics, to form its tunic or middle layer and then goes on with a new structure to constitute the tunic or outside layer which by degrees becomes continuous with the wall of the middle intestine. The structure of the two tunics, the middle and the external one, is worth examining for the physiological significance to be assigned to The prov. of E. The first (internal) has a thin muscle layer and an epitelia formed of tall cylindrico-prismatic cells, of clear aspect, with a cuticle rim. These clear cells appear to have the nature of cellular secretory elements and show some resemblance to muciparous* cells. The second (external) has a thin muscle layer with circular fibres inside and sparse longitudinal fibres outside, an epitelia coating with dark cylindrical cells, a little smaller than the clear cells, fairly narrow (height 40-45 μ, width 8-10 μ) with a delicate cuticle rim

* It. mucipare - not in It. dictionary, nor English. So by analogy with 'fissiparous' - I make 'mucus producing'

and granular cytoplasm which is ~~very fine~~ quite easily coloured: these cells emit their secretion through the cuticle rim into the prov. space, in the shape of granulous little spheres. Before becoming detached ~~they~~ these remain for a certain time stuck to the cell body by very thin little pedunculs. The epitelia covering of the outside layer of the prov. is becomes * by degrees continuous with the covering of the middle intestine.

My data are insufficient yet for me to define exactly whether the prov. of the imago derives from a modification of the larva one. However in any case, as we have seen, it resembles it structurally, suggesting therefore that it fulfils a similar function. The physiological significance, then, to be attributed to the proventricle of the E. ~~when~~ when fully formed cannot just be ~~that~~ of a mechanical one of œsophagal valve, but also (and perhaps then not finally) one of the elaboration of digestive substances, as is proved by the characteristics of a secretory activity shown by the epitelias of its two layers, the internal and the external. These substances, together with the secretion from the gastric glands, are poured into the chylific stomach to act upon ingested food. ‡

Ingluvial or sucking stomach

This organ, missing in the larva (while in the larvæ of Muscidi a sucking stomach is present (or food tank or œsophagal sac) is dependent on the stomach [or is a dependance ** of the stomach]. This results from a body (2 mm. wide circa) with two folded lobes, contained in the abdomen on the ventral side beneath the intestine and from a long peduncle or neck which originates from the œsophagus at the point at which it is about to penetrate into the proventricle, goes ventrally backwards along the thorax to join, as it gets larger † at the funnel, the above body. The neck wall is furnished with a powerful musculature, composed of internal longitudinal striated muscle muscular fibres and of external circular fibres. But it reduces to a thin layer of slender muscle fibre, striated, variously directed, in correspondence

* I have often had trouble with the verb 'continuate'. If I translate 'it continues with' this suggests that both walls or whatever continue independently. If I translate 'is continuous with' this suggests loss of form and becoming the new shape or substance into which it continues. Only a zoologist knows the truth. Same problem with 'dipendenza'.**

† Not sure of this because I can't visualise it. It cd. mean 'broadens into a funnel'.

‡ See & note bottom of p. 196 →

with the body of the inglurias. The epitelia covering, which has the appearance at the neck of epitelia with low, cubic cells, with fairly big cuticle provided with processes form delicate spines flattening constantly towards the body, where it assumes the look of a simple *pavemented epitelia, raised into numerous small folds, covered with a thin smooth† cuticle. The whole gluvia pulses with quite quick movements of the diastole and sistole.

Mid stomach or chylific stomach

From the external layer one passes by steps to the mid- intestine or chylific stomach or also the ventricle properly named. This is about 12 mm. long and represents a lengthy portion, almost half, of the intestinal tract between the proventricle and the rectal ampulla. It runs straight on its thoracic part, then bends in loops in the whole subsequent tract contained in the abdomen: it narrows slowly from the proventricle to its passage into the abdomen, then grows again in calibre up to the piloric valve, which marks the the boundary between the mid- and posterior intestine. Internal striated muscular fibres and longitudinal external ones, make up that seen as a whole on the surface look like a trellis-work, constitute the muscle wall of the chylific stomach. The epitelia covering of cylindrical cells on the initial tract of the ventricle afterwards is composed of cells with the distal end broadened into a cupola covered with a thin cuticle rim striated with fine rods, and the proximal end narrowed to look like pedunculated. Their nucleus, not big and oval-shaped, is usually located near the peduncle. As for their size, the epitelia cells of the chylific stomach of the fully formed insect are about 15 μ high and max. 10 μ broad, so they are much smaller than those of the larva. For the most part these show cytoplasm with dense trabecles lying along the major axis of the cell body and containing fine metaplasmatic granules, taking colouration strongly. The substance elaborated by the aforesaid cells pours into the intestine vessel in the form of granulous spheres, which little by little rise and the became detached

* could be 'parquet flooring'? Possible in 1895? Yes.

† could be 'glossy'

from the free edge of the cell. Often it is the whole cupola-shaped part of the cell body, in which the product of secretion collects, that becomes separate from the rest of the cell and falls into the stomach cavity. Next to these cells with the signs of secretion activity lie the other cells with the rim striated uniformly and uninterrupted along the whole distal edge of the cell body. These are directed to the function of absorption.

The epitelia as a whole then rises almost regularly in folds° circumscribing hollows, in the fornix† of which the cells are much lower.

A pyloric valve (pylorus, ileo-gastric valve), the result of an epitelial fold, marks the passage from the mid- to the posterior intestine. Its cell elements are cylindrical, tall and narrow, with dark-looking homogeneous protoplasm. They are differentiated by their characteristics both from the cells of the chylific stomach and those of the terminal intestine. From this point the calibre of the intestine undergoes a slight narrowing, and the Malpighian tubes open, passing through the valvola and each of them projecting into the intestinal vessel with a small papilla covered with cells similar to those of the valvola itself.

Posterior intestine – Long and convoluted, it shows a uniform structure throughout its length. Without talking of an ileo (small intestine) or colon (large intestine) etc. we can distinguish two portions of it: one proximal (anterior) and the other distal (posterior) or rectal with rectal papillae or glands. The muscle wall in the proximal part is formed only of large circular fibres, to which in the rectal part are added some longitudinal fibres situated internally, thus becoming the whole muscular tunic more powerful. The epitelia, with a coarse gentle undulatory, in soft folds** consists of low cells (10 μ), with a small round or oval nucleus (5 μ), with cytoplasm of striated looking perpendicularly pointed* pointing perpendicularly to the epitelia surface, covered with a thin cuticle rim turned double round it.

° 'folds' = a guess because my It. dict. does not give anything for 'pliche'. Yes. Anatomy = folds

** !! 'folds' is a guess because it is not in the dict. in fem. form, as here. Dict. plico – chi = a bundle, pack

† 'fornix' OK for Anatomy/Zoology? = 'arch' in Architecture

* Not clear whether the phrases are related. It could be 'perpendicular to the epit. surface' as I have interpreted it, separately

The boundaries between the cells are defined wholly by means of slight notches at the free edge of the epitelia. Step by step approaching the anal aperture the epitelia constantly becomes flatter. On account of the characteristics themselves of the epitelia it doesn't seem to me that one ought to deny an absorbent function to this part of the posterior intestine which precedes the rectal ampulla.

The rectal ampulla and the rectal papillae attract our closest attention in the posterior intestine. We shall be focussing on them in talking of the glandular appendages of the intestine. The rectal ampulla merely represents a dilation of the distal portion of the posterior intestine and it therefore possesses all the structural characteristics of this;* namely a very flattened covering epitelia and a muscle wall with external circular fibres, somewhat oblique

namely a very flattened covering epitelia and a muscle wall with external circular fibres (but somewhat slanting passage**) and longitudinal external fibres

[detailed makeup] [overall look] — but somewhat slanted (contour) (the covering epitelia) and external longitudinal fibres [I think this is the meaning] Quite other histological characteristics mark the papillae or rectal glands, on the other hand, as we shall see.

Glandular Appendices of the Intestine

Salivary Glands –

Whereas in the Muscidi two pairs of salivary glands are usually present, in E. these are represented solely by one pair of simple tubular glands, quite long and running laterally and ventrally to the oesophagus and backwards to the abdomen where they are contained, each one wrapped in broad loops. Towards their posterior end they become dilated, towards the front they narrow, then before joining up into a single excretory conduit which, after undergoing a slight swelling reinflation, enters the hypopharynx, runs through it a certain distance and issues on the dorsal face of it, not very far from its apex. The secretory epitelia coating the body of each gland consists of cells which

⊙ I note here that the circular fibres are external (with a slanting contour) and the longitudinal fibres are also external. Does this make sense? At other points these fibres are usually contrasted external and internal.

** Horrible. 'Decorso' means 'period' 'passage of time' and I don't know what the whole phrase is qualifying. Decorso = contour I think

* A bit bumpy here as the plane lands at Stansted.

rest on a very thin base membrane, have a cylindrical shape, not very noteworthy dimensions (20–25 μ height and 10 μ width), small nucleus, cytoplasm containing abundant metaplasmatic granules, which are quite largeish and easily ~~stainable~~ stained. But it is not ~~through~~ by this means that the secretion is discharged from the cells, rather through by means of a ~~not~~ quite finely ~~granulated~~ granulous substance collected into small spheres which are visible either already fallen into the glandular hold or still attached, thanks to a very thin & little peduncle, to the secreting parts that produced them. In the cavity of the glands ~~is also found~~ there is also a homogeneous substance which looks like an albuminoid liquid coagulated as a result of the action of reagents on it. The excretory canal of each gland is extremely ~~thin~~ sharp, and is coated on its inside with thin cuticle, and the common channel for excretion appears chitinous as far as the orifice in the hypopharynx.

Gastric glands and blind glands – They are two in number, and ~~they~~ given their relationship with the proventricle into which they discharge, they should with greater precision in our case be called proventricle glands rather than gastric glands. In length about 2.5 mm. they are contained in the thorax, situated respectively on the sides of the proventricle. They project a little beyond the proventricle. So does the initial portion of the chylific stomach. Regarding their relationship with the proventricle, each gland can be seen to have a small anterior part and a large posterior part: a very short section which stands out ~~separates the two above mentioned parts~~ at the level of the boundary between the aforementioned parts, joins the glands to the proventricle. A single orifice opens on the anterior edge of the proventricle at the point where the external layer of the proventricle is about to bend back over the middle layer. ~~Künckel~~ In relation to the Vol. Künckel speaks of two ~~little~~ small upper glands and two large lower gastric glands. We however, relying on what we ~~have~~ know about it, are resolved to believe that in all probability a similary behaviour* may be established in the Vol. and the gastric glands are really only two in number, each subdivided into two 'false' portions in the way we outlined. From the point of view of their external layout

* 'behaviour' does not sound right here but that is what it says (comportamento). Perhaps 'arrangement', 'layout'?

the gastric glands are cylindroid in shape, with a surface made lumpy through numerous small roundish prominences, which gives the appearance of little clusters with sessile acini [pool.] [berries]. In regard to their detailed structure we can regard them as branched alveolar glands with a main cavity or vessel from which originate the numerous alveolar evaginations of various size, though always quite small. The secretory epithelia is composed of not very big cells, wider than they are high (height μ 10, width μ 15) and cubical at times, with not very clear edges and a small nucleus (5 μ). Their cytoplasm is denser and darker at the base, clearer however at the free edge of the cell, bounded by a very thin cuticle rim. Again here as usual the secretion or more properly the emission (excretion) of the substance formed by the cells occurs in the form of little spheres, more or less voluminous (some of those already fallen into the vessel gland even attain 10 μ), and containing fine granules.

I am not going to discuss now whether the blind glands of the fully formed insect, of which we said there were two, each opening through a single orifice in correspondence with the anterior edge of the proventricle, can be identified as homologous with those of the larva, which are on the other hand forward and opening at the start of the chylific stomach; nor whether the gastric glands of the imago should be regarded as a completely new formation or derive from the transformation of parts of the tubular larval gastric glands, as Künckel d'Her. maintains in the case of the Vol. Such a discussion will be possible only after following step by step the modifications the proventricle and the blind larval glands are liable to, although the a priori judgement inclines to a less than complete homology, principally on the grounds of such different anatomical relationships as to suggest a diverse genetic one.

Malpighian tubes – we said before that physiologically these appendices should be taken into examination together with other excretory organs since we judge them to be such, with the majority of authors, even though Lowne in pursuit of his own particular ideas,

considers them as hepatic tubes and therefore also physiologically related to the digestive system.

The Mal. tubes meet with slight and not profound modifications during the nymph stage, the and their cells continue to show the characteristics of an excretory activity the whole time. In the imago they remain four in number as they were, that is, in the larva and, as in the larva, placed two anterior and two posterior, all opening with their own orifice in correspondence with the pyloric valve, namely or that is to say at the point of passing (pylorus) between the chylific stomach and the posterior intestine: the orifices are close to each other two by two, as in the larva, those of the two anterior tubes and those of the two posterior, are placed at the same level, opposite each other. Every malph. t. crosses the wall of the intestine and projects into the vessel of the intestine with a little papilla which has the orifice of it lined with cells similar to those of the pyloric valve. The consequence of this moreover is that at every orifice there arises a disposition to bring about, in the role of valve, the closing of the orifice itself, thus preventing the influx of the contents of the intestine into the urinary tubes. Overall the m.t., yellow-brown in colour are thinner and more convoluted in contour * than in the larva, and the anterior ones have lost that sac or terminal tank, which they had during the larva stage. Their epitelia is formed of large characteristic cells which can reach 35-40 μ in height and do not differ much from the larva ones. Their nucleus, also large (20-25 μ), is round, vesicular. Their cytoplasm contains abundant spheroid yellow-brown granules (excretion substances, uricates †), and on the free edge is convex and jutting more or less into the vessel of the channel, has a very tall rim with large rods (from 5 to 8 μ according to the state of cell activity), which brings to mind very clearly the striated rim or with cilia (also called brush apparatus) possessed as an integral part of them by the epitelice of the contorted portion of the little urinary canals ×× of the Vertebrates.

i.e. the rim is tall

Glands or rectal papillæ – They belong to the ampulla or rectal pocket and are four in number as in the Muscidi.

×× canicolo – not in Dict. but must mean 'a little channel'. On this page also 'canalicoli' for urinary channels of Vertebrates.

† urati – not in dict. Only in Ital. → Japanese dict. as 'purin' derivate, for insects apparently.

* It. a decorso – Something like 'trajectory' or 'path' I am looking for. Not 'shape' because that's static. Contour?

In E. I did not find them at the same level in the way Künckel indicates in fig. 7 of Chap XV in The Volucelle, and I found instead that usually two are upper and two lower, conforming with what Weismann noted before in the Muscidi. The rectal papillæ of the imago of E. have no genetic connection with the anal glands of the larva. I state this with absolute certainty after being present at the decomposition and complete disappearance of the former and at the new formation of the latter, during the first pupal stages.* The rectal ampulla consists of a spindle-shaped dilation of the posterior intestine and the rectal glands develop as true and proper deep, crater-shaped invaginations of the ampulla. They project into its vessel therefore in the form of four conical prominences, reaching a height of 0.4 – 0.5 mm.

To talk of their structure it is noteworthy that while the wall of the rectal ampulla is throughout its whole length provided with an extraordinarily developed muscular tunic, with large internal longitudinal fibres and circular external slanting ones, any muscle fibre is absent completely in relation to the papillæ, although there remains here uniquely a very thin membrane, the peritoneal membrane and the basal one being joined together. On this the peculiar epitelia of the papillæ rests. It is perhaps because of this that is owing the persistence of the rectal invagination even when the ampulla is distended to the fullest extent. From two to four tracheal trunks arrive at each papilla. These bury themselves in the crater-shaped invagination and branch out plentifully. Particular cylindrico-prismatic cells form the epitelia of the papillæ, placed on top of simple layer, quite high from 55 to 100 μ, in transverse section polygonal, relatively narrow, not exceeding 15-20 μ in breadth, with a not very big round or oval nucleus (10-15 μ) situated towards the middle third of the cellular body, with almost homogeneous protoplasm and with the free edge furnished with a cuticle rim with a double turn. The flat, lamellate epitelia of the ampulla abruptly gives way to the cylindrical high epitelia of the papillæ, and the boundary between them is therefore marked

* This sounds the wrong way round to me. 'Quello' is the former, 'questo' the latter in Ital.

by a rather deep groove. The small tracheal trunks continue to branch out under the membrane on which the epitelia rests. The tracheal capillaries cross through the basal membrane and run along the intercellular spaces, branching out. Their last branches penetrate the cytoplasm of the high epitelial cells and rise to touch the cuticle rim. As a result of this behaviour, the cytoplasm looks under close observation to be traversed by very fine canals owing to the final branchings of the trachea among the cells. The wealth and distribution of the tracheal capillaries is truly ~~so~~ surprising when a rectal papilla prepared freshly for the purpose is examined.

The function of the ~~rectal~~ glands ~~and~~ or rectal papillæ has been discussed at length above. Some do not even want to call them glands, denying to them any capacity for making ~~secretory~~ substances whether secretory or excretory. Given their abundance ~~with~~ of trachea ~~in mind~~ Leydig & Newport regarded them as organs meant for respiration, ~~Similar~~ as with to the rectal tracheal branches of the larvæ of Libellulæ. Bowne made a study of the rectal papillæ in the Muscidi from 1869 onwards & believed that they performed a urinary function, although he expressed this first opinion of his more recently with some doubt. Vine examined the rectal papillæ in 8 predatory Syrphids as well recently and thought he had proved the existence of uric acid in the liquid expressed from the papillæ. Not to have succeeded in eliminating the doubt whether the substances of excretion found on the surface of the papillæ or in the juice expressed from them belong properly to a product elaborated in the epitelia of the papillæ or are instead those substances that come from the Mal. tubes, ~~and~~ pass through the rectal ampulla and bathe the papillæ; ~~not~~ moreover not to have succeeded either ~~to~~ in showing clear evidence, in the protoplasm

of the peculiar cells of the papillae, of the substances of excretion, leaves me unsure about their urinary job. On the other side however the richness of tracheæ is not enough in itself to make us unreservedly admit the respiratory function of the rectal papillæ, when such an abundance of tracheæ could be considered as being physiologically connected with particular processes, not yet recognised by us, occurring in the large epithelial cells of the papillæ and on account of which perhaps the name of rectal glands would also be accorded to them as well. Only new and extensive research will be of use in clarifying the true physiological significance of these particular organs.

After referring to the digestive apparatus and to the various organs connected to it in the image of the E.t. we must point out afresh that the description and illustrations that Buckton gave of it are not true at all. Firstly, we note that no such long narrow tract between the proventricle and the chylific stomach as he is found as represented by Buckton in fig. 2, Chap. VIII. Second, Buckton illustrates a very short chylific stomach showing it not going beyond the thorax, both in fig. 2, Chap VIII and in fig. 3, Chap IX. We on the other hand have seen it to be very extended and to a large extent, turning in loops, contained in the abdomen. It is furthermore to be pointed out that, as a result of this error, for Buckton the mal. t. join the intestine very high up at the far end of the thorax without saying that these tubes at the junction with the intestine behave rather quite differently from how the *A. shows. Even if we ignore other mistakes we cannot remain silent in the case of the mistake B. falls into over the salivary glands. According to the A. they should issue through two distinct orifices in the proventricle, but, as we have said, they join into one excretory conduit which opens on the dorsal side of the hypopharynx a short distance from its apex. Lastly we note that in the two illustrations in which the whole digestive apparatus is shown

* Is this A. the Author? See also p 206 and p 212, where it refers to Künckel.

the gastric glands are not shown by Buckton at all, and that fig. 2, Chap VII, in which these glands are intended to be shown, does not correspond to the facts since the said glands are two only, not several (... "several short and blind gastric glands pour in their contents" the A. writes in explanation of the illustration) and do not match with the manner in which they are shown by the A.

Circulatory System (dorsal vessel or heart)

Although the dorsal vessel is subject only to slight modifications during the nymph stage, in which it remains almost continuously active, it nevertheless shows some characteristics worth describing in the imago, on account of which it differs somewhat from the larva state. In the imago it is perhaps more convenient to distinguish the dorsal vessel in two major parts: a posterior abdominal part, the heart properly so-called, of larger calibre, capable of diastole and systole; and an anterior thoracic part, the aorta, very thin, capable of contracting only in the longitudinal direction. The abdominal part or heart has a curved line with a ventral cavity and a medially restricted calibre, fully dilated, with a two or threefold increase, at the two ends of its shape, so that besides a posterior cul-de-sac, the heart of the imago has another anterior cul-de-sac. And indeed the dorsal vessel is joined to the end of the thorax, and bends on the sagittal plane and goes ventrally somewhat backwards so that it gives rise to the aorta which then goes in the direction of the thorax, passing into the space left vacant by the scutum and the scutellum of the metathorax. Following on this bending it happens that the anterior dilation of the heart pushes forwards above the scutum and the point of origin of the aorta so as to constitute a large anterior cul-de-sac which is fixed to the scutum and the scutellum of the metathorax by means of numerous small muscular striated fibres which radiate out from it and make up a wide anterior radiated* muscle, which I do not find mentioned by Künckel in the case of the Vol. The thickness of the

* 'radiare' in Ital. means 'to expel' and there is no instance of 'radiato'. But context suggests Zool. use here.

muscular wall of the heart becomes greater and greater in step with the approach to the anterior cul-de-sac, where it reaches its maximum, of over double the size of the posterior heart wall.

In correspondence with the anterior dilation a pair of valves, distinctly apparent on every edge of which there is a small oval nucleus. Given the remarkable thickness of the wall of the anterior cul-de-sac it contracts more energetically and can therefore be considered the most powerful part of the apparatus for propulsion of the nutritive liquid and on this rather than the posterior cul-de-sac the name of ventricle would therefore better be conferred.

The posterior cul-de-sac, or posterior part of the abdominal portion of the dorsal vessel, has large pericardial cells whilst the anterior ~~part~~ cul-de-sac or anterior part has small pericardial cells.

The striated wing muscles, that keep the abdominal portion of the circulatory system in place, extend laterally up to the body wall, on which they are inserted.

The aorta or thoracic portion of the dorsal vessel has no cells whatsoever, it runs forward by itself, situated dorsally ~~at~~ the chylific stomach, ~~on~~ the proventricle, on the final tract of the oesophagus until it ~~joins~~ reaches the suspensory ring. This does not in fact disappear, contrary to the opinion of Künckel d'Her., ~~shows~~ and shows almost all the characteristics and structure which we described in the larva ~~but~~ which we are not repeating here: in the fully formed insect this [the suspensory ring] is placed above the oesophagus, just in front of the anterior ends of the two gastric glands. After passing through the suspensory ring the aorta goes on between two tracheal trunks up to the brain, increasing in ~~size~~ calibre somewhat while getting thinner and thinner in the wall.

Body or adipose tissue

We ~~are speaking~~ shall speak here of the imago's adipose tissue captured in ~~adults~~ E. adults, and therefore in those for the most part born a few days before.

As in the Diptera braciceri in general, the a. t. in the imago of E. is newly formed. Wheeler rightly maintained before that the a.t. is mesodermal in origin and does not derive from the enocytes, contrary to the opinion expressed by Graber. That, next, the adip. cells of the adult have no excretory job is proved by the experiences of Kowalevsky and by the recent studies of Berlese. Though admitting the mesodermal origin of the imago a.t., the results of the research by Berlese on the one hand and by Supino on the other are contradictory; since while for Berlese the a. body of the i. derives from larva muscle tissue that has decomposed, for Supino its source is the mesenchymatic cells that are at first spread through the animal body, then join up with each other at given points, to be dispersed in series and so constitute the layers of i. a. t. To discuss such an essential divergence in results on the way in which the i. a.t. originates we cannot and must not enter for the time being and hold back until our research on the processes occurring in E. during the nymph stage has made clear what the facts of the case really are in the species taken for examination by us. And we come without further ado to the tissue of the adult E.

Regarding the a.t. of the adult E., certain differences of make-up demand a separate description for the abdominal a.t. and that of the head.

In the case of the abdominal a.t. I have found great individual variations with a.t. present in some examples in greater quantities than in others; and the same also in females at almost the same degree of ovarian development. As a whole * it turns out to be edges and lobules of different shape and size, variously joined * together, and the lobules are composed in their turn of cellular strands and columns variously united.

* My impression is that here the writer goes for alliterative style rather than detailed accuracy: 'lembi e lobuli', 'cordoncini e colonnette'

As with other insects it abounds in the far abdomen, dorsally underneath the integument and around the genital organs. Two sorts of cellular elements are found in the abdominal a.t.: adipose cells proper, of which we shall here speak briefly, and the enocytes, represented one one side at least by the so-called intercalated cells, not containing fat, with which we shall busy ourselves but below.

The a. cells, their edges marked by distinct though thin membrane, stand crowded together closely, yet appear in a few cases to be roundish, with, however, a polyhedric diversified shape, as they differ very much in dimensions. In regard to dimensions though they do not ever attain the conspicuous size of the larva a. cells, they are nevertheless remarkable enough to measure as much as 100–130 μ by 40–50 and more μ. Usually they contain a single nucleus, round, vesicular, nucleolate, 10–12 μ in diameter, and have reticulate plasma through the presence of numerous vacuoles, some larger others smaller, irregularly positioned, that invade the whole cell body as far as beneath the membrane. They are owing to droplets of fat. In the cytoplasmatic trabecles (rather than) of the network small albuminoid granulations are settled, which colour brightly with eosin and also with saffranine. On the other hand the look of the a. cells can change somewhat according to how more or less fattened they are.

Among the cells being described, particularly in the a.t. of the end of the abdomen and that surrounding the genital organs, others of smaller dimensions are encountered that possess two or more nuclei, denser protoplasm, and are more easily colourable and have fewer vacuoles. The nuclei, if numerous, are rather small. For my part I also believe, basing myself chiefly on intermediate passing stages which are seen not seldom, that, conforming with what Berlese states in the case of the a.t. of the imago of the adult Calliforа, other a. cells take their origin from the above mentioned polynuclear cells and grow bigger, to acquire their definitive characteristics.

a

We proceed to the a.t. of the head: the cellular elements here group themselves in an extremely particular way so as to justify their being spoken of separately. In correspondence with the occipital region, from the top to the ventral margin, in that space which in a frontal section of the head remains behind the optical ganglia and on the inside of the compost eyes, that is to say in that space that is occupied on every side by the cervical tracheal ampulla, there nestle numerous very distinct adipose lobules, cylindroid in shape, in length about 0.3 mm, up to 0.15 mm wide, so milky white in colour as to be mistaken for nerve substance and with an exterior appearance that would easily lead to their being taken as glandular otricles. Each one of these lobules is composed of cells similar to those of the abdominal a.t., but more clearly defined and placed more or less regularly on the inside of a small tracheal tube of 8-10 μ diameter, a dependence of the cervical ampulla, a small tube that bifurcates at times, runs through the whole length of the lobule, simulates an excretory canal belonging to it and so contributes to making the lobule look as a whole like a glandular otricle. Every lobule remains independent and sharply defined from its surrounding neighbours, and in transverse section is circular in shape. The cells of the cephalic a.t. attain a height of 70 to 90-100 μ and a width of 40-50 μ, have a delicate membrane almost always very easily seen, cytoplasm somewhat less reticulated than that of the fat cells of the abdomen, with few or no vacuoles on the inside of the nucleus, which shows itself granulous. Minute albuminoid granules scattered colourable with eosin are scattered in the cytoplasmatic trabecles. The round nucleus, nucleolate, 10-12 μ in diameter is usually single, seldom double. Moreover there are cells that contain several small nuclei of not more than 5-7 μ diameter, more intensely stainable. Recalling what was said about the a.t. of the abdomen it is reasonable to consider such cells as elements in process of proliferating. A proof of this would be in fact to find some small cells with small nucleus near to the big ones.

Adipose cells

Similar to those described above, but of smaller size, lower, are besides disposed* as a covering for the inside surface of the occipital region and the external surface of the tracheal ampulla of this region with a single layer.

The cephalic a.t. of the imago precedes that of the abdomen in the development during the nymph stage, so that in a nine day old nymph the occipital lobules already have a diameter of 70-80 μ with cell height of 20-25 μ, whilst the columns of the a.t. of the abdomen in the imago have a thickness of max. 20 μ and very small elements.

We noticed this peculiar state of things that does not seem to occur in the cephalic a.t. of the Muscidi. It also escaped Buckton on the E. He does not show it either in fig. 5 Chap II, where he illustrates a frontal cut through the head, nor in fig. 1 Chap. VI, where he illustrates a section of the compost eye and the optic ganglia. Künckll d'Her. does not mention it in his study of the Vol.

Excretory Organs

These are represented in the imago, just as in the larva, by the mal. tubules which we have already referred to, by the pericardial cells and by the essye enocytes.

Pericardial Cells — We said before about these they that they pass from the larva to the imago retaining very similar characteristics: however in the fully formed insect they become more numerous. The big pericardial cells (up to 60 μ max. diam.) lie on the sides and below the posterior cul-de-sac of the abdominal portion of the dorsal vessel, the small ones on the sides of the anterior cul-de-sac. Besides, small pericardial cells exist also laterally to the strips formed by the large ones. Superimposed in two or three layers, †also up to five or six (layers) at the back, they are held between the branches of the wing muscle tendons, adhering to the branches. The cytoplasm acquires a more yellowish colour than in the larva and is laden with granules of ex-

'up to' 'also'

† financo - not in dict. Prob. fine tenche

* are ready to cover = 'cover' [it seems to me]
= are disposed as a covering for the

crement, yellowish or yellow-brown; it is somewhat more dense and homogeneous at the periphery, and contains only a few small vacuoles in its interior. The nucleus is usually single, with, in somewhat rare exceptions double, different from what is found in the Vol., where according to Künckel's research the pericardial cells possess two nuclei, whence the name of binucleate cells with which the *A. designated them.

Enocytes – The enocytes of the imago of E. are more abundant than in the larva and they are newly formed because the larva ones at a certain rather late period, in rather late however, in the nymph stage, disappear and are replaced by other enocytes whose origin we shall have to study when we get busy on the nymph. Koschevnikov similarly states that the imago enocytes in the bee do not derive from the larva ones.

The imago enocytes of E. are partly scattered partly in the abdominal a.t. and partly gathered in large groups on the sides of the abdomen, there taking a certain segmental disposition.

Interspersed among the cells of the abdominal a.t. other cellular elements that do not contain fat are found in isolation or in heaps of three four or more still more. They are easily distinguished when examined fresh by their dense, unreticulated cytoplasm, of light yellowish colour. They show up most strongly † in contrast with opposite the ad-cells as much in the both in the sections and strips of treated tissue coloured tissue and observed tissue fixed, coloured and observed on the surface. They are fairly easily coloured with emallum and eosin. These elements correspond at least in part the to those in the Muscidi known as 'intercalated cells. They lean against each other [or 'are backed up against each other'] and have a variable polyhedric shape; provided as they are with a delicate membrane they their edges stand out; they are also characterised by the fact that they often contain a double nucleus. Their

† not sure whether this is position or appearance. 'In opposition to' 'in contrast with' ✓

* C'A. – this comes up several times. First I thought it was a ref. to an illustration in Künckel's work. Now I am not sure. A = author? See also on pp 205–6 about Buckton.

maximum dimensions reach 20-30-35 μ. The cytoplasm, uniformly and finely granulous is marked by some spaces or vacuoles in the manner of narrow little channels that run through it in various directions, especially round the nucleus, so as to make it look like larval enocytes. The round vesicular nuclei, 10-15 μ in diameter, with a large nucleole, sometimes double, are rich in nuclear juice and fundamental substance, while they have few and thin fiat nucleinic filaments which have a preference for the periphery. From what has been said above it seems that the enocytes of the imago are smaller than the larva ones but by contrast, they are more numerous and provided with characteristics that make them resemble them as well.

Worth considering next is the fact that there are on the sides of every segment of the abdomen, more especially near and below the stigmi, large accumulations of enocytes sometimes grouped into true and proper little lobules. More remarkable still is that under the stigmi lobulettes are constantly found that are dark Havana brown in colour (or the colour given by Bismarck brown or by vesuvian brown) which results exclusively from enocytes loaded in more or less abundance with spheroid yellow-brown granulations or vesuvian-tinted granulations. These same granulations gather and throng greatly round the periphery of the cell body, in a way that constitutes a peripheral halo. Other enocytes can be seen that through containing few or scarce pigmented granules represent stages in the passage to those heavily loaded. Finally it is noteworthy that the granulations with which the enocytes are loaded have characteristics like the granulations contained in the cells of the mal. tubes and are therefore to be thought of as the work of excretory substances; from which comes evident in favour of the excretory function being attributed to the enocytes. Similar facts about the enocytes of already aged queen bees have been highlighted by Koschevnikov, who in his note gives many bibliographical references on the history of these peculiar excretory cells.

Genital Organs

The tiny number of males will not permit a very accurate study of the male genital apparatus, so we are reluctantly forced to put it off until a more favorable time. However we ~~must~~ have to note that Buckton says in his text that each testicle is provided with a vas deferens, then in fig. 1 of Chap VIII shows the two testicles placed along one single vas deferens, which is not the case. From what little we have up till now ~~been~~ observed it appears that each testicle has its own vas deferens and that overall the disposition of the internal male genital organs resembles that described by Vine in the Syrphus luniger.

The reproductive apparatus of E. t. was studied before and presented by Leydig in his research on the anatomy of Insects. Vine made observations on the predatory Syrphids and also ~~did work on the~~ gave some attention to the genital apparatus of E. Recently Büel investigated the anatomy and development of the genitalia and their connexions in Calliphora erythrocephala.

I shall now refer very briefly ~~at~~ to some details of the female sexual apparatus.

This consists of two ovaries, two oviducts, one vagina, to which are connected three semen receptacles (spermathecae) and two accessory glands or sebaceous glands.

The mature ovaries are very voluminous, measuring 6 mm in length and 3 mm. in width, filling the abdominal cavity. Each oviduct is lengthened in the respective ovarian mass by means of a chalice cup into which the ovarian tubes or ovarioles open. The oviducts have muscle wall and are internally covered with a simple

epitelia layer made of very flattened ✱ cells, which go on afterwards to line the surface of the cup. The muscular wall of the oviduct turns into a muscular covering that surrounds the whole ovary mass composed of circular striated muscle fibres with a few external longitudinal fibres. On the inside face of this covering single muscle fibres are detached and inserted into the wall of the ovary tubes. In a live specimen I observed the ovary subject to very energetic contractions most of all when it was mechanically stimulated.

The vagina derives from the union of the two oviducts, has also a muscle wall with fibres contoured longitudinally, and extends into a long articulated oripasiton, that is protractile and retractile.

While Buckton did not manage to see more than two sperm receptacles, I have observed that these are always three of these, agreeing with the findings of Vine on the Sypphid predators and also on E., and with those of Lowne on Calliphora. The receptacles, in the shape of vesicular circles about 0.30 mm in diameter, have a very intense brown colour. Usually the three vesicles are very closely backed up to each other; in only one case did I see a receptacle separated and distant from the other two. Each receptacle possesses a long thin vas or pedunele. Topographically the vesicles are placed on the ventral side at a point corresponding to where the two oviducts are joined to the vagina. The three pedunceles lead however, in a convoluted contour, dorsally to the vagina and then run straight backwards until they open each with a distinct orifice into a papilla situated dorsally, not very far from the vulva.

The wall of each receptacle has a rather complex structure, since there can be distinguished, going from the outside towards the inside, a case of lengthened fusiform * pigmented cells, a layer of muscle fibres some of which are also pigmented, a cylindrical high epitelia and a cuticle intima. The cells of which the epitelia is formed are cylindrical-prismatic and narrow, with the characteristics of secretory elements: they have a clear appearance,

* = spindle-shaped = ?

delicately reticulated cytoplasm, and the nucleus situated at their proximal end. The internal surface of the epitelia is covered with a pigmented cuticle which when seen from above has a finely speckled surface and minute round holes as well, through which the secretion from the epitelial cells must find a way in order to reach the receptacle cavity. Through being unpigmented and therefore white in colour the vessel that comes from the receptacle contrasts with it. In it the epitelia covering continues, its cuticle no longer pigmented. The peduncle epitelia becomes all the time very much more flat step by step as it approaches the outlet into the vagina. From the start the vessel coming from the receptacle is furnished on the outside with striated muscle fibres that are then gradually lost. Its rather narrow hollow is everywhere bordered by a relatively thick cuticle. The three vessels, their walls now reduced to a single chitinous cuticle, go through the dorsal wall [or cross the dorsal wall] of the vagina in correspondence with a large chitinous papilla and finally issue into the hollow of the vagina with three distinct orifices. An arrangement very different therefore from the one seen by Buckton that shows quite short peduncles issuing at the union of the two oviducts.

The accessory glands, or sebaceous glands as called by preference, are two tubular glands that branch abundantly. Each of them is furnished with a long excretory canal running alongside the vagina. Each becomes very much thinner and issues into the vagina just before meeting the orifices of the seminal receptacle vessels. In the accessory glands a simple pavemented epitelia can be distinguished. It is extremely flattened, lines the hollow of the tubes, and provides the cuticle intima for them. Also [to be seen] a characteristic secretory epitelia situated beneath this [the cuticle intima] and consisting, it might be said, of a combination of unicellular glands. The cells of this epitelia are quite low, generally wider than they are high (height 12-15 μ, width 18 μ). In the middle of each cell a cavity can be seen with sharp borders of the thinnest cuticle. It is flask or bottle-shaped, that is to say round, with a narrow neck that opens on the surface of the

epitelia. The cytoplasm surrounding the cavity is very dense, and dark; the ~~nucleus~~ fairly large nucleus is pushed beneath the cavity into the distal end of the cellar body. When these small unicellular glands are seen from the front thus in the middle of a clear round area formed by the cavity, ~~there appears~~ a small more transparent ~~and shining~~ circle appears strongly evident. It corresponds precisely to the orifice of the neck of the cavity, the thin cuticle of which is continuous with the cuticle of the covering surface epitelia. The nuclei of the ~~latter~~ last named are very small, usually ~~placed in~~ positioned in correspondence with the edges between the unicellular glands and therefore on the sides of ~~the~~ single orifices.

The particular structure of the accessory glands now described, recalls, against a certain histological ~~point of view~~ backdrop, that of the lobules of the pigidial* glands of the Carabidi and of the Ditiscidi illustrated by Dierkx: in this case indeed every lobule derives from a combination of unicellular glands and every secretory cell possesses, as well as a nucleus, a second large body, ~~differen~~ diversely shaped, the so-called terminal vesicle or radiate vesicle which issues into the ~~cavity~~ lobule cavity by means of a thin cuticle ~~cavity~~ canal; and here also the lobules are composed of two sorts of epitelia: long glandular cells provided with radiate vesicles, and cubic cells of the ~~co~~ covering epitelia positioned between the ~~mouths~~ outlets of the little intracellular canals.

← pp 215–217 excretion staining the margins of the before mentioned pages resulting from unexpected secretion from salivary glands of a very aged specimen of homo sinsapiens, issuing from cephalic frontal opening situated transversely to the sagittal direction by means of loose inferior labral body, and not directed at Buckton.

* Not to me, no ideas on This. 'pigia' It. = 'crowd' / 'pigiama' Et. = 'pyjamas'. No doubt it is Zoology babble