

CHAPTER XX.

SUPERNUMERARY APPENDAGES IN SECONDARY SYMMETRY.

INTRODUCTORY.—THE EVIDENCE AS TO INSECTS.

OF all classes of Meristic variations those consisting in repetition or division of appendages are by far the most complex and the most difficult to bring into system. There is besides no animal which normally presents the condition seen in the variations about to be described, though there may be a true analogy between them and phenomena found in colonial forms. It has nevertheless seemed well to introduce some part of this evidence here for two reasons. First the subject is a necessary continuation of the evidence as to digits, which would otherwise be left incomplete; secondly it will be shewn that though many of the cases are irregular and follow no system that can be detected, there remain a large number of cases (being, indeed, the great majority of those that have been well studied) whose form-relations can be put in terms of a simple system of Symmetry. Thus not only are we introduced to a very remarkable property of living bodies, but also the way of future students of Variation may be cleared of a mass of tangled facts that have long been an obstacle; for on apprehension of the system referred to it will be seen that cases of repetition in Secondary Symmetry are distinct from those of true Variation within the Primary Symmetry and may thus be set apart.

Arrangement of evidence as to Repetition of Appendages.

In the first instance I shall give the evidence as to Secondary Symmetries in Insects and Crustacea, prefacing it with a preliminary account of the system of Symmetry obeyed by those cases which I shall call *regular*, and explaining the scheme of nomenclature adopted. Besides the regular cases of extra parts in Secondary Symmetry there are many *irregular* examples which cannot be shewn to conform to the system set forth. Of all but a few of these, details are not accessible, and of the rest many are

mutilated or so amorphous that the morphological relations of the surfaces cannot be determined.

Over and above these there remain a very few cases of Repetition of parts of appendages where the arrangement is certainly not in Secondary Symmetry, but is of a wholly different nature, exemplifying in Arthropods that *duplicity of limbs* already seen in the human double-hands (p. 331) and in the double-feet of Artiodactyles (p. 378). Genuine cases of this kind are excessively rare; but owing to hasty examination great numbers of cases have been described as instances of duplicity, though in reality the supernumerary parts in them can be shewn to be of paired structure. To emphasize the distinctness of these cases they will be made the subject of a separate consideration. Logically they should of course be treated before the Secondary Symmetries; but their essential features may be understood so much more readily if the latter are taken first that I have decided to change the natural order.

In continuation of the evidence as to Secondary Symmetry in Arthropods will be given a brief notice of similar phenomena in vertebrates. This evidence is comparatively well known and accessible and I shall attempt no detailed account of it, referring to the facts chiefly with the object of shewing how the principles found in Arthropods bear on the vertebrate cases.

It will then be necessary to consider how repetitions in Secondary Symmetry are related to other phenomena of Repetition. Lastly something must be said with regard to the bearing of these facts on the general problems of Natural History.

PRELIMINARY ACCOUNT OF PAIRED EXTRA APPENDAGES IN SECONDARY SYMMETRY (INSECTS).

Supernumerary appendages in Insects are not very uncommon, perhaps 120 cases of this kind being recorded¹. Nearly all known examples are in beetles, but this may be due to the greater attention paid to the appendages in that order. They do not seem to appear more often in one family than in another, but perhaps the rarity of instances in Curculionidæ is worth noting. They are found in both sexes, in all parts of the world, and in species of most diverse habits.

Supernumerary parts may be antennæ, palpi or legs. (Extra wings are probably in some respects distinct. They have already been considered. See p. 281.) Extra appendages may be either outgrowths from the body in the neighbourhood of the part repeated, or, as in the great majority of cases, they occur as outgrowths from an appendage, extra legs growing from normal legs, extra antennæ from antennæ, &c. In every case there are two essentials to be determined: first the *constitution*

¹ Not including some 110 cases of alleged *duplicity* of appendages given later.

of the extra parts, and secondly the *symmetry* or relation of form subsisting on the one hand between the extra parts themselves, and on the other between the extra parts and the normal parts.

In few cases of extra appendages arising from the body itself have these essentials been adequately ascertained.

For brevity I shall describe the phenomena as seen in extra legs. The same description will apply generally to the antennæ. Recorded cases of extra palpi are very few, but probably are not materially different.

Structure of Paired Extra Legs.

The parts composing extra legs do not as a rule greatly differ from those of the normal legs which bear them. Though in many instances extra legs are partially deformed, they are more often fairly good copies of the true leg. Not rarely the extra parts are more slender or a little shorter than the normal appendage, but in form and texture they are real appendages, presenting as a rule the hairs, spurs, &c. characteristic of the species to which they belong.

The next point is especially important. *The parts found in extra legs are those parts which are in the normal leg peripheral to the point from which the extra legs arise, and, as a rule no more.* Though in extra legs parts may be deficient or malformed, structures which in the normal leg are central to the point of origin of the extra legs are not repeated in them¹. For instance, if the extra legs spring from the trochanter they do not contain parts of the coxa, if from the second tarsal joint, the first tarsal joint is not represented in them, and so on.

Extra legs may arise from any joint of the normal leg, and are not much commoner in the peripheral parts than in the central ones, but there is a slight preponderance of cases beginning from the apex of the tibia. It is rather remarkable that cases of extensive repetition are not much less rare than others, the contrary being for the most part true of the limbs of vertebrates.

It does not appear that extra legs arise more commonly from either of the three normal pairs in particular.

Supernumerary legs of double structure are sometimes found as two limbs separate from each other nearly or quite from the point of origin, but in the majority of cases their central parts may be so compounded together that they seem to form but one limb, and the essentially double character of the limb is not then conspicuous except in the periphery. For example it frequently happens that the femora of two extra legs are so compounded together that they seem to have only a single femur in common,

¹ Particular attention is therefore called to one case of extra antennæ, which did actually contain parts normally central to the point of origin. (See No. 804.)

and careless observers have often thus declared them to be two legs with one femur. Similarly the two tibiæ or the two tarsi may be more or less compounded. In the case of *Silpha nigrata* (No. 769), the two extra legs which arose from a femur were compounded throughout their length, having a compound tibia and tarsus (see Fig. 167). Even in cases when the two extra legs appear to arise separately it will generally be found that they articulate with a double compound piece of tissue which is supernumerary and is fitted into the joint from which they appear to arise. This is especially common in cases of two extra tarsi, which seem to spring directly from a normal tibia. As a matter of fact in all such cases these extra tarsi articulate with a supernumerary piece of tissue, as it were let into, and compounded with, the apex of the normal tibia. These bodies are themselves double structures, composed of parts of two tibiæ. In determining the morphology of the limbs they are of great importance, but unfortunately they are not generally mentioned by those who describe such formations. But though extra parts are generally present in the leg centrally to the point from which the extra legs actually diverge, it should be expressly stated that if this point is in the periphery of the leg, the central joints are normal: if for example, there are two extra tarsi, there may be parts of two extra tibial apices, but the base of the tibia, the femur, &c. are single and normal.

Symmetry of Paired Extra Legs.

To appreciate what follows it is necessary to have a distinct conception of the normal structure of an insect's leg, and to understand the use of the terms applied to the morphological surfaces.

If the leg of a beetle, say a *Carabus*, is extended and set at right angles to the body, the four surfaces which it presents are respectively dorsal, ventral, anterior and posterior. In the femur, tibia and tarsus the dorsal is the extensor, and the ventral is the flexor surface. The anterior surface is seen from in front and the posterior from behind. (The terms 'internal' and 'external' are to be avoided as they denote different surfaces in the different pairs.) Difficulty as to the use of terms arises from the fact that as the beetle walks or is set in collections, the legs are not at right angles to the body but are rotated on the coxæ, so that the plantar surface of the first pair of legs is turned forwards, but the plantar surfaces of the second and third pairs are turned backwards¹.

¹ Attention is directed to the fact that in a beetle there is a complementary relation not only between the legs of the right and left sides but also imperfectly between the legs of the first pair and those of the second and third pairs, which are in some respects images of the first leg of their own side. For instance, in *Cerambyx* (see Fig. 160) the trochanter of the fore leg is kept in place by a process of the coxa which goes down *behind* it, but the corresponding process in the second and third legs is *in front* of each trochanter. Again in *Melolontha* &c. the tibial serrations of

Extra legs may arise from any one of the morphological surfaces, but more often their origin is in a position intermediate between them, *e.g.*, antero-ventral, or postero-dorsal.

The next question is that of the determination of parts which are extra from the parts which are normal. Two extra legs spring from a normal leg. The appearance is often that of a leg single proximally, but triple peripherally. All three limbs are often equally developed and at first sight it might well be supposed that the three collectively represent the single leg of the normal.

In many cases of Meristic Variation I have contended that the facts are only intelligible on the view that there has been such collective representation. But in these Secondary Symmetries this supposition is [?always] inadmissible. On closer examination it is generally more or less easy to see that the three legs do not arise in the same way, but that one arises as usual while the other two are, as it were, ingrafted upon it. It is thus possible in all but a very few cases to determine the normal leg from the others by tracing the surfaces from apex to base, when it will be found that some surface of the normal is continuous throughout the appendage while those of the extra legs end abruptly at some part of the normal leg.

Nearly always besides, as has been mentioned, the extra legs are more or less compounded together at their point of origin even if separate peripherally. In a few very exceptional cases it happens that one of the extra appendages is compounded with the normal and not with the other extra appendage. A remarkable case of this in an antenna may be seen in *Melolontha*, No. 800, and in a leg in *Platycerus caraboides*, (*q.v.*)

We have now to consider the positions of the paired extra legs in regard to the normal leg and in regard to each other. At first sight their dispositions seem entirely erratic; but though it is true that scarcely two are quite identical in structure, yet their divers structures may for the most part be reduced to a system. This system, though far from including every case, still includes a large proportion and even the remainder do not much depart from it except in very few instances. The comprehension of the general system will also greatly help to make the aberrant cases appreciated with comparatively few words. For simplicity therefore, the consideration of exceptional cases will be deferred and the principles stated in a general form. It will be remembered that we are as yet concerned only with *double* extra legs.

When extra appendages, arising from a normal appendage, are thoroughly relaxed and extended, the following rules will be

the first legs curve backwards, but those of the other legs curve forwards. This circumstance is mentioned lest it might be thought to have been neglected in what follows, but this complementary relation has nothing to do with that which will be shewn to exist between the extra legs.

found to hold good with certain exceptions to be hereafter specified.

- I. *The long axes of the normal appendage and of the two extra appendages are in one plane: of the two extra appendages one is therefore nearer to the axis of the normal appendage and the other is remoter from it.*
- II. *The nearer of the two extra appendages is in structure and position formed as the image of the normal appendage in a plane mirror placed between the normal appendage and the nearer one, at right angles to the plane of the three axes; and the remoter appendage is the image of the nearer in a plane mirror similarly placed between the two extra appendages.*

Transverse sections of the three appendages taken at homologous points are thus images of each other in parallel mirrors.

As the full significance of these principles may not be at once seen it may be well to add a few words of general description. The relation of images between the *extra* legs is easy to understand. They are a complementary pair, a right and a left. This might indeed be predicted by any one who had considered the matter.

The other principles, which concern the relations of the extra legs to the normal leg, are more novel. For first it appears not that either of the extra legs indifferently may be adjacent to the normal, but that of the extra pair the adjacent leg is that which is formed as a leg of the other side of the body. If therefore the normal leg bearing the extra legs be a right leg, the nearer of the extra legs is a left and the remoter a right. This principle holds in every case of double extra appendages of which I have any accurate knowledge, where the structure of the parts is such that right limbs can be distinguished from left.

But perhaps of greatest interest is the fact that the inclination of the surfaces of each extra leg to those of its fellow and to those of the normal are determined with an approach to uniformity in the manner described.

These principles of arrangement may be made clear by a simple mechanical device (Fig. 153). A horizontal circular disc of wood has an upright rod fixed in its centre. This rod passes through one end of a vertical plate of wood which can be turned freely upon it as an axle, so as to stand upon any radius of the horizontal circle. The head of the axle bears a fixed cog-wheel. In the vertical wooden plate are bored two holes into which two rods each bearing a similar cog-wheel are dropped, so that each can rotate freely on its own axis. The three cog-wheels are geared into each other. They must have the same diameter and the same number of teeth. Three wax models of legs are fixed on the head of each wheel as shewn in Fig. 153. In that figure, R represents the apex of the tibia and tarsus of a normal right leg. The anterior surface is dark, and the posterior is white. The anterior and posterior spurs of the tibia are shewn at A and P. SL and SR represent the two supernumerary legs, SL being a left, SR a right. (They are supposed to arise from the leg R at some proximal point towards which they converge.) When the wooden plate is put so that the arrow points to the word "Posterior" on the disc, the models will then take the positions they would have if they arose from the posterior surface, all the ventral surfaces coming into one plane. If the arrow be

set to "Ventral" the two supernumeraries will turn their dorsal surfaces to each other, and so on. The model SL thus rotates twice on its own axis for each

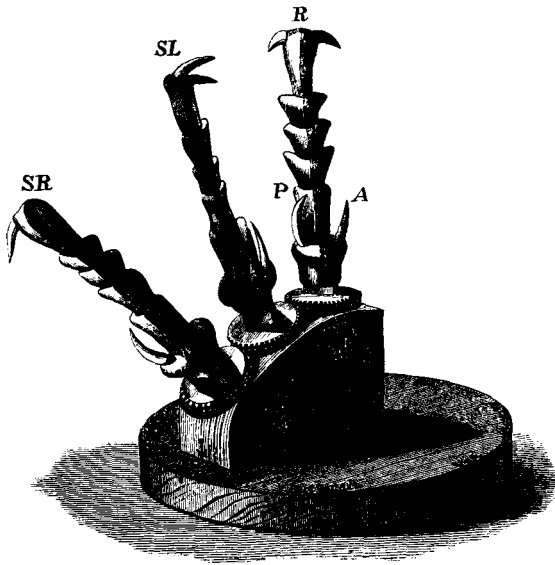


FIG. 153. A mechanical device for shewing the relations that extra legs in Secondary Symmetry bear to each other and to the normal leg from which they arise. The model *R* represents a normal right leg. *SL* and *SR* represent respectively the extra right and extra left legs of the supernumerary pair. *A* and *P*, the anterior and posterior spurs of the tibia. In each leg the *morphologically anterior* surface is shaded, the posterior being white. *R* is seen from the ventral aspect and *SL* and *SR* are in Position VP.

revolution round *R*, but the surfaces of the model *SR* always remain parallel to those of the model *R*. In every possible position therefore each model is the image of its neighbour in a mirror tangential to the circle of revolution. In the figure the models have the position they should have if arising postero-ventrally. Here the plantar surface of *SL* is at right angles to the plantar surfaces of the other two legs.

Since at each radius the relative position of the legs differs, it is possible to define these positions by naming the radius. This will be done as shewn in Fig. 154. In this diagram imaginary sections of the legs are shewn in the various positions they would assume at various radii. The central thick outline shews a section of the normal leg, a longer process distinguishing the anterior surface from the posterior. The radii are drawn to various points *D*, *A*, *V*, *P*, representing the dorsal, anterior, ventral and posterior positions respectively. Intermediate positions may be marked by combinations, *DA*, *VVP*, &c., using the system employed in boxing the Compass.

On several of the radii ideal sections of the extra legs are shewn in thin lines, the shaded one being the nearer and the plain one the remoter. M^1 and M^2 shew the planes of the imaginary mirrors.

The manner in which the pair of extra limbs are compounded with each other in their proximal parts, and with the normal limb at their

point of origin is most extraordinary. It does not appear that the surfaces compound together along any very definite line or that the

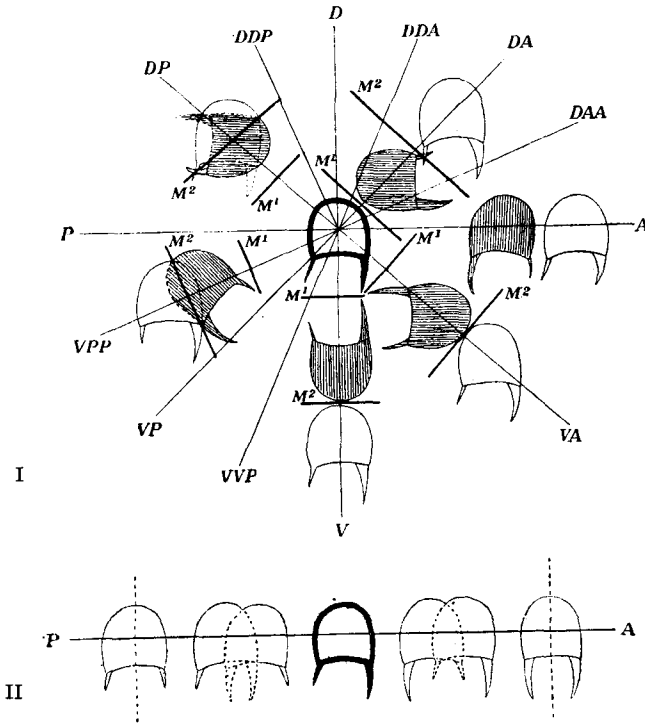


FIG. 154. Diagrams of the relations of extra legs in Secondary Symmetry at various positions relatively to the normal leg from which they arise.

The legs are represented in transverse section, the morphologically anterior side of each being indicated by the longer spur. The section of the normal leg, in which the radii converge, is shewn with a thick black line. The section of the nearer extra leg in Diagram I is shaded, while the remoter is blank. The radii shew them in various positions, anterior, posterior, dorsal, ventral, &c. relatively to the normal leg.

M¹, the plane of reflexion between the nearer extra limb and the normal. M², plane of reflexion between the nearer and the remoter extra limbs.

Diagram II is constructed in the same way to illustrate special cases of extra legs arising anteriorly or posteriorly. If the two extra legs diverge from each other centrally to the tibial apex each tibial apex is then complete, as on radius A of Diagram I. In Diagram II are shewn two degrees of composition of the two tibial apices, illustrating how, in cases of complete composition, the extra parts may consist wholly of two morphologically posterior or anterior surfaces according as they arise posteriorly or anteriorly to the normal leg. (See for instance Nos. 750 and 764.)

line of division between the several limbs is determined by the normal structure of the limbs. The homologous parts seem to be compounded at any point, almost as an object partly immersed in mercury compounds with its image along the line to which it is immersed, wherever that line may be.

From this some curious results follow. For instance, if two extra limbs arise anteriorly and are separate at their tibial apices, they bear *four* spurs as shewn at radius A in the upper diagram of Fig. 154. But if the two are fully compounded at the tibial apices in the anterior position the compounded limb will only have two spurs, both being shaped as anterior spurs (as shewn in the lower diagram) and conversely for the posterior position (see No. 764). The parts, in fact, where the pair may be supposed to interpenetrate (dotted in the diagrams) are not represented.

Those who have described these phenomena have in consequence often made the following error. Observing a limb giving off a morphologically double limb with a common proximal part subsequently separating into its two components, they speak of this as a "primary and secondary dichotomy." When the facts are understood it is clear that there is no dichotomy between the extra legs and the normal, for the parts are not equivalent and the normal is undivided.

Such are the principles followed. *It would not be true to assert that these rules are followed with mathematical precision, but in the main they hold good.* Special attention will be given to cases departing from them, but the number of such cases is small. The cases of slight deviation from the schematic positions are besides mostly those of extra limbs in the Positions A and P, and generally the deviation in them takes the same form, causing the ventral surfaces of the extra parts to be inclined to each other downwards at an obtuse angle instead of forming one plane.

In all cases possible I have examined the specimens myself, and I am under obligation to numerous persons who have very generously given me facilities for doing so. Amongst others I am thus greatly indebted to M. H. Gadeau de Kerville, Dr G. Kraatz and Dr L. von Heyden for the loan of many valuable insects, and also to Messrs Pennetier, Giard, Dale, Mason, Westwood, Waterhouse, Janson, Harrington, Bleuse, &c. In this part of the work I am under especial obligation to Dr D. Sharp, for without his cooperation it would not have been possible for me to have undertaken the manipulations needed. He has most kindly given up his time to the subject, and in the case of almost every one of the specimens examined at Cambridge I have had the benefit of his help and advice.

Of cases not seen by me few are described in detail sufficient to warrant a statement as to the planes in which the parts stood, but sometimes the figures give indications of this. Some of the accounts are quite worthless, merely recording that such an insect had two extra legs: in such cases I have thought it enough to give the reference and the name of the insect for statistical purposes. But every case known to me is here recorded: there has been no rejection of cases.

The cases will be taken in order of the Positions, beginning

with the Position V and taking the other radii in order, going round against the hands of a watch.

CASES OF EXTRA LEGS IN SECONDARY SYMMETRY.

(1) *Position V.*

- *736. **Carabus scielderi** ♀ : pair of extra legs having a common femoral portion arising from the trochanter of the right fore leg (Fig. 155). This case is of diagrammatic simplicity. The troch-

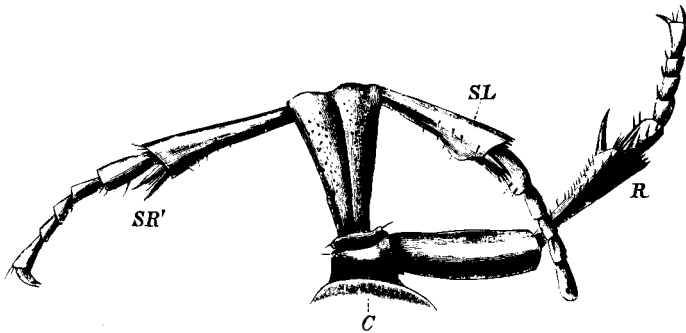


FIG. 155. *Carabus scielderi*, No. 736. The normal right fore leg, *R*, bearing an extra pair of legs, *SL* and *SR'*, arising from the ventral surface of the coxa, *C*. Seen from in front. (The property of Dr Kraatz.)

anter bears a normal leg (*R*) articulating as usual. Immediately ventral to this articulation there is a second articulation upon a small elevation. This bears a double femur made up of parts of a pair of femora compounded by their dorsal borders. The double femur has thus two structurally ventral surfaces opposite to each other.

The apex presents two articular surfaces in the same plane as that of the normal leg, each bearing a tibia, both tibiæ flexing in the same vertical plane.

Since the double femur of the extra legs stands vertically downwards at right angles to the normal femur, it will be seen that both the extra tibiæ flex *upwards*, but one of them is a left leg (*SL*), bending to meet the normal leg, while the other is a right (*SR'*), bending towards the ventral surface of the body. The tibia of the left extra leg is a little shorter than that of the normal, and the tibia of the right extra leg is a little longer than it. All three tarsi are thinner than a normal tarsus; and the claws are a good deal reduced in the case both of the normal and the right extra leg, while in the left extra leg they are absent altogether. This is an example of a pair of extra legs arising

in the position marked V in the Scheme and having precisely the relations there shewn. Specimen first described by KRAATZ, G., *Berl. ent. Zt.*, 1873, p. 432, fig. 9. I am greatly indebted to Dr Kraatz for an opportunity of examining it.

737. **Carabus marginalis**: penultimate joint of left hind tarsus is enlarged and presents two articular surfaces, a proximal one on the ventral surface, and another at the apex. The latter bears the normal last joint with its claws. From the proximal articular surface arises a thick joint shorter than the normal last joint, bearing at its apex *two pairs* of claws set back to back, as in the Position V. Specimen re-described from KRAATZ, G., *Deut. ent. Zt.*, 1880, xxiv. p. 344, Pl. II. fig. 29.
738. **Carabus granulatus** ♂, left posterior tibia bearing an amorphous rudiment of two extra tarsi arising from the ventral surface of its apex. The apex of the tibia is produced at the dorsal border to form an irregular process which bears a tarsus of normal form but reduced size and immediately ventral to this tarsus is a pair of tibial spurs. Ventral to these spurs is another deformed pair of spurs and below them again is a deformed 3-jointed rudiment which probably represents two tarsi. Ventral to the rudiment of the extra tarsi is a third deformed pair of spurs. It was not possible to recognize the surfaces of the tarsal rudiment, but the presence of *two* extra pairs of spurs indicates plainly that the extra parts are morphologically of double structure; and as the spurs indicate the morphologically ventral surfaces, it follows that the surfaces adjacent in the extra tarsi are *dorsal*. This specimen was originally described by Dr L. VON HEYDEN, who was so good as to lend it to me for examination, see *Deut. ent. Zt.*, 1881, xxv. p. 110, fig. 26.
739. **Prionus coriarius** (Longicorn): three legs in region of right posterior leg. The proximal relations not quite clear and hence it is not easy to distinguish the normal. Presumably it was the most dorsal. This leg was of normal form but of reduced size and it wanted the claw-joint. Internal to it, arising by a double coxa, trochanter and femur, were the other two legs. The remoter was a normal right, but the nearer was a left leg of reduced size, slightly crooked and lacking three apical tarsal joints. The compound femur was just as in No. 736. The normal leg must either have been the most dorsal or the most ventral. If the former, the extra parts are in the Position V; if the latter, they are in the Position D, but in this event the normal would be compounded with one of the extra legs. [Redescribed from description and figure given by KRAUSE, *Sitzb. nat. Fr. Berl.*, 1888, p. 145, fig.]
740. **Melolontha vulgaris** ♀ (Lamellicorn): right posterior femur bears a supernumerary pair of limbs having a double tibia in common. The supernumerary parts are rather smaller than the normal ones. [The position of origin and symmetry, according to the figure, must have been approximately V.] KOLBE, H. J., *Naturw. Wochens.*, 1889, iv. p. 169, fig.
741. **Carabus perforatus** ♂: from the ventral or plantar surface of the 5th tarsal joint of left hind leg project an extra pair of claw-joints compounded in Position V, each bearing a pair of claws, set back to back. This is a diagrammatic case, well and clearly described by ASMUSS, *Monstr. Coleop.*, 1835, p. 54, Tab. IX.

(2) *Position VAA.*

742. **Feronia (Pterostichus) mühlfeldii** ♀ (Carabidæ): left middle tibia bearing two supernumerary tarsi arising by a common proximal joint (Fig. 156). As in other cases of supernumerary tarsi arising from the tibia, the apex of the tibia itself is really a triple structure, containing parts of the apices of a pair of tibiæ in addition to the normal apex. This is shewn by the presence of three pairs of spurs, &c. The additional parts are in this case anterior and ventral to the normal apex and a complementary pair. All three are completely blended together, forming in appearance a single apex. The relations of the three component parts are almost exactly those indicated in the Scheme for the Position VAA.

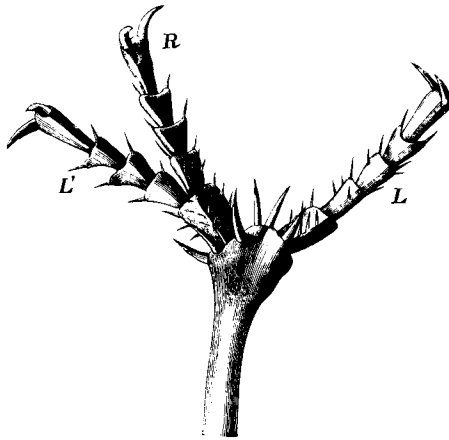


FIG. 156. *Pterostichus mühlfeldii*, No. 742. Semidiagrammatic representation of the left middle tibia bearing the extra tarsi upon the antero-ventral border of the apex. *L*, the normal tarsus; *R*, the extra right; *L'* the extra left tarsus. (The property of Dr Kraatz.)

The two extra tarsi (*R*, *L'*) arise by a common proximal joint of double structure having two complete ventral surfaces inclined to each other as in the Position VAA. Peripherally to this the two tarsi are separate. The tarsus which is nearer to the normal tarsus is perfect, and stands in the schematic position. The second joint of the remoter arises in the position shewn for VAA, but its apex is slightly shrivelled and in consequence the remainder of this tarsus, though perfect in size and form is thrown a little out of position. This specimen was kindly lent to me by Dr KRAATZ, and was originally described and figured by him in *Deut. ent. Zt.*, 1877, XXI. p. 56, fig. 21.

743. **Aromia moschata** ♀ (Greece) (Longicorn): right anterior tibia enlarged at apex bearing anteriorly a supernumerary pair

of tarsi. The widened apex bears three supernumerary spurs of which the middle one is thicker than a normal posterior spur. This is no doubt a double spur representing the two *posterior* spurs of the extra tibiæ. The other two extra spurs are ordinary *anterior* spurs. The relative positions of these spurs are exactly those marked VAA in the Scheme. Of the extra tarsi 3 joints only remain and the two tarsal series are so closely compounded that superficially they seem to form one tarsus only. In their first joints the inclination of the ventral surfaces to each other is at an *acute* angle, thus departing from the Scheme, but in the second and third joints, where they are more separate from each other, the inclination is at approximately the same angle as that of the lines joining their respective spurs. Specimen in General Collection of the British Museum.

744. **Carabus græcus** ♀: trochanter of right middle leg bears a supernumerary pair of legs having trochanter, femur, tibia and 1st tarsal joint common. The coxa of the normal leg is enlarged and the trochanter has two heads, of which the anterior belong to the extra pair of legs. The femur of the extra pair is a single piece but is morphologically double, presenting *two structurally anterior surfaces and two structurally ventral surfaces*, the latter being inclined to each other at an angle of about 120° . From the apex of this femur there arises a double tibia, also composed of two anterior and two ventral surfaces. This fact is especially clear in the case of the tibia and is proved by the arrangement of the spines and spurs. In a normal tibia there are two spurs, one posterior and one anterior, and the posterior spur is longer than the anterior. Now in this tibia there are *three* spurs, two shorter ones at either margin of the apex, and *one longer one with a bifid point* between them, which is clearly therefore *a pair of posterior* spurs not completely separated from each other. This view of the structure of the double tibia is equally evident from the arrangement of the remainder of the spines on its surfaces. In it the inclination of the ventral surfaces is about the same as in the femur, but is perhaps rather more acute. The 1st tarsal joint is similarly a double structure. Its apex presents two articulations, but while the posterior bears a complete 4-jointed continuation, the anterior bears only a single aborted joint, from which possibly some portion has been detached, but this is not certain.

The relations of the parts are a little obscured by the fact that the normal tibia is slightly bent. The double part of the trochanter lies very nearly anterior to the single part but it is also somewhat *dorsal* to it. This gives to the base of the double femur a trend dorsalwards: but from the base the femur curves ventralwards so that the nett result is that its apex is actually ventral to the apex of the single femur when both limbs are extended. This curve of course gives the femur an abnormal form which is increased by the fact that it is perceptibly shorter than the single femur. Now the relative position of the pair of extra limbs is that marked VAA, and as it stands when extended the apex of the double femur and the peripheral parts of the double limb stand in the Position VAA with regard to the single limb;

but as has been mentioned, by the curvature of the double femur its base is somewhat dorsal to the single limb. This specimen was very kindly lent to me by Dr L. VON HEYDEN and was first described and figured by him in *Deut. ent. Zt.*, 1881, xxv. p. 110, fig. 25.

(3) *Position A.*

- *745. **Eurycephalus maxillosus** (Longic.): right anterior femur divides at base into two parts, of which the posterior bears a normal leg. The other part of the femur is *bilaterally symmetrical*, being made up of the anterior surfaces of two femora, for both sides present the same convexity (Fig. 157), neither being flattened as the posterior surface of a normal first femur is. With the apex of this joint articulates a bilaterally symmetrical tibia of extra width, bearing a 1st and 2nd tarsal joint, each of nearly double width.

The 2nd tarsal joint bears two 3rd tarsal joints, which are both much wider than the normal 3rd joint of the tarsus. (This is exaggerated in the diagram.) One of these in 1891 bore a perfect terminal joint with a pair of claws; but the terminal joint and claws of the other side were gone, though Mocquerys' figure shews that they were originally present. Mocquerys' statement that "*la cuisse antérieure du côté droit se bifurque dès son origine en deux branches ayant chacune le volume d'une cuisse normale*" is misleading, as suggesting that the two femora are similar, while upon closer examination they are seen to be dissimilar. Here a pair of extra legs arising from the anterior surface of the normal limb, are compounded together as in the position marked A in the Scheme. Specimen originally described by MOCQUERYS, *Col. anorm.*, 1880, p. 54, fig.

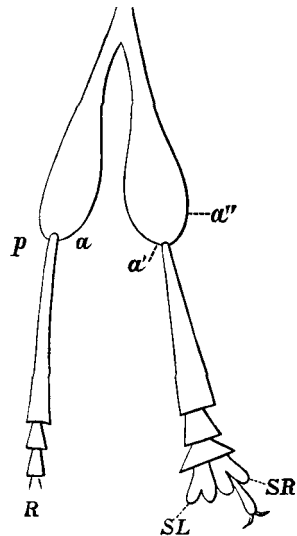


FIG. 157. *Eurycephalus maxillosus*. Right anterior leg bearing an extra pair arising from the femur. R, the normal right. SL, supernumerary left. SR, supernumerary right. p, posterior surface. a, anterior surface of normal femur. a', a'', the two structurally anterior surfaces of the extra legs. (In Rouen Mus.)

- *746. **Eros minutus** (Malacoderm): right anterior tibia slightly divided at apex, forming two apices (Fig. 158). The posterior apex bears a normal tarsus. The anterior apex bears a double tarsus having the first three joints simple (3rd being enlarged). The 4th joint is of nearly double width and bears peripherally two claw-joints each with a pair of claws. From the structure

of these it was clear that they are a *pair*. When extended the three plantar surfaces are not truly in a horizontal plane, as they

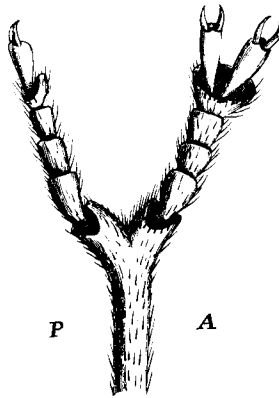


FIG. 158. *Eros minutus*, No. 746. The right fore leg seen from dorso-posterior aspect. P, posterior face. A, anterior face. This figure was drawn from the microscope and has been reversed. (From a specimen the property of Dr Mason.)

should be in Position A, but they are nearly so. This deviation is exaggerated in the figure. Specimen very kindly lent by Dr MASON.

747. **Aleochara mæsta** (Staph.): middle left tibia has two articulations at apex. The posterior bears a tarsus normal in form but without claws. The anterior bears an extra tarsal series with a *pair* of rudimentary terminal joints, each having a pair of claws. Of this double tarsus the 3rd and 4th joints are not distinctly separated. The parts are in Position A. Specimen kindly lent by Dr MASON.
748. **Meloe proscarabæus** ♂ (Heteromera). The apex of the femur of right hind leg is extended on the anterior side so as to form a second apex in the same horizontal plane. With this second apex articulates the common head of a pair of extra tibiae each bearing a complete tarsus. As usual they are a right and a left respectively. The two extra legs are twisted out of their natural position so that they turn their ventral surfaces upwards. The tibia which in origin is remoter from the normal tibia is moreover bent over the nearer tibia so that it stands actually nearer to the normal tibia. In this way the morphological relations are obscured, but nevertheless on tracing the ventral surfaces up to the point of articulation with the femur it is clear that they arise in the normal position and that they have the relations marked in the Scheme for the Position A, which is their position of origin. As this case is a somewhat obscure one, I may add that Dr Sharp, who has kindly examined this specimen, gives me leave to state that he concurs in the above description. This is the specimen described by von HEYDEN, *Isis*, 1836, ix. p. 761 and by MOCQUERYS, *Col. Anorm.* p. 52, *fig.*, and was kindly lent to me by Dr L. von HEYDEN in whose possession it remains.
749. **Cetonia opaca** (Lamell.): [right fore leg bears a pair of extra terminal tarsal joints very nearly in Position A, arising from 4th tarsal joint. All the claws are turned ventralwards, but those of the extra joints are turned away from each other as well as downwards]. MOCQUERYS, *l.c.*, p. 61, *fig.*
- *750. **Prionus coriarius** ♀ (Longicorn), having parts of a supernumerary pair of tarsi arising from the middle right tarsus, and also a similar double structure arising from the posterior

right tarsus (Fig. 159). This is a very important case as a clear

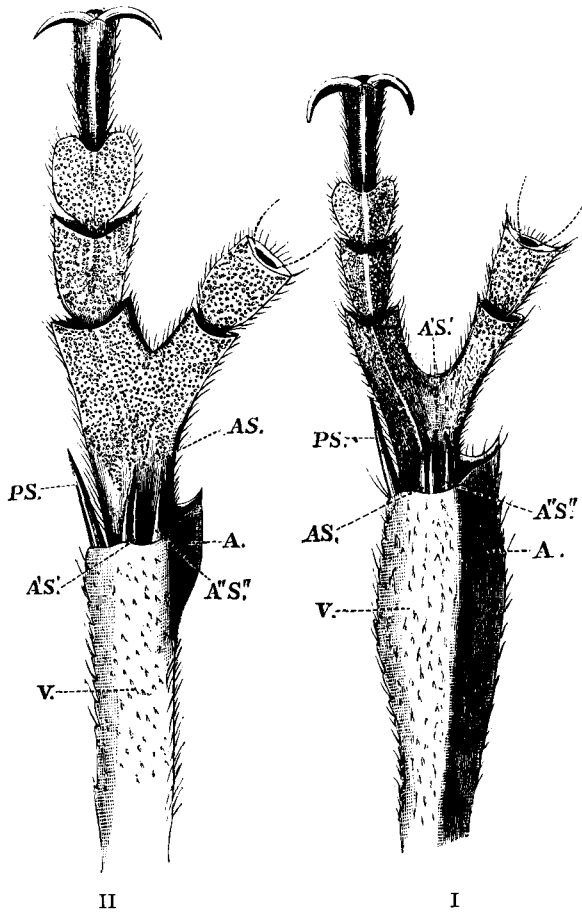


FIG. 159. *Prionus coriarius*, No. 750. I. Apex of tibia of right hind leg with its tarsus. II. Similar parts of right middle leg. (The property of Dr von Heyden.) PS, AS, posterior and anterior tibial spurs belonging to the normal leg. A'S', A''S'', the spurs of the extra legs, all structurally anterior spurs. A, anterior surface. V, ventral surface. (The property of Dr von Heyden.)

illustration of the mode in which double supernumerary limbs may be compounded together so as to closely simulate a single limb. Each of the extra parts in this case in the original account was described as a *single* extra limb, but as will be shewn, each is really composed of parts of a complementary pair. Cases of this kind suggest very strongly that other cases of supposed single extra limbs are really instances of double extra limbs in which the duplicity is disguised.

Right hind leg (Fig. 159, I), the tibia is dilated towards the apex which presents dorsally two emarginations instead of one as usual. On the ventral aspect of the apex there are two whole spurs *PS*, *A''S''* and a double one *AS*, *A'S'*, between them.

These spurs give the key to the nature of the structure. The proximal tarsal joint gives off a process on its anterior side and is then continued to bear a normal termination as shewn in the figure. The process from the first tarsal bears a second tarsal from which the termination has been broken off. The extra parts are as in the figure, being covered ventrally from edge to edge with papillæ, and having *no longitudinal cleft* in the middle line like the normal tarsus.

Looking at these tarsal joints alone, the real nature of the extra parts does not appear, for the anterior and posterior surfaces of the normal tarsi are not differentiated from each other, and hence it is not possible to say of what parts the supernumerary limb is made up. Fortunately, however, the tibial spurs are normally distinguishable from each other, for the anterior spur is a short spur while the posterior is a long thin spur. Now the spurs present in this case are firstly *one* long posterior spur *PS*, and then *three short anterior* spurs, of which two are united for part of their length *AS*, *A'S'*. *The extra spurs are thus both anterior spurs*, that of the extra tarsus which is nearer to the normal being united to the normal anterior spur. Hence this case is a case of a supernumerary pair of appendages compounded together in the Schematic Position A, having the posterior surfaces adjacent and suppressed.

Right middle leg. (Fig. 159, II.) In this case there would have been more difficulty in making out the real nature of the parts; for in the normal middle leg the anterior spur is not so much differentiated from the posterior one as it is in the hind leg: but having this case for comparison it is easy to see that this also is a case of a pair of appendages similarly compounded in Position A. This case differs from that of the hind leg in the fact that the parts are not so fully formed, and especially the anterior spur of the nearer extra tarsus is scarcely separated from the anterior spur of the normal. By turning the specimen over in the light however, its form can be made out to be that shewn in the figure. When the specimen was received by me the parts present were as shewn in the figure, but when originally described by VON HEYDEN there was a third joint in the extra appendage which was small and elongated, and to all appearance it was the original termination and nothing had been broken off. For the loan of this specimen I am indebted to Dr L. VON HEYDEN, who originally described and figured it in *Deut. ent. Zt.*, 1881, xxv. p. 110, *figs.* 27 and 28.

In the two following cases there was nothing to differentiate

the normal limb from the two supernumeraries, and the Position may either have been P or A.

751. **Fœnius tarsatorius** (Ichneumon): tibia of left posterior leg bears a pair of supernumerary limbs. This is rather a remarkable case by reason of the great similarity in the modes of origin of the three limbs, whence it is difficult to determine positively which is the normal one. The tibia divides into three parts which lie in a horizontal plane and are separate from each other for about $\frac{1}{3}$ of the length of the tibia. Of these the anterior is a good deal more slender than the other two which are similar and about of normal size. The middle of the three is shewn by its spurs to be a *right* limb. Each bears a complete tarsus. The ventral surface of the most anterior tibia is horizontal while those of the other two are not quite so, but converge downwards at a very obtuse angle. From this fact, and from the equality in size between them, it seems probable that the two posterior limbs are the supernumerary pair. The Position is therefore very nearly P or perhaps A. This specimen was described by Mr HARRINGTON in *Can. Ent.*, 1890, p. 124, who was so kind as to lend it to me.
752. **Agestrata dehaanii** (Lamellicorn): the coxa of the right anterior leg has two articulations, one anterior and the other posterior. With the anterior there articulates a single trochanter, bearing a normal right leg. The posterior articulation bears a large structure which is composed of two trochanters united together. This double trochanter bears two legs and is placed in such a way that the two do not lie in the same horizontal plane; but the posterior extra leg is in the same horizontal plane as the normal leg while the anterior extra leg is wedged out towards the ventral surface, between the normal leg and the posterior extra leg. The posterior extra leg is a normally shaped right leg having its structurally anterior surface forwards as normally. The anterior extra leg is fashioned as a *left* leg and the surface of it which is structurally anterior faces backwards towards the other extra leg. These two are therefore a complementary pair, having their structurally anterior surfaces adjacent: all three legs are normal and similar in form, size and colour. [Specimen kindly lent by Mr E. W. Janson.]

(4) *Positions DAA and DA.*

- *753. **Cerambyx scopolii** (Longicorn.): pair of extra legs arising from the coxa of the right anterior leg. As this is a remarkably simple and perfect case it will be well to describe it in some detail, as it will serve to illustrate the arrangement of such cases in general.

A normal leg of such a beetle as *Cerambyx* consists of coxa, trochanter, femur, tibia and four tarsal joints. To a proper understanding of the mode of occurrence of the extra legs in this case it is essential that the forms of these parts and their mode of movement with regard to the body and to each other should be accurately known.

Of the large, irregularly pear-shaped *coxa* only the hemispherical face is seen from the exterior. It is chiefly enclosed by embracing out-growths from the sternum, forming a socket in which it can be rotated like a ball. Upon its broad, exposed surface it is itself hollowed out to form a socket for the ball of the *trochanter*. For our purposes it is necessary to find some means of distinguishing the anterior face of the coxa from the posterior face. The structure which at once enables us to do this is the process (Fig. 160, *p*), which goes down from the coxa to embrace the neck of the ball of trochanter and lock it into its socket. Now in the case of an anterior leg, this process is *posterior* to the trochanter (but in a middle or hind leg it is *anterior* to the trochanter). The next point to be considered is the position of the *femur*. The

femur itself is flattened antero-posteriorly, having two broad surfaces, morphologically anterior and posterior, and two narrow surfaces which are extensor and flexor surfaces, or morphologically dorsal and ventral.

By rotation of the coxa the whole leg may assume a great variety of positions, and it is thus of the utmost consequence that the nature of the surfaces be truly recognized. If the front leg be placed with the

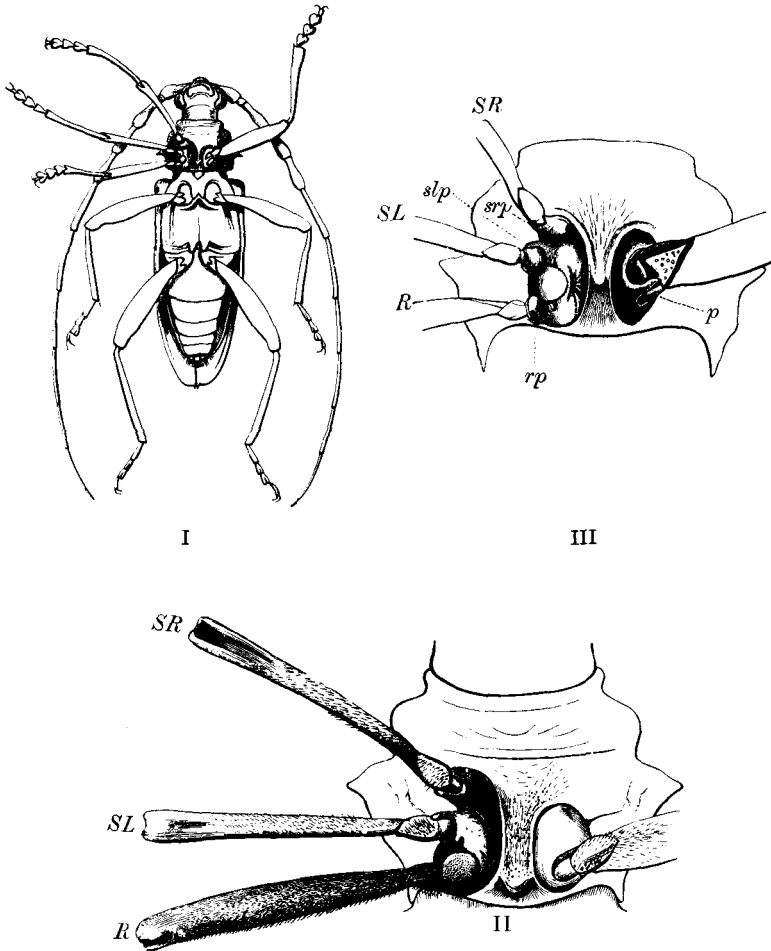


FIG. 160. *Cerambyx scopolii*. No. 753. I. The whole beetle seen from ventral surface. II. Details of right anterior coxa bearing extra trochanters and legs. In this figure the legs are rotated so as to shew that *SR* is an image of *SL*. III. The same, placed so as to shew that *SL* is an image of *R*.

p, process of coxa locking in the trochanter. *srp*, *slp*, corresponding processes for the extra trochanters. (From a specimen belonging to M. H. Gadeau de Kerville.)

femur at right angles to the body it may either be placed so that the ventral surface is downwards, or by rotation of the coxa through 90° the broad posterior surface may be downwards. The rotations of the middle and hind legs are complementary to this.

In the abnormal specimen the extra pair of legs arise from the anterior side of the normal coxa, forming with it a solid mass and preventing its free rotation in its socket, so that the normal leg can scarcely be moved from the first position with the ventral surface downwards. The common coxal piece is about half as large again as the normal. Posteriorly it bears the trochanter of the normal leg, which is of full size and of proper proportions. The process of the coxa locking in the ball of the trochanter is *posterior*, as in the normal front leg.

Anteriorly the legs *SL* and *SR* articulate with the coxa by separate trochanters. Each is separately closed in by a process of the coxa, *slp* and *srp*, respectively. Of these processes that of the leg *SR* is *posterior*, but that of *SL* is *anterior*. Hence the two legs are complementary to each other, and *SR* is a *right* leg while *SL* is a *left*. This complementary relation is maintained in all the other parts of these legs. In size the two extra legs are rather more slender than the normal leg.

It was explained in the introduction to the subject of supernumerary legs that the relations of form between them depend upon the surface of the normal leg from which they arise. Here the point of origin is chiefly anterior to the normal leg, but is also slightly nearer to the extensor or dorsal surface of the coxa. This is not at first sight evident owing to the rotation of the normal leg due to the great outgrowth from its anterior surface; but nevertheless if the plane of the ventral surface of the normal femur were produced, it would pass ventrally to the ventral surface of the remoter extra leg *SR*, and therefore this leg is morphologically dorsal to the leg *R*. The positions of the extra legs are approximately those of the Scheme for the radius marked DAA, and while the surfaces of *SR* are parallel to those of *R* when both are extended, the surfaces of *SL* are inclined slightly to them as in position DAA. In the enlarged Figure III the coxa is rolled forwards so as to exhibit the relation of images between *R* and *SL*, and the figure II shews the coxa rolled back to shew the similar relation between *SR* and *SL*.

For the loan of this beautiful specimen I am greatly obliged to M. Henri Gadeau de Kerville.

754. **Harpalus rubripes** (Carabidæ): left posterior tibia bears a supernumerary pair of tarsi. The apex of the tibia is widened and presents two articulations, of which the posterior bears a normal tarsus. The anterior articulation bears a pair of complete tarsi having proximal joints compounded. The two extra tarsi are a complementary pair, the posterior being fashioned as a *right*. The surfaces adjacent in these two tarsi are structurally posterior surfaces, but they are a little supinated, so that the ventral surfaces are also partly turned towards each other. The position of origin and the relations of the surfaces to each other are almost exactly those which are

indicated in the Scheme for the position DAA. This specimen was described by M. A. FAUVEL (*Rev. d'Ent.*, 1889, p. 331) and was kindly lent by him for further examination.

755. **Chrysomela banksii** (Phytophagi): right hind tibia bearing an extra pair of tarsi. The border of the tibia which corresponds in position to the ventral or flexor border of the normal tibia is covered with the hairs which characterize it in the normal limb; but the opposite border of this abnormal tibia is similarly covered with hairs, shewing that the anterior parts of at least two tibiae are included in it. A rigid process projects from the wide apex of the tibia. Upon the inner side of this process is the articulation for the tarsus, which from its direction and position appears to be the normal tarsus of the limb. Outside the process articulates a slightly smaller tarsus, which from its form and from the plane in which it moves is a *left* tarsus, flexing away from the normal one. At a point slightly external to this is the third tarsus, which is again a *right* tarsus and moves in a plane complementary to the middle one. The two are therefore a pair. The position of origin is anterior and dorsal, being nearly that marked DA, but the relative positions of the extra tarsi are approximately DDA. As to the nature of the tibial process I can make no conjecture. (Fig. 161.)



FIG. 161. *Chrysomela banksii*, No. 755. View of right hind tibia from posterior surface. A normal right hind tibia is shewn for comparison. (From *Proc. Zool. Soc.*, specimen the property of Dr D. Sharp.)

This specimen is the property of Dr Sharp, who was good enough to lend it to me. It was briefly described and figured by me *P. Z. S.*, 1890, p. 583, but I was not at that time aware of the complementary relation existing in these cases and failed to notice the somewhat inconspicuous differences which are evidence of it in this case.

756. **Hylotrupes bajulus** (Longic.): right middle tibia bears a supernumerary pair of limbs having proximal parts in common. From the antero-dorsal surface of the base of the normal tibia, there arises a slender tibial piece which is not so long as the normal tibia and bears no spurs. At the apex of this supernumerary tibia, which is doubtless a double structure, articulate a pair of tarsi having their first and second joints compounded together. After the second joint the two tarsi separate from each other and each bears a pair of claws. The relative position of the two tarsi when they separate from each other is almost exactly that marked DA. It should be mentioned that the supernumerary parts central to the 3rd tarsal joints are not fully formed, being deficient in thickness, and the transverse separation between the 1st and 2nd tarsal joints is incomplete. Specimen first described by MOCQUERYS, *Col. anorm.*, 1880, p. 53, fig. I am indebted to Dr L. VON HEYDEN for an opportunity of examining it.

(5) *Position D.*

- *757. **Aphodius contaminatus** ♂ (Lamellicorn.): left middle tibia bearing two supernumerary tarsi which stand very nearly in the position DDP, being rather nearer to D. The relative positions are shewn in Fig. 162. The articular surface at the apex of the tibia is extended along an elongated process which projects on the dorsal side of the tibia. Upon this extension of the apex articulate two extra tarsi. They stand with their ventral or

plantar surfaces facing each other, and the tarsus *RT* is placed so that its dorsal surface is very nearly opposed to the dorsal surface of the normal tarsus *LT*, and the three tarsi thus flex almost in the same vertical plane. It is to be observed, however, that the tarsus *LT* is not actually in the same plane as the other two, but is a little deflected from it so as to flex rather more towards the posterior surface of the line than it would do if it stood actually as *L'T'* stands. This may be made clear by reference to the Scheme (p. 481): for while the two extra tarsi are placed relatively to each other as if they were in the position D, the position of *RT* to *LT* is that which it would have if it stood in DDP.

In this species the middle tibia in the male bears one large spur, namely, the posterior one, while the anterior spur is rudimentary. *PS* in the figure represents the large posterior spur of the normal tarsus *LT*, while a large double spur *RP'S*, *LP'S*, standing posteriorly and between the two extra tarsi represents their two posterior spurs. The double nature of this spur is seen

when it is examined from the anterior side, for upon that surface it is marked by a longitudinal ridge-like suture. This specimen was first described by KRAATZ, *Deut. ent. Zt.*, 1876, xx. p. 378, fig. 13, and I am indebted to Dr Kraatz for an opportunity of examining it.

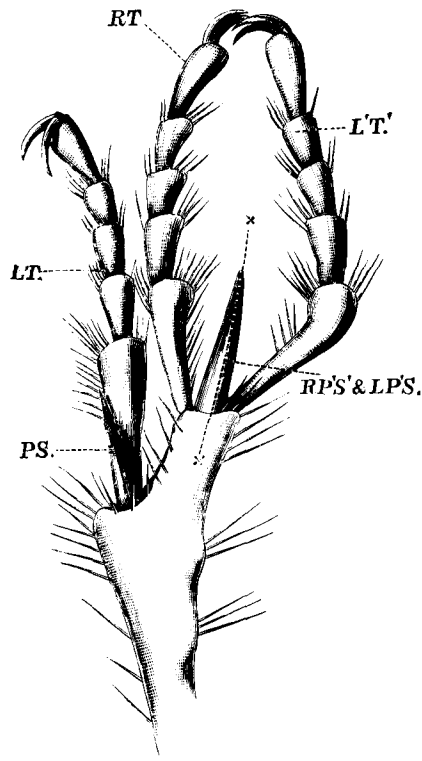


FIG. 162. *Aphodius contaminatus*, No. 757, left middle tibia bearing extra parts. *LT*, normal left tarsus. *RT*, *LT*, right and left extra tarsi. *PS*, normal posterior spur. *RP'S* and *LP'S*, spur representing compounded spurs of *RT* and *LT* corresponding with the single spur *PS* of normal. *x, x*, line of suture between these two spurs. The limb is seen from the posterior surface. (Specimen the property of Dr Kraatz.)

758. ***Galerita africana*** (Carab.): (Fig. 163) right middle leg normal as far as the last tarsal joint, which bears three additional claws arising dorsally to the normal pair. The extra claws are three in number, two of them being small and standing at the anterior border of the limb, while at the posterior border there is one claw of larger size. This larger claw is really a double structure, which is clearly shewn by the

presence of *two* channels on its concave surface. Position of origin is therefore D, while the inclination of the extra pairs of claws to each other is about that required

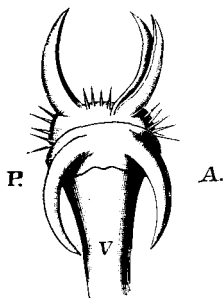


FIG. 163. *Galerita africana*, No. 758. Apex of right middle tarsus. *A*, anterior. *P*, posterior. *V*, ventral. (Specimen in Rouen Mus.)

for the position DDA; for the planes of the two pairs are not parallel but incline to each other at an acute angle. Specimen originally described by MOCQUERYS, *Col. anorm.*, p. 64, fig.

(6) *Position DP.*

- *759. **Pyrodes speciosus** (Longic.); having two supernumerary legs articulating with the thorax by a common coxal joint, which is distinct from the coxa of the left middle leg, but is enclosed in the same socket with it. In this remarkable case the normal leg is complete, though slightly pushed towards the middle line. The socket in the mesothorax is enlarged posteriorly and dorsally so as to form an elongated, elliptical articulation, which lies obliquely, so that its ventral end is anterior to its dorsal end. The anterior and ventral end is occupied by the coxa of the normal leg, while the coxal joint of the two extra legs fills the space dorsal and external to it. Both are capable of being moved independently in the relaxed insect. The extra legs articulate with their coxa by a common double trochanter which has two apices, from which point the legs are distinct. Their position is dorsal and posterior to the normal leg, being practically that marked DP in the Scheme, and the relative positions of the extra legs are very nearly those indicated for the Position DP. The leg nearest the normal leg is of course a *right* leg in structure, and its plantar and a little of its *structurally anterior* surfaces are turned posteriorly. On the other hand, the remoter leg is a true left leg and the ventral surface of its femur is placed almost exactly horizontally. All three legs are complete, but they are a little shorter and more slender than the middle leg of the other side.

This specimen is in the Hope Collection at Oxford.

- *760. **Carabus irregularis** ♀; left middle leg and right hind leg bearing supernumerary tarsal portions. In the *left middle leg*, Fig. 164, I, the 2nd tarsal joint is short and thick; the 3rd joint is partially double, as shewn in the figure. One of its apices bears a tarsus of reduced size, and the other apex, which is *postero-dorsal*, bears a double tarsus having common 4th and 5th joints. The 5th joint of the latter bears two pairs of claws which curve ventrally and partly *towards* each other. The figure I shews the appearance from the ventral or concave side of the claws, while the figure II is drawn from the convex or dorsal side. The disposition and small number of the spines on the ventral side of the extra 5th joint shew that the ventral surfaces are partly suppressed, and in fact that the surfaces which are adjacent in the extra tarsi are in part *ventral* surfaces. This view is also borne out by the direction and curvature of the claws. Relatively to each other and to the normal the extra parts have nearly the Position DP.

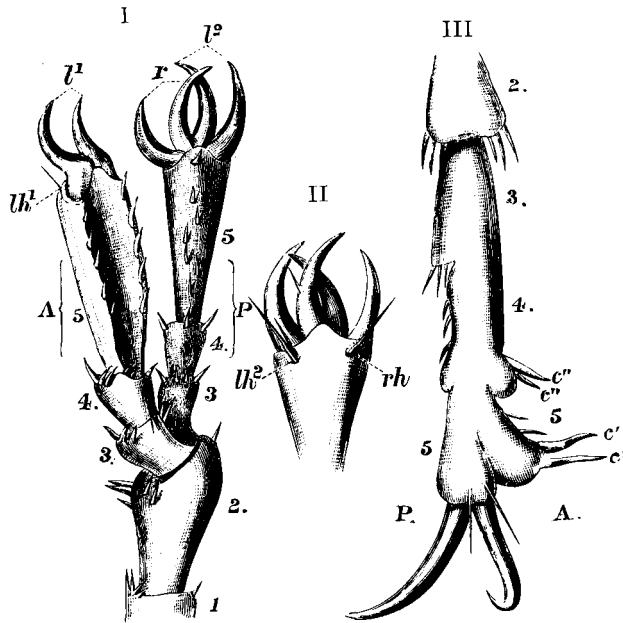


FIG. 164. *Carabus irregularis*. I. Semi-diagrammatic view of left middle leg from antero-ventral surface. r , l^2 , the claws of normal left tarsus. r , l^2 , claws of extra tarsi compounded together. lh^1 , hair marking the dorsal surface between the claws. A , anterior. P , posterior. II. Dorsal view of apex of extra tarsus rh , lh^2 , two hairs marking dorsal surfaces. III. Dorsal view of right hind leg. $c'c'$, $c'c'$, claw-like spines, perhaps representing extra claws. (Specimen the property of Dr Kraatz.)

The *right hind tarsus* has the form shewn in Fig. 164, III. The 3rd, 4th and 5th joints are not fully separated from each other. Both the 4th and 5th joints bear extra parts, but their nature is obscure. The 5th joint is partly double, and the anterior part bears two shapeless claw-like spines ($c'c'$). The 4th joint bears a similar pair of claw-like

structures of smaller size (*c''c''*). Probably these should be considered as rudiments of extra tarsi; but if this view is correct, it appears that two extra tarsi are present, arising from different joints. For the loan of this specimen I am indebted to Dr G. KRAATZ, who first described and figured it in *Deut. ent. Zt.*, 1877, XXI. pp. 57 and 63, fig. 27.

761. **Chrysomela graminis** (Phytophagi): the femur of the right middle leg bears a supernumerary pair of legs attached to the posterior and dorsal side of its apex. At this point there is an articulation with which the single proximal part of the extra pair of tibiæ articulates. This piece, which is common to the two supernumerary tibiæ, is a sub-globular, amorphous mass from which the two tibiæ diverge. Each of the two tibiæ bears a complete tarsus, except that the most posterior has only one claw. In colour the two supernumerary tarsi differ from the normal, being brown instead of metallic green, but the tibiæ are normal in colour. From the shape of the articulations and the arrangement of the pubescence, it is clear that the surfaces of the legs which are naturally adjacent are constructed as posterior surfaces, and the forms of the two are complementary to each other, the hindmost of the extra legs being formed as a left leg, while the foremost is a right leg. As they stand, however, the two tibiæ are not in the same position relatively to the body, for the foremost is placed normally, having its plantar surface turned downwards, but the hindmost is rotated so that its plantar surface is partially turned forwards. The relative positions are nearly those marked DP in the Scheme, but the most posterior tarsus is more rotated than it should be according to that diagram. This condition may be to some degree connected with the presence of the amorphous growth at the base of the extra tibiæ. This specimen was kindly lent for description by Dr Mason.
762. **Pimelia interstitialis** (Tenebrion.): left posterior femur bears two supernumerary tibiæ arising from the postero-dorsal surface of its apex. These two are a pair, for the tibia nearest to the normal tibia is a *right* tibia, the remoter being a left. The adjacent surfaces are chiefly anterior surfaces in structure, but the ventral surfaces are inclined to each other at an obtuse angle. The position of the extra legs is almost that marked DP in the Scheme, but the inclination of the ventral surfaces of the extra legs is rather more acute than it would be in the Position DP. The tarsi are all broken off. Specimen originally described by MOCQUERYS, *Col. anorm.*, p. 44, fig.
763. **Acinopus lepelletieri** (Carab.): two extra legs arising from posterior surface of base of femur of *l.* middle leg. From position it seems that the most anterior is the normal, but this is doubtful. The arrangement is nearly that of Position DP, but as one of the femora is constricted and bent, the relations are rather irregular. Specimen first described by MOCQUERYS, *Col. anorm.*, p. 41, fig.

(7) *Position P.*

- *764. **Silis ruficollis** ♂ (Malacoderm): right anterior femur bearing a supernumerary limb (Fig. 165). The coxa and trochanter normal. The femur is of about twice the antero-posterior thickness of a normal femur and at its apex presents two articulations in the same horizontal plane. Of these the anterior bears a normal tibia and tarsus, but the posterior bears an extra tibia which appears at first sight to be a single structure. This tibia is more slender than the normal one and is provided with four tarsal joints, the terminal one being withered and without claws. Upon closer examination it is found that this extra tibia is in reality made of the *posterior surfaces of a pair of tibiæ* not separated from each other. In this case the morphological duplicity of the extra tibia is capable of proof. For, as shewn in Fig. 165, II, the normal tibia is not bilaterally symmetrical about its middle line. On the contrary the anterior surface is differentiated from the

posterior by several points. This may be seen in the spurs at the apex of the tibia, for the anterior spur (*a*) is long, but the

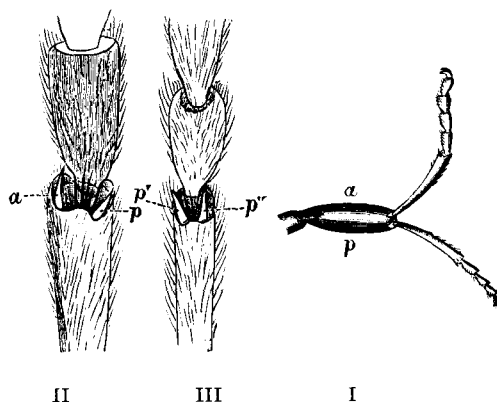


FIG. 165. *Silis ruficollis*, No. 764. I. The right anterior leg seen from ventral surface. *a*, anterior. *p*, posterior. This figure was drawn with the microscope and is reversed. II. Detail of apex of tibia of the anterior or normal tibia, shewing *a*, the anterior, and *p*, the posterior spurs. III. Similar detail of apex of the tibia of the extra limb, shewing *p'* and *p''*, two structurally posterior spurs.

posterior (*p*) is short (as is usual in the *front* leg of many beetles). The hairs on the surface of the tibia are also directed asymmetrically and the parting or division between them is not median, but is nearer to the anterior border (see figure).

But in the extra part there is no such differentiation, and *both surfaces are structurally posterior surfaces*. The hairs part in the middle, and both spurs (*p'*, *p''*) are formed as posterior spurs. This extra structure is therefore made up of the two posterior borders of a right and a left tibia compounded together in Position P. (See diagram, Fig. 165, II.)

This specimen was found by Dr Sharp amongst a number of insects collected by myself in his company at Wicken Fen on Sunday¹, July 26, 1891.

Such a case taken in connexion with others (*e.g.* No. 801) makes it certain that many cases of supposed "single" extra appendages are really examples of *double* extra parts.

¹ A day or two before, the manuscript of this part of the subject had been put by with the remark that no good opportunity of thoroughly investigating a case of "single" extra leg had occurred, but that it could scarcely be doubted that traces of duplicity would be found in them. Considering the great rarity of extra appendages in Insects, and remembering that even of the whole number very few are of the supposed "single" order, I have thought the occurrence of this capture a coincidence of sufficient interest to be worthy of mention. Dr Sharp tells me that amongst all the beetles that have gone through his hands only one case of extra appendage (No. 755) was seen.

765. **Scarites pyracmon** (Carab.). At base of posterior face of the trochanter of left normal front leg, immediately above the cotyloid articulation was implanted an elongated lanciform joint. This joint was directed backwards and represented a pair of trochanters compounded by their anterior surfaces. With each of the two apices of this double trochanter was articulated a complete leg, in all respects formed as an anterior leg. The two moved as a complementary pair. [Details given. This is one of the earliest and best described cases. ASMUSS¹ in quoting it points out that the description and figure plainly shew that the two extra legs were a pair, a right and a left, respectively. They were in fact a pair, arising from the posterior surfaces of the normal leg, and presenting their anterior surfaces to each other.] LEFEBVRE, A., *Guérin's Mag. de Zool.*, 1831, *Tab.* 40.

766. **Geotrupes mutator** (Lamellicorn): two supernumerary limbs arising from femur of right anterior leg. Femur greatly widened, upon posterior border giving off a large prominence which divides into two processes at right angles to each other. Each of these processes bears a normal tibia and tarsus, but the foremost of these tibiæ is shaped as a left tibia, having its serrated border placed anteriorly, while the other extra tibia is formed as a right tibia, having its serrated border placed posteriorly. [The pair of limbs arise from the posterior surface of the normal limb and have their anterior surfaces adjacent, as in Position P.] FRIVALDSKY, J., *Term. Füzetek.*, 1886, x. p. 79, *Pl.*

767. **Pterostichus lucublandus** ? (Carabidæ): third tarsal joint of left middle leg at apex presents wide articular surface. On this stands a triple 4th joint, made up of a single anterior portion, bearing the rest of the normal tarsus and a posterior portion, double in structure, the two parts being completely united. The single anterior part of this 4th joint bears a normal 5th joint with claws. The double posterior part of the 4th joint bears a pair of separate 5th joints, each having a pair of claws. Of these the anterior is perfect, but the peripheral part of the posterior 5th joint is crumpled, so that its claws are twisted out of position, but at its base it stands exactly as the normal 5th joint, and as the 5th joint of the anterior extra tarsus, all three being in the same horizontal plane. These extra parts, therefore, are in the Position marked P in the Scheme and have the relations there indicated for that position. This specimen was kindly lent to me by Mr HARRINGTON, who first described it *Can. Ent.*, 1890, xxii. p. 124.

(8) *Positions VPP to VVP.*

*768. **Ceroglossus valdiviæ**, Chili (Carabidæ): left anterior tibia bearing a pair of supernumerary legs. The tibia widens, and in its middle part gives off posteriorly and ventrally a wide branch having the form of a pair of tibial apices compounded together. The double tibia bears two tarsi (Fig. 166, *R', L'*) having a common proximal joint, but these have unfortunately been broken, two joints being missing from the one and three from the other. The legs are a right and left as usual, and they stand in the relative positions marked VPP in the Scheme. This is a very simple and striking case, for the animal is of good size and the parts are well formed. The two tibial spurs which are adjacent in the two extra tibiæ are compounded so as to form a double spur with two points as shewn in the figure. As shewn for the Position

¹ *Monstrositates Coleopterorum*, 1835, p. 44, *Pl.*

VPP in the Scheme, the *compounded* parts of the extra appendages, viz., the double tibia and the double first tarsal joint have two complete ventral surfaces inclined to each other at an obtuse angle, while there are only two *halves* of dorsal surfaces.

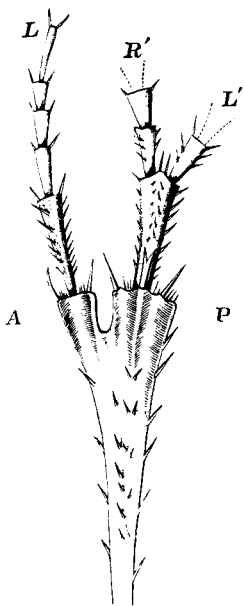


FIG. 166. *Ceroglossus valdivia*, No. 768. Left anterior tibia with extra parts seen from the ventral surface. *L*, the normal left tarsus. *R'* and *L'*, the extra tarsi, compounded in their proximal joint. *A*, anterior. *P*, posterior.

Note that the anterior spur of the normal is curved and that the double spur representing the two anterior spurs of the extra tibial apices has thus a bifid point. (Specimen the property of Mr E. W. Janson.)

Similarly there are two structurally posterior surfaces, but no structurally anterior surfaces, for these are adjacent and undeveloped. This specimen was kindly lent by Mr E. W. JANSON.

769. **Silpha nigrita** (Heteromera): from right middle femur arises a pair of legs which are completely united as far as the apex of the last tarsal joint. The point of origin of the supernumerary limbs is on the anterior and ventral border of the femur. The form of the extra limbs is shewn in Fig. 167. The surfaces *V* and *V'* are structurally ventral surfaces. They are turned chiefly forwards, but are inclined to each other at an acute angle. The surfaces, therefore, which are adjacent in this pair of legs, and which are consequently obliterated, are chiefly the morphologically anterior surfaces and to some extent the dorsal surfaces. The plantar or ventral surfaces of the last tarsal joints are inclined to each other rather more obtusely than those of the tibiae, so that the curvatures of the two pairs of claws are very nearly turned forwards as well as away from each other. This is not fully brought out in the figure. The position of origin is about VP, but the claws are in Position VPP. Specimen first described and figured by MOCQUERYS, *Col. anorm.*, p. 43, fig.

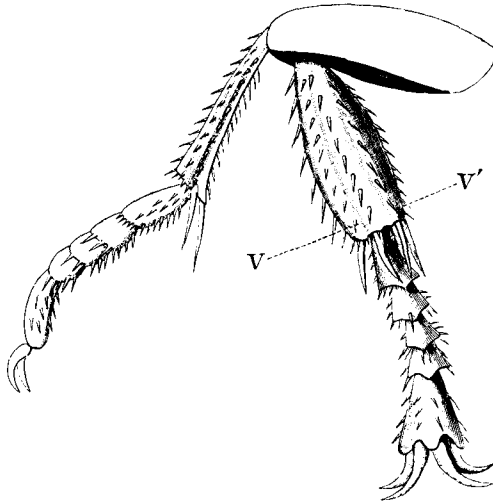


FIG. 167. *Silpha nigrita*, No. 769. Right middle femur bearing a compounded pair of extra legs. *V*, ventral surface of nearer extra leg. *V'*, ventral surface of the remoter extra leg. (In Rouen Mus.)

770. **Tenthredo solitaria** (Sawfly): tibia of right middle leg divides in peripheral third to form two branches, of which the anterior bears the normal tarsus. The posterior branch arises from the postero-ventral surface of the normal and bears a double tarsus consisting of the posterior parts of a pair compounded in Position VP, almost exactly. Tibial spurs as in Fig. 166. The compound tarsus has only 4 joints, the 5th being apparently broken off. In Cambridge Univ. Mus., history unknown.
771. **Telephorus rusticus** (Malacoderm): tibia of left middle leg dilated and somewhat deformed in its peripheral portion. It presents two apical processes, the one anterior and the other posterior. The anterior of these bears a normal, backwardly directed tarsus, but the posterior process bears two tarsi by separate articulations. The anterior of these two tarsi is directed forwards to face the tarsus of the other apex, but the posterior tarsus is backwardly directed. [From its attitude it is clear that the middle of these tarsi is a structure complementary to one of the others, but there is no evidence to shew whether it is a pair to the anterior or to the posterior. Position either VPP, or DAA, probably the former.] KRAATZ, *Deut. ent. Zt.*, 1880, p. 344, fig. 33.
772. **Anthia** sp. (Carabidæ): left posterior tibia bearing two supernumerary tarsi. The postero-ventral side of the apex of the tibia is dilated so as to form a triangular projection, causing the point of articulation of the normal tarsus to be raised upwards. The projection bears two tarsi of which the posterior curves downwards and backwards, being fashioned as a left tarsus while the anterior curves forwards and slightly upwards being a right tarsus. These two tarsi have unfortunately been broken but were presumably complete. The whole apex of the tibia bears five spurs instead of two, but the relation of the spurs to the separate tarsi was not clear. The

tarsi are very nearly in the Position VPP. Specimen very kindly lent by Mr E. W. Janson.

773. **Julodis æquinoctialis** (Buprestidæ): the extra legs arise from the posterior and ventral side of the base of the tibia of left middle leg. They are a pair, and are compounded together by their lateral and dorsal surfaces in such a way that the morphologically ventral surfaces of the two are almost in contact along the anterior border of the compound limb. The ventral surfaces here converge at an acute angle. The two extra legs are compounded together throughout the tibiæ and first 4 tarsal joints. The 5th tarsal joints are free, but only one of them remains. The former presence of the other is only shewn by a socket. The normal tibia is constricted and bent at one point so that it does not stand in its normal position. The femoro-tibial articulation is rigid.

This is a case of a pair of legs compounded as in the position marked VVP in the Scheme but the point of origin is more nearly that of VPP. Specimen originally described by MOCQUERYS, *Col. anorm.*, p. 47 fig.

774. **Metrius contractus** (Carab.) Esch.: specimen in which the middle left femur bears an incomplete pair of legs in addition to the normal one. The femur is of normal length. The tibia of the normal leg is articulated with the end of the femur as usual, but is somewhat shorter, stouter and more curved than the tibia of the corresponding leg of the other side. A supernumerary tibia arises from the posterior [and ventral?] side of the femur a short distance within the apex, and is articulated with it by a separate cotyloid cavity; the two articular cavities for the two tibiæ are confluent, being connected by a groove. The end of this tibia is dilated at its outer end, and bears two articular surfaces, one on each side; with each of these surfaces, a complete tarsus is articulated, nearly normal in form but somewhat stouter than a normal tarsus. There are four terminal spurs to this tibia, two being below the outer tarsus and two being below the inner tarsus. [It therefore seems that this tibia is made up of parts corresponding with the ventral side of a right tibia and the ventral side of a left tibia, and it is hence probable that if the disposition of the claws of the tarsi had been examined, it would have been found that they too were a pair, one being a right foot and the other a left. Position probably VVP.] JAYNE, H. F., *Trans. Amer. Ent. Soc.*, 1880, viii. p. 156, Pl. iv. figs. 3 and 3a.

775. **Aromia moschata** ♀ (Longicorn): right anterior coxa bearing a pair of supernumerary legs having trochanter and the proximal half of the femur in common. The normal leg and the extra ones were all somewhat reduced in size but were complete. The extra leg adjacent to the normal is a left leg. [From the figure it appears that the legs arose in the Position P, or VPP, and their relative positions seem to have been those indicated in the Scheme. Of course it is not possible to state this definitely without examination, but it is clear that there was at least no great departure from the position shewn in the Scheme.] It is remarked that in this specimen the right mandible was abnormally small. KOLBE, H. J., *Naturw. Wochens.*, 1889, iv. p. 169, figs.

(9) *Two cases not conforming to the Scheme.*

Two cases of double supernumerary tarsi require separate consideration. The arrangement in both of these cases departs from that which is usually followed, but it will be seen that there is considerable though imperfect agreement between the two exceptions. Both of these occur in the anterior legs of males of the genus *Calathus*, and it happens that in the normal form the apex of the tibia presents a considerable modification from the simple structure of other beetles. This modification affects the anterior legs only, and is found in several genera of Carabidæ, being especially pronounced in *Calathus*.

In order to appreciate the nature of these cases it is necessary that the anatomy of the parts should be understood.

The apex of the tibia in the simple form, *e.g.* the second or third leg in *Carabus*, bears two large articulated spurs. The two spurs are ventral to the articulation of the tarsus, and one of them is placed at the anterior border of the tibial apex while the other is posterior. In these unmodified legs both spurs are placed at the same level in the limb, so that the bases of both are in the same transverse section (cp. Fig. 166). In the forms presenting the sexual modification, the anterior spur is of somewhat small size but occupies the same position relatively to the other parts that it does in a simple leg.

The posterior spur however, which is large, does not stand at the same level on the tibial apex, but has, as it were, travelled up the tibia so that it stands at a considerable distance central to the apex, and instead of marking the posterior border of the limb it is placed nearly in the middle of the actual ventral surface. A long channel runs from the posterior spur to the anterior one, and the appearances suggest that the modified form is reached by a deformation of the original apical surface, which is twisted so that the posterior spur is thus drawn up into the secondary position. In the fore leg of a male *Carabus* the beginning of such a change can be seen, but in *Pterostichus* and especially in *Calathus* it reaches a maximum. The change may be briefly described by saying that a section to include the two spurs must be taken in a plane which is oblique to the long axis of the limb instead of transverse to it.

As a result of this modification the morphological surfaces of the anterior tarsus of *Calathus* &c. have a peculiar disposition relatively to the same surfaces of the tibia when compared with other forms. Commonly the ventral surface of the tarsus is parallel to a line taken through the bases of the spurs, but owing to the rotation of the posterior spur into its secondary position this plane is here oblique to the ventral surface of the tarsus. These points will be at once evident if the front leg of a male *Calathus* is examined.

It was laid down as a principle generally followed in cases of double extra appendages, that the three terminations, when extended, stand in the same plane, and the chief feature which distinguishes the two following cases is that the three terminations are not in one plane.

Moreover, though the two supernumerary tarsi are a complementary pair, and together with the normal tarsus are arranged as a series of images, yet in order to produce the arrangement of the present cases the planes of reflexion would not be parallel to each other (as in Fig. 154) but inclined in the manner to be described.

*776. **Calathus græcus** ♂ (Carabidæ): left anterior tibia bearing a pair of supernumerary tarsi compounded together. The diagram, Fig. 169, I, shews, in projection, the relations of the parts round the tibial apex. As has been explained, the posterior spurs P^1 , P^2 and P^3 are really much central to the apex, but they are here represented as if they were projected upon the apex. The head of the tibia is produced posteriorly into a long and narrow process which is formed of the united parts of the two extra limbs and bears the articulation common to the two extra tarsi. The two tarsi stand with their ventral surfaces almost at right angles to each other, but the united dorsal surfaces are almost in a continuous plane. The fifth joints alone are separate, that of RT being small (Fig. 168).

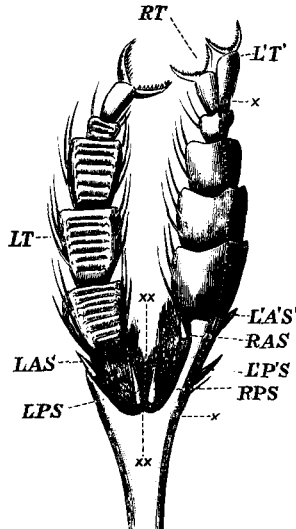


Fig. 168. *Calathus græcus*, No. 776. Left anterior tibia bearing a double extra tarsus. LT, normal tarsus. RT, L'T, extra pair of tarsi. LAS, LPS, normal anterior and posterior spurs. L'A'S', L'P'S', anterior and posterior spurs belonging to L'T. RAS, RPS, anterior and posterior spurs belonging to RT. x, x, dotted line indicating plane of morphological division between extra tarsi. xx, xx, plane of division between the normal and RT. (Specimen the property of Dr Kraatz.)

In studying this case one source of confusion should be specially referred to. It is seen that though the origin of the extra tarsi is posterior to the normal tarsus, the extra tarsi are as a fact united along their morphologically posterior borders. Nevertheless the position of the spurs shews that it is the anterior surfaces which are morphologically adjacent to each other, for the spurs are arranged in the series A^1P^1 , P^2A^2 , A^3P^3 , and the union of the posterior borders of the tarsi is a result of the modification in the form of the tibia consequent on the rotation of the posterior spur.

To produce the arrangement here seen, the planes of reflexion would be M^1 and M^2 respectively, and these are almost at right angles to each

other. The present case therefore is very different from those hitherto described, for in them the planes of reflexion were nearly or quite parallel. Whether this difference in the Symmetry of the extra parts may be connected with the departure of the normal tibia from its own customary symmetry cannot be affirmed, but such a possibility should be borne in mind.

This specimen was kindly lent to me by Dr G. KRAATZ, who first described it in *Deut. ent. Zt.*, 1877, XXI. p. 62, fig. 23.

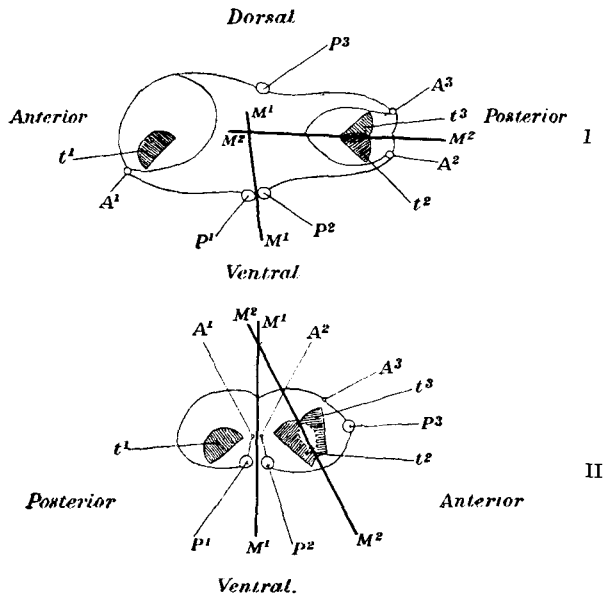


FIG. 169. I. Ground-plan of tibial apex of *Calathus græcus*, No. 776. II. Similar ground-plan of the tibial apex of *Calathus cisteloides*, No. 777.

In each case the spurs are conceived as projected upon one plane. t^1 , the normal tarsus. A^1 , P^1 , its anterior and posterior spurs. t^2 , A^2 , P^2 , similar parts of nearer extra tarsus. t^3 , A^3 , P^3 , similar parts of remoter extra tarsus. M^1 , plane of reflexion between t^1 and t^2 . M^2 , plane of reflexion between t^2 and t^3 .

- *777. **Calathus cisteloides** ♂ (Carabidæ): right anterior tibia bearing a pair of supernumerary tarsi compounded together. In this case the extra parts were anterior to the normal tarsus. The parts were arranged as in the diagram, Fig. 169, II, which is a projection of the tibial apex. The apex is produced anteriorly so as to form a wide expansion which bears the common articulation for the double tarsus. This produced portion is of course formed by the composition of parts of a pair of tibiæ. It is noticeable that the three tibial apices which enter into the formation of the general apex are in one respect not actually images of each other. For the angular distances between A^1 and P^1 , and between A^2 and P^2 , are exceedingly small, being far less than in a normal tibia of the species, and in fact the grooves running from each anterior spur to the corresponding posterior one are almost paral-

lel to each other and to the long axis of the tibia. The tarsi t^2 and t^3 separate in the first joint.

The relative positions are shewn in the diagram, and it is thus seen that the planes of reflexion M^1 and M^2 are inclined to each other at an acute angle.

This specimen was kindly lent to me by Dr L. VON HEYDEN and was first described and figured by MOCQUERYS, *Col. anorm.*, 1880, p. 65, *fig.*

It is difficult to observe the two foregoing cases without suspecting that the fact that they deviate from the normal symmetry of extra parts may be connected with the normal modification of the anterior tibia in these *Carabidæ*. It should be remembered that the tibia and tarsus of the unmodified leg of a beetle are very nearly bilaterally symmetrical about the longitudinal median plane of the limb, but in this leg of these forms the symmetry is lost. Possibly then the upsetting of the ordinary rules for the Symmetry of extra parts may follow on this modification. The difference between the two cases moreover is possibly due to the fact that in one the extra parts are on the posterior surface of the leg, while in the other they are on the anterior. Since the normal limb is not bilaterally symmetrical it is reasonable to expect that the results would differ in the two cases. One other case of a pair of extra tarsi in the fore leg of a male *Calathus* is recorded (No. 777 *a*), but insufficiently described. It is to be hoped that a few cases of extra tarsi in the fore leg of male *Calathus* or *Pterostichus* may be found, and it is very possible that such a case even in *Carabus* would help to clear up these points.

77 *a*. **Calathus fulvipes** ♂ (*Carabidæ*): tibia of right fore leg bears pair of extra tarsi. [Fig. and description inadequate.] PERRY, *Mitth. nat. Ges. Bern*, 1866, p. 307, *fig. 5*.

(10) *Nine other cases departing from the Schematic Positions.*

Each of these needs separate consideration.

778. **Platycerus caraboides** (Lucan.): left hind tarsus has form shewn in Fig. 170. The terminal joint had only one claw. *R* and *L'* are presumably the extra pair, but it will be seen that they arise at separate places from the 3rd tarsal joint. Otherwise, they stand approximately in Position V. Described originally by MOCQUERYS, *Col. anorm.*, p. 67, *fig.*

779. **Philonthus ventralis** (Staphylinidæ): third joint of right posterior tarsus bearing supernumerary termination of double structure. The apex of the third joint is enlarged, and at a point anterior and slightly dorsal to the articulation of the normal fourth joint the super-

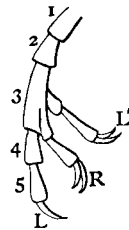


FIG. 170.

Platycerus caraboides, No. 778. Left hind tarsus from posterior surface. *L*, the presumably normal apex, has only one median claw. *R* and *L'*, arise separately from the 3rd joint. (In Rouen Mus.)

numerary parts arise. The fourth and fifth joints of the supernumerary tarsi are of double structure, but are not separated from each other. The double fifth joint bears two pairs of claws, of which the two adjacent members are compounded together at their bases. The plane in which one pair of claws stands is about at right angles to the plane in which the other pair is placed, the opposed surfaces being ventral surfaces. Stated in terms of the Scheme on p. 481, the supernumerary tarsi are placed as in the position DDA, whereas their position of origin is DAA. It is noticeable that the normal fifth joint does not stand quite in its usual position, but is a little twisted so that it partially turns its ventral surface in an anterior direction. This specimen was described and figured by FAUVEL, *Rev. d'Ent.*, 1883, II. p. 93, Pl. II. No. 2. It was kindly lent to me by M. Bleuse, to whom it belongs.

780. **Alaus sordidus** (Elateridæ): Ceylon, femur of right middle leg bears two supernumerary legs arising from its postero-dorsal surface. All three legs are somewhat abnormal in form and the principal femur is partly shrivelled at its base. At a point on the postero-dorsal surface about halfway from the apex there is a large, irregular boss from which the two extra femora diverge. Of these that which is nearest to the normal leg may be distinguished as a *left* leg by the planes of movement of its tibia and tarsus, while the remoter leg is a right leg. The tarsus of the latter is broken but was probably complete. The surfaces which the extra legs present to each other are structurally anterior surfaces, but the relative positions of the three legs do not correspond with any of the positions shewn in the Scheme. It should however be noticed that this fact may be connected with the presence of the amorphous thickening at the point of origin of the extra femora. Specimen in Hope Collection first described and figured by WESTWOOD, *Oriental Entomology*, Pl. xxv. fig. 9, and mentioned *Proc. Linn. Soc.* 1847, p. 346.
781. **Clythra quadripunctata** (Phyt.): left anterior trochanter bears two supernumerary legs. Both the normal leg and the two extra ones are complete. The position of the latter is very peculiar; for, arising from the anterior surface of the trochanter, they turn their structurally dorsal surfaces towards the anterior surface of the normal leg, which thus stands *between* them, one of them being above it and the other ventral to it. Of these that which is placed dorsally is structurally a *right* leg, while the lower one is a *left*, like the normal one. Both the extra legs are also partly rotated so that their ventral surfaces are partially directed *upwards*. From these facts it appears that the position of these extra legs relatively to the normal one does not correspond with any of the positions indicated in the Scheme, and it did not seem to be possible to refer this deviation from the usual arrangement to any special malformation of any of the parts. Specimen originally described by MOCQUERYS, *Col. anorm.*, p. 42, *fig.*
782. **Clytus liciatus** (Long.): right tibia reduced and thickened, being shapeless and bent. Its apex presents two articulations, the one anterior and the other posterior, the latter bearing a normal, 4-jointed tarsus. The anterior articulation bears a slender double tarsus, the two parts of which are compounded in the 1st, 2nd, and 3rd joints but separate in the 4th or terminal joints. The supernumerary tarsi are very

slender and the whole thickness of their common proximal joint is even less than that of the proximal joint of the normal tarsus. The

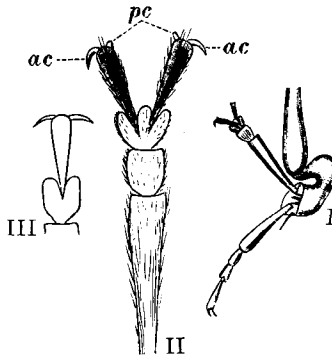


FIG. 171. *Clytus licciatus*, No. 782. I. View of right tibia. II. Detail of the extra parts, from plantar surface. *ac, ac*, claws supposed to be morphologically anterior. *pc*, rudiments supposed to represent posterior claws. III. Enlarged view of the end of the normal tarsus. (The property of Dr Kraatz.)

terminal joints of the extra tarsi are well formed, but they each bear only *one* fully developed claw, the claw of the adjacent side of each being only represented by a rudimentary knob. It appears at first sight that these extra tarsi are at their origin from the tibia only a single appendage and that their double nature only begins from the third joint. This however is not the case, for there are five spurs on the tibia, together with a small brown knob which perhaps represents the sixth spur. The tibia is greatly misshapen and the arrangement of the spurs is so amorphous that I did not succeed in determining their morphological relations. This specimen was kindly lent by Dr KRAATZ, having being first described by him in *Berl. ent. Zt.*, 1873, xvii. p. 433, figs. 17 and 17 a.

783. ***Cryptohypnus riparius*** (Elater.). The tibia of the right anterior leg is enlarged at its apex and bears one very large tarsal joint: this joint has two apical articulations, of which the posterior bears the remaining 4 joints of what is presumably the normal tarsus. The other articulation bears a large tarsal joint, common to a pair of complete extra tarsi. This pair of tarsi stand with their lateral parts closely adjacent and their plantar surfaces downwards, but the other tarsus which is posterior to them, and is presumably the normal, stands with its plantar surface turned *backwards*. This disposition differs considerably from that indicated in the Scheme. For the place of origin of the extra tarsi and their position relatively to each other is A; but the normal tarsus is twisted so that it turns its dorsal surface forwards, towards the posterior surface of the nearer extra tarsus. For this specimen I am obliged to Dr Mason.
784. ***Taurhina nireus*** (Lamell.): right middle tibia bearing two extra tarsi. [In the normal leg of this beetle the tibia is like that of many other Lamellicorns, presenting at its apex two sharp processes, the one anterior and the other dorsal: and ventrally two articulated spines, one anterior and the other posterior to the tarsus. The abnormal tibia of this specimen is considerably widened at its apex, and bears in addition to the normal two processes two other processes of a similar kind separated from each other by a pair of articulated spines. Instead of a single

pair of articulated spines, this tibia bears *five* such spines, of which a pair stand between the two extra processes. The disposition of these spines could not be made clear without several figures. There are two complete tarsi and both have their ventral surfaces turned downwards. The anterior tarsus is somewhat the smaller. I did not succeed in definitely determining the homologies of the parts in this specimen. It should be specially observed that while the tarsi are only *two* in number, suggesting that the supernumerary part is *single*, the spines indicate that there are here at least some elements of further repetition.] Specimen figured by KRAATZ, *Deut. ent. Zt.*, 1889, xxxiii, p. 221, fig. 18, and kindly lent by him.

785. **Ranzania bertolonii** (Lamellicorn): in the right posterior foot the last joint of the tarsus is curved outwards and bears six claws instead of two, and three onychia instead of one. The arrangement of the parts is somewhat complex and could not well be made clear without elaborate figures. Speaking generally, the last (fifth) tarsal joint presents at its apex a large articular surface of irregular shape. This surface bears four large claws disposed in the same direction as the normal pair of claws. Of the four claws the two adjacent ones are in solid continuity for a part of their length, being joined together by chitin much as the extra dactylopodites are in Fig. 184, III. It is clearly shewn that the conjoined claws are respectively the fellows of the two free claws, for the two extra onychia stand one upon either side of and opposite to the curvature of the conjoined claws. Terminally the fifth tarsal joint bears also a small pair of somewhat deformed claws with which an enlarged and misshapen onychium corresponds. This specimen was kindly lent to me by M. Henri GADEAU DE KERVILLE and was mentioned by him in *Bull. Soc. Ent. France*, Ser. 6, VI. 1886, p. CLXXX.

- *786. **Rhizotrogus æstivalis** ♀ (Lamellicorn), bearing supernumerary parts of double structure upon the right posterior 5th tarsal joint (Fig. 172). The structure found in this case is very remarkable and is, I believe, in some respects unique. The tarsus is normal as far as the extremity of the terminal joint, and the abnormality consists entirely in repetition of claws and pulvillus. The normal formation is shewn from the ventral surface in Fig. 172, A. There is an anterior claw, a posterior claw and a small pulvillus, placed ventrally to the claws, bearing two hairs. Fig. 172, B, shews the abnormal foot from the ventral side. Each claw gives off from its base a ventrally-directed supernumerary claw, and each supernumerary claw is bifid at its point. Examined from below each of these extra claws is seen to bear *two grooves separated by a ridge*, and is therefore morphologically a double structure. The next structure of importance is the pulvillus. The normal pulvillus (*pul*) is in place and of the usual form, but *dorsally* to it there is a supernumerary pulvillus (*pul*²) of cylindrical form and rather longer than the normal pulvillus. At its apex this extra pulvillus bears a median bifid hair with another hair on each side of it; these hairs thus prove that the extra pulvillus is morphologically double.

In this foot, therefore, a supernumerary pair of claws and a supernumerary double pulvillus are intercalated between the normal claws and the normal pulvillus. Hence though the repetition affects both claws and pulvilli, and the structures found are sufficient for an incomplete pair of extra feet, yet the extra parts are disposed in the system of symmetry of the normal foot, forming, all taken together, *one* foot only. Specimen very kindly lent by Dr G. KRAATZ.

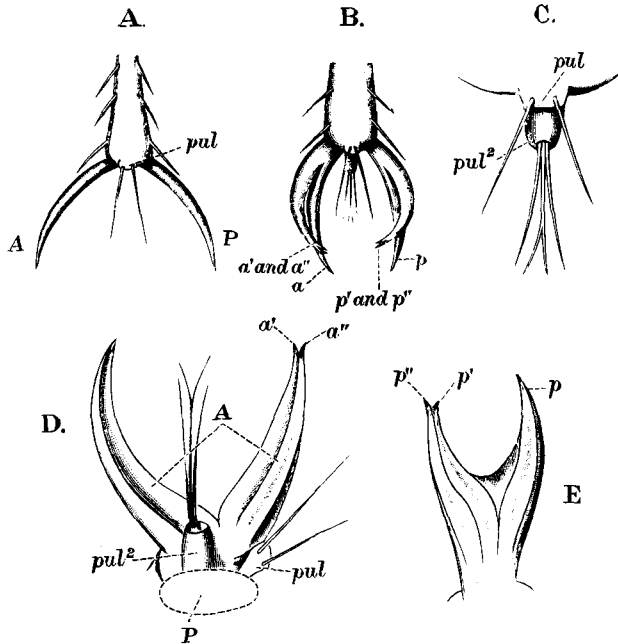


FIG. 172. *Rhizotrogus aestivalis*, No. 786. A, normal hind foot from ventral surface. B, right hind foot of No. 786 from ventral surface. C, enlarged view of pulvilli. D, inside view of the claws at the anterior border of the apex. E, inside view of the claws at the posterior border of the apex. A, anterior. P, posterior. a, normal anterior claw of abnormal foot. p, normal posterior of the same. a', a'', the two points of extra claw of anterior side. p', p'', the two corresponding posterior points. In D the posterior group of claws is supposed to be cut off at P. pul, normal pulvillus. pul², extra double pulvillus.

(11) Cases in which the legs were either mutilated, or in part amorphous, or insufficiently described.

787. Want of space prevents me from giving more than a list of references to these cases. Most of them besides are imperfectly known. Of those seen by myself the case of *Hister* would, I think, be interesting, but I regret that my notes of this case are imperfect. In the following list the letters R and L shew the leg affected; the † means that the case probably *did not* agree with the Scheme, the || that it probably *did* agree; the ‡ means that the parts were either mutilated, or imperfect, or deformed. Of those unmarked, the accounts are inadequate.

Ichneumon luctatorius	R ₃	TISCHBEIN, <i>Stet. ent. Ztg.</i> , 1861, xxii. p. 428.
‡ Carabus auratus		KRAATZ, <i>Deut. ent. Zt.</i> , 1889, xxxiii. p. 222, fig. 17.
C. auronitens	L ₁	GREDLER, <i>Korresp. zool.-min. Ver. Regensb.</i> , 1877, xxxi. p. 139.
C. cancellatus	R ₂	LANDOIS, <i>Zool. Gart.</i> , 1884, xxv. p. 288 [q.v.]
‡ ditto ♂	L ₂	KRAATZ, <i>Berl. ent. Zt.</i> , 1873, xvii. p. 432.

* †	C. catenulatus	L ₃	<i>Brit. Mus.</i>
	C. italicus	R ₃	BAUDI, <i>Nat. Sicil.</i> , VIII. No. 9, p. 199.
	Dyschirius globulosus (Car.)	R ₁	JAYNE, <i>Trans. Amer. Ent. Soc.</i> , 1880, VIII. p. 157, Pl. iv. figs. 6, 6a.
	Calopus cisteloides (Het.)		VON HEYDEN, <i>Isis</i> , 1836, IX. p. 761.
	Pterostichus prevostii (Car.)	L ₃	MÜLLER, A., <i>Proc. Ent. Soc.</i> , 1869, p. XXVIII.
* †	Chlanius nigricornis (Car.)	L ₃	MOCQUERYS, <i>Col. anorm.</i> , 1880, p. 62, fig.
†	Agra catenulata (Car.)	L ₃	STANNIUS, <i>Müll. Arch. f. Anat. Phys.</i> , 1835, p. 306, fig. 13.
†	Prionus coriarius (Long.)	R ₃	PERTY, <i>Mitth. nat. Ges. Bern</i> , 1866, p. 308, fig. 11.
	Prionus sp.	?	<i>Ann. and Mag. N. H.</i> , 1841, p. 483.
†	Aromia roschata ¹ (Lam.)	L ₁	KRAATZ, <i>Deut. ent. Zt.</i> , 1877, XXI. p. 56, Pl. I, 2, fig. 11.
†	Dorcadion rufipes (Long.)	L ₃	PERTY, <i>l. c.</i>
	Blaps sp. (Het.)	R ₃	LABOULBÈNE, <i>Bull. Soc. Ent. Fr.</i> , S. 4, v. 1865, p. XLIX.
†	Ptinus latro (Plin.)	L ₁	VON FRICKEN, <i>Ent. Nachr.</i> , 1883, IX. p. 44.
†	Dytiscus marginalis (Dyt.)	R ₁	RITZEMA BOS, J., <i>Tijds. v. Ent.</i> , 1879, XXII. p. 206, Pl.
	Colymbetes sturmi (Dyt.)	L ₁	STANNIUS, <i>l. c.</i> , p. 307, fig. 9.
	Strategus antæus (Lam.)	L ₃	JAYNE, <i>l. c.</i> , p. 159, fig. 10.
	Rutela fasciata (Lam.)	R ₃	SPINOLA, <i>Ann. Soc. ent. Fr.</i> 1835, IV. p. 587, Pl.
*	Hister cadaverinus (Clav.)	R ₁	MOCQUERYS, <i>l. c.</i> , p. 59, fig.
	Cetonia morio ² (Lam.)	L ₁	SARTORIUS, <i>Wien. ent. Monats.</i> , 1858, II. p. 50.
	Melolontha vulgaris (Lam.)	L ₃	TREUGE, <i>Ent. Nachr.</i> , VIII. 1882, p. 177.
†	ditto	R ₁	DOUMERC, <i>Ann. Soc. ent. Fr.</i> , 1834, III. p. 171, Pl. I A, fig. 1.
	ditto	L ₃	BOULARD, <i>Bull. Soc. ent. Fr.</i> , 1846, S. 2, IV. p. XLVIII, fig.
	ditto	R ₃	TIEDEMANN ³ , <i>Meckel's Arch. f. Phys.</i> , 1819, v. p. 125, Pl. II. fig. 1.
* † †	ditto	L ₃	MOCQUERYS, <i>l. c.</i> , p. 68, fig.
	Rhizotrogus castaneus (Lam.)	R ₁	BASSI, <i>Ann. Soc. ent. Fr.</i> , 1834, III. p. 373, Pl. VII A.
†	R. aestivalis	L ₁ and R ₃	PERROUD, <i>Ann. Soc. Linn. Lyon</i> , 1854, II. p. 325.
	Oryctes nasicornis (Lam.)	R ₁	AUDOUIN, <i>Bull. Soc. ent. Fr.</i> , 1834, III. p. IV.
	Enema pan. (Lam.)	L ₃	TASCHENBERG, <i>Zts. f. ges. Naturw.</i> , 1861, XVIII. p. 321.

¹ As Kraatz suggests, this is presumably the case given by SARTORIUS, *l. c.*

² Probably same specimen as that of GREDLER, *Korresp. zool.-min. Ver. Regensb.*, 1869, XXIII. p. 35.

³ Tiedemann's grave comment is of interest as recalling past phases of thought. He says: "Was die Entstehung der oben beschriebenen Missbildung betrifft, so lässt sich wohl annehmen, dass die Phantasie der Mutter des Maikäfers durch ein vorausgegangenes Versehen aufgeregt, hier nicht als Ursache beschuldigt werden kann, theils weil wir überhaupt keine Beweise für eine lebhaftere Phantasie der Maikäfer haben, und theils weil die Bildung des Embryo ausserhalb des Leibes der Mutter nur sehr langsam geschieht, und die Mutter ohnehin gleich nach Legung der Eier stirbt" *l. c.*, p. 126.

PAIRED SUPERNUMERARY ANTENNÆ.

In dealing with extra antennæ there is more difficulty in determining the true nature of the parts than there is in the case of extra legs. We have seen that the real duplicity of compounded extra parts often appears only in the fact that they have a bilateral symmetry, while in the normal appendage one side is differentiated from the other. Now in very many species of Insects the antenna seems to be a bilaterally symmetrical filament, having joints cylindrical or elliptical in section. When from such an antenna there proceeds an extra filament, itself bilaterally symmetrical, it is almost impossible to determine whether the extra filament is really a *single* repetition of the normal or whether it is made up of two homologous borders of a *pair*. (Cp. Nos. 801 and 764.) In speaking of actual cases of duplicity in Arthropodan appendages we shall have to return to this subject.

Meanwhile evidence will be given as to examples of obvious duplicity in extra antennæ. It will be seen that in species having normally a marked differentiation between the anterior¹ and posterior borders of the antennæ (Lamellicorns, Lucanidæ, &c.), and the case has been really studied, there is often clear proof not only of the duplicity of the extra parts but also that they are arranged as images, almost as described for legs.

We shall moreover meet cases where of the paired extra parts one springs free from the normal at a point proximal to the point of origin of its fellow. Among extra legs there is scarcely any certain example of this phenomenon, *Platycerus caraboides* No. 778 being perhaps the clearest case. But among antennæ there are several where no other interpretation seems possible. These cases I have set in a separate section.

Of the remainder, little can be said with confidence. Probably if they were carefully examined microscopically it would be found that differentiation between the two sides exists in respect of the distribution of sense-organs or hairs, and that thus the duplicity and symmetry might be traced.

After giving the clear cases I have thought it enough to give a list of those of this doubtful order. As has been said, there is little doubt that with careful study of the specimens many of the cases now included in the list of supposed single extra appendages might be shewn to be cases of extra parts in Secondary Symmetry.

¹ This term is used, as in the case of legs, to denote the border which is anterior when the appendage is extended horizontally at right angles to the body. The upper surface will then be dorsal, the lower ventral. These terms are thus applied without any intention of affirming that they are morphologically correct.

(1) *Clear cases of Supernumerary Antennæ in Secondary Symmetry.*

(a) *The extra parts arising together.*

- *788. **Phyllopertha horticola** (Lamellicorn): specimen in which the right antenna bears a supernumerary pair of clubs. This specimen may conveniently be described in detail as it furnishes a good example of the mode in which repetition of the antennæ occurs in the Lamellicorns. The left antenna is normal and possesses nine joints (Fig. 173, L). The first is a large pear-shaped joint, articulating with the head by its narrow end. The

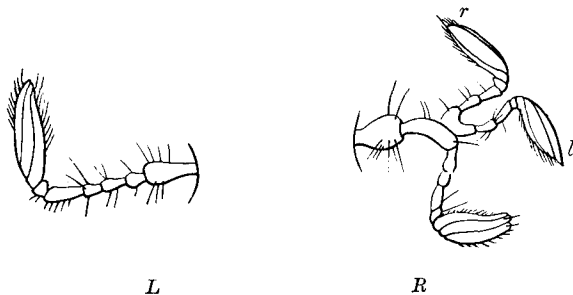


FIG. 173. *Phyllopertha horticola*, No. 788. L, the normal left antenna. R, the normal right antenna. l, r, extra left and right clubs.

second joint is also a pear-shaped joint, of about half the size of the first. The third, fourth and fifth joints are elongated and cylindrical. The sixth is short and wide. The seventh, eighth and ninth are each expanded into a lamella. These three lamellæ are generally kept firmly closed together and form the sensory organ, or "club." In *Melolontha* (*v. infra*) and several other genera of Lamellicorns, there are ten joints, of which seven are developed as lamellæ, forming the club.

In the *right* antenna (Fig. 173, R), which bears the extra pair of clubs, the basal joint is rather thick. The second joint is longer than it normally is, and curves slightly backwards and downwards. At its apex it bears the rest of the normal antenna, which is in all respects well formed. In addition to the normal antenna, the second joint upon its anterior surface gives attachment to a large joint which is imperfectly constricted into two parts in a vertical plane at right angles to the general direction of the normal antenna. Each of these half-joints bears a structure containing in itself all the parts proper to an antenna peripherally to the third joint, the clubs being well-formed and normal. In absolute size they are equal, but are a little smaller than the normal antenna.

These two antennæ curve in opposite directions and are in all respects complementary to each other, forming a true *pair*. The most anterior of them, *r*, is disposed as a *right* antenna, while the posterior, *l*, is disposed as a *left*. This specimen was taken by M. Albert Mocquerys, and was kindly lent to me by M. Henri Gadeau de Kerville.

789. **Melolontha vulgaris** ♀ (Lamellicorn): left antenna bearing a pair of supernumerary clubs. The extra pair arises from the second joint of the normal antenna, and they have their third joints united at the base. The relative positions of the extra clubs and the normal one are those marked VP in the Scheme. All these three clubs are perfect and of the same size, but each is a little smaller than a normal club. At the thoughtful suggestion of Prof. Howes this specimen was very kindly lent to me by Mr E. E. Green, and has been placed in the Museum of the Royal College of Surgeons.
790. **Melolontha vulgaris**: [right antenna bearing a supernumerary pair of clubs in Position P. For details see original, where a different and I think untenable view is taken] LEREBoullet, *Rev. et Mag. de Zool.*, S. 2, III., 1851, *fig.*
791. **Melolontha vulgaris** ♀, with a pair of supernumerary antennæ arising from the left antenna. [The figure shews that the proximal joint or scape was of abnormal thickness and had two peripheral articulations in the same horizontal plane. The anterior articulation bore a normal antenna. The posterior articulation bore a single large first funicular (2nd) joint which in its turn bore a pair of clubs in the same horizontal plane, the anterior being a *right* club and the posterior a *left*, having their anterior surfaces adjacent: they are therefore a complementary pair in Position P.] KRAATZ, G., *Deut. ent. Zt.*, 1880, XXIV. p. 341, *figs. 7 and 7 a.*
792. **Amphimallus solstitialis** (Lamellicorn): left antenna bearing a supernumerary pair of imperfect antennæ articulating by a common stalk on the *anterior* surface of the second joint. The two extra clubs are an imperfect pair, complementary to each other, being set on back to back, in Position A. The most anterior of the clubs has only two lamellar joints, one small and one large. The posterior has three lamellæ. The normal club has three lamellæ as usual. Originally described by MOCQUERYs, *l. c.*, p. 15, *fig.*
793. **Anomala junii** (Lamellicorn): left antenna bears 3 clubs, each having 3-jointed stem articulating with elongated 2nd joint of antenna. [Symmetry not clear: possibly Position DPP.] KRAATZ, *Deut. ent. Zt.*, 1881, xxv. p. 111, Pl. III. *fig. 4.*
- *794. **Geotrupes typhæus** ♂ (Lamellicorn): left antenna bearing a pair of supernumerary clubs compounded together. The antenna is normal up to the 7th joint which is dilated. The 8th is still more dilated and bears posteriorly the normal club composed of three lamellæ; and anteriorly by a separate articulation a supernumerary structure (Fig. 174, *nr*, *ml*) consisting of three joints, each of which has the form of a complementary pair of lamellæ joined by their morphologically posterior (sc. external) edges. The whole supernumerary structure is thus morphologic-

ally a pair of clubs, a right and a left, compounded together. The histology of the supernumerary lamellæ is just the same as

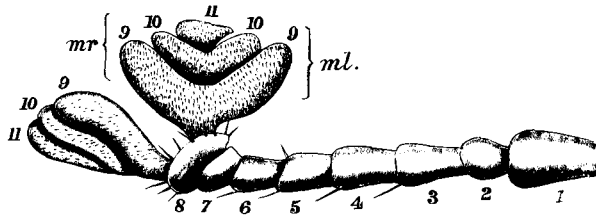


FIG. 174. *Geotrupes typhaeus*, No. 794. Left antenna bearing a compounded pair of clubs. *ml*, *mr*, morphological left and right of the extra parts. (The property of Dr Kraatz.)

that of the normal lamellæ, all being covered with pubescence. The form of the compound eleventh joint is somewhat irregular. The extra parts are in the Position A of the Scheme. Specimen kindly lent by Dr KRAATZ, and first described and figured by him in *Deut. ent. Zt.*, 1889, XXXIII. p. 221, fig. 13.

5. **Melolontha hippocastani** ♂ having supernumerary parts of double structure upon both the right and the left antenna.

Right Antenna. Third joint elongated, thickened and presenting two articular surfaces; of these one is terminal and bears a normal antennary club, while the other is dorsal and bears a supernumerary double club. This structure has the form shewn in the drawings. Fig. 175, A, shews its appearance when looked at from above, B shews the structure when seen from below and externally. It consists of seven pieces shaped like half-funnels, fitted into each other.

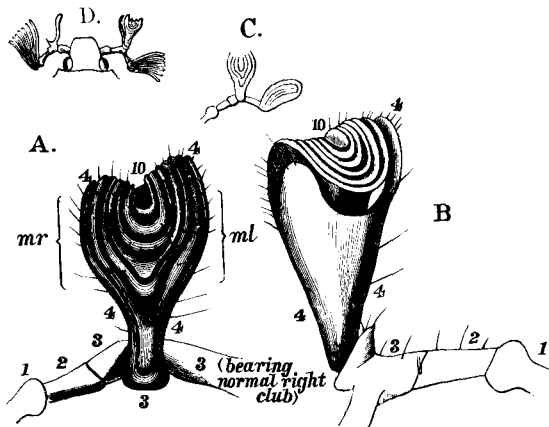


FIG. 175. *Melolontha hippocastani*, No. 795. D, view of the whole head and antennæ after von HEYDEN. C, view of right antenna. B, detail of right antenna from below. A, detail of the same from above.

The morphological nature of this supernumerary organ may be determined thus. The upturned edges of the folds bear hairs as shewn in the figure A; since in the normal antenna the dorsal edges of the lamellæ alone bear hairs, these edges are in this case dorsal morphologically as well as by position.

Since the outermost lamella (marked 4) is articulated into the third joint of the funiculus, it is therefore the 4th joint, or proximal lamella, and the remaining lamellæ are therefore 5th, 6th, 7th, 8th, 9th and 10th respectively. Next, the surface *mr* is structurally like that of the internal (sc. anterior) surface of the proximal lamella of a normal club, and the surface *ml* is a similar surface: but *ml*, being an *internal* surface, faces towards the right and is therefore morphologically a *left*; while *mr*, being an internal surface and facing towards the left, is a *right*; hence this club consists of two clubs compounded together by their external or posterior borders, and the two are a right and a left, the left being next the normal right club.

Lastly, since the upper free edges of the lamellæ are structurally dorsal, it follows that their lower edges are structurally ventral: but these lower edges do not exist as free edges, for the lamellæ are continuous upon their ventral aspect; therefore the surfaces which are adjacent in the extra right and left clubs, and by which they are compounded together, are partly *ventral* surfaces. This is approximately Position DP of the Scheme.

Left Antenna. Second joint thickened and presenting three articulations as follows. 1. a peripheral articulation bearing the normal club; 2. a ventral articulation bearing a 4th joint and club composed of 3 formless lamellæ; 3. a dorsal articulation bearing a small cylindrical joint only. The shape and formation of these extra parts is so indefinite that their morphology could not be determined.

For the loan of this specimen I am indebted to Dr L. VON HEYDEN, who first described it in *Deut. ent. Zt.*, 1881, xxv. p. 105, fig. 1.

796. **Rhizotrogus æquinotialis** (Lam.): 4th joint of right antenna bears a supernumerary structure projecting forwards and lying in the same horizontal plane as the normal club. This structure is lanceolate in form and its outer surface is in texture similar to the external surfaces of a normal club. On the ventral aspect it presents a simple ridge, but on the dorsal side its outer coating is divided by a spindle-shaped slit through which part of the internal structure protruded. The edges of this opening and the protruding portion of the interior bear a few hairs. There can be little doubt that this supernumerary body represents an imperfectly formed pair of clubs, and that it is in fact a more rudimentary condition of the parts found in No. 795. Specimen originally described and figured by MOCQUERYS, *Col. anorm.*, p. 16, fig.

797. **Lichnanthe vulpina** (Lam.): right antenna bears in addition to normal club a small spherical club made up of three joints, arising from posterior border of a long

joint apparently representing the normal 4th, 5th, and 6th joints not segmented from each other. [As this supernumerary part is in itself symmetrical it probably contains within itself parts of a pair of clubs compounded in Position P. Cp. No. 795.] JAYNE, H. F., *Trans. Amer. Ent. Soc.*, 1880, viii. p. 158, Pl. iv. fig. 8.

798. ***Polyphylla decemlineata*** (Lamellicorn). A specimen in which the right antenna bears a partially double supernumerary branch in addition to the normal antenna. This additional structure articulates with the second joint of the antenna by means of a single large joint. This joint carries a double club consisting of two sets of lamellæ, seven being in each set. The two sets of lamellæ are united at their bases at an angle of forty-five degrees. The plane of the normal club is perpendicular to that of the abnormal ones. The normal club itself is $\frac{1}{3}$ th shorter than that of the other side. [The details of the structure of this specimen are difficult to follow and the reader is referred for further particulars to the description and figures given in the original.] JAYNE, H. F., *Trans. Amer. Ent. Soc.*, 1880, viii. p. 158, figs.

(b) *The extra parts arising from the normal at separate points.*

- *799. ***Odontolabis stevensii*** ♀ (Lucanidæ). As the repetition in this specimen is almost complete and the relations of the parts fairly clear though in some respects peculiar, a detailed account will be useful.

The body, legs, &c. are normal, save that the back of the head and thorax have been crushed by some accident. The antennæ are both abnormal in the way shewn in Fig. 176. The condition will be better understood if the normal antenna is first described.

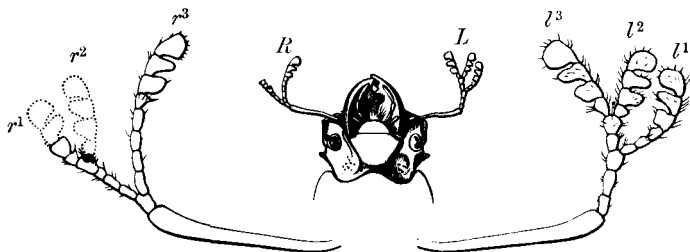


FIG. 176. *Odontolabis stevensii*, No. 799. The head seen from below, and enlarged views of the two antennæ. *R*, right. *L*, left. There is some doubt as to which of the branches is the normal and which the supernumeraries. See description in text.

The normal antenna of *Odontolabis* is much like that of its ally *Lucanus cervus*, the Stag-beetle. It is made up of 10 joints composing three parts differentiated from each other.

The first, or "scape," is a single joint as long as the rest of the antenna. It widens a little from its central end or base towards the apex, and is slightly flattened from above downwards. The second part, or "funiculus," has six simple joints. The last three joints form the club. They are flattened from above downwards and lie in a horizontal plane. The anterior ("inner") border of each of these three joints is produced into flat expansions, covered with sensory pores, which together form a series of serrations along the anterior border. When in its natural

position the serrated border of the right antenna faces towards the left side, and that of the left is turned towards the right. The structure of the abnormal specimen is as follows.

Left Antenna. Scape normal. Its plane however is not quite horizontal as usual, but is a little oblique, the anterior border being slightly higher than the posterior. In the funiculus the 1st and 2nd joints (2nd and 3rd of the whole antenna) are a little thicker than usual but otherwise normal. The 3rd joint of the scape is enlarged and presents at its apex two sockets, each bearing a continuation as shewn in the figure. The two sockets are not in a horizontal plane, but their plane is oblique and nearly at right angles to the plane of the scape, the socket bearing the branch l^1 being the higher. It is important that the precise relations of these parts should be clearly understood.

This *outer* socket of the 3rd funicular joint bears the branch l^1 , made up of three more funicular and three club-joints, turning their serrated border *in the direction of the right antenna*: l^1 is therefore structurally a *left* antenna. Its surface is of the same nature as that of a normal antenna, but its size is a little smaller. It is in an oblique plane inclined to the horizontal at about 45° , the posterior (outer) border being the higher.

The *inner* socket of the 3rd funicular joint bears a cylindrical joint not quite fully segmented off from the next joint peripheral to it. These two are 4th and 5th funiculars. The 5th again presents two sockets, bearing respectively the branches l^2 and l^3 . The branch l^2 has one small joint (6th funicular) and three club-joints, turning their serrated border towards l^1 . This branch is therefore structurally a *right* antenna. It stands in the same oblique plane as l^1 , the serrated border being the higher. In size it also agrees with l^1 , being rather smaller than the normal. The branch l^3 is a normal *left* in size and shape, and it lies in a horizontal plane.

Here therefore there is a *left* antenna and a pair, one a *right* and the other a *left*. Which then is the normal, l^1 or l^3 ? Inasmuch as l^3 and l^2 arise by a common stalk it may seem that they are the extra pair and that l^1 is the normal. We have now seen in many cases that extra parts in Secondary Symmetry are compounded together as l^3 and l^2 are here. But considering the fact that l^3 is of normal size and in the normal horizontal plane, whereas l^1 and l^2 are both smaller and are in an oblique plane complementary to each other, I incline to the view that if one branch is the normal, it is l^3 , and that l^1 and l^2 are the extra pair in Secondary Symmetry, *though they do not arise together*. They are then nearly in Position DPP, but depart from that position in the fact that l^1 is not horizontal (cp. No. 757).

If l^1 and l^2 are really the extra parts, in the fact that they do not arise together, but spring separately from different points on the normal, we meet with a condition rarely seen, but that

this is a possible condition is proved beyond doubt by the succeeding case.

Right Antenna. Scape precisely as in left antenna. The 1st funicular (2nd antennary) has two sockets at its apex, placed like those on the 3rd funicular of the left side, the anterior socket being the lower and the posterior socket being the higher. The anterior socket bears a normal right antenna, r^3 . The posterior bears the structure shewn in the figure. This appendage has unfortunately been broken, but enough remains to suggest the original structure. It consists of five funicular and a 1st club-joint. The 5th joint of the whole funiculus bears a large socket looking downwards and forwards, its other socket looking backwards and upwards. From the former the original continuation has been lost. The latter bears the 6th funicular and its 1st club-joint, this again having an empty socket.

The plane of the two sockets of the 5th funicular is oblique to the horizon, like that of l^1 and l^2 . Though it is clearly impossible to shew how this antenna was in its unbroken state, we may note that if it were continued in the way suggested by the dotted lines it would have borne a complementary pair of clubs, r^1 and r^2 , like l^1 and l^2 of the other side, placed like them in an oblique plane nearly corresponding with DPP of the Scheme.

This specimen was kindly entrusted to me by M. Henri Gadeau de Kerville. He tells me that he believes a description of it has already appeared, but this I have failed to find. I have therefore ventured to describe it again, with apologies to the original describer. The specimen bears a label in the handwriting of the late Major Parry and was no doubt in his celebrated collection of Lucanidæ.

800. **Melolontha vulgaris**: right antenna bearing a pair of incomplete supernumerary antennæ (Fig. 177). The first joint is normal; it bears a second joint of singular form, consisting of a long anterior branch, and a short posterior branch $\frac{1}{3}$ the length of the anterior. The anterior bears two clubs in the manner shewn in the figure (Fig. 177). Of these

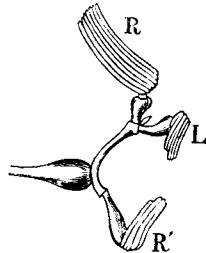


FIG. 177. *Melolontha vulgaris*, No. 800. Lettered according to the view that R is the normal right club. L , the supernumerary left, and R' the supernumerary right. (From Wesmael.)

one (*R*) is inwardly directed and is as wide as, but only $\frac{3}{4}$ the length of a normal club. The posterior of the two clubs (*L*) is directed backwards and has only four lamellæ which are apparently united together. The other small club (*R'*) is also composed of only four lamellæ which are similarly united together. In both *L* and *R'* the middle lamellæ shew traces of further subdivision. The figure represents the three clubs as being all in one plane, but the club *R'* is really below *L*, which stands up from the normal antenna. It is mentioned that some of the tarsi were mutilated or defective. [Here *L* and *R'* are clearly a complementary pair, though separately arising from the normal. It will be observed that as in Lereboullet's case (No. 790) the second joint, which is common to two clubs, is greatly elongated.] WESMAEL, *Bull. Ac. Belg.*, 1850, xvi. 2, p. 382, *fig.*

- *801. **Navosoma** sp. (Longic.) Left antenna abnormal. The joints of the normal are a little flattened from above downwards and are nearly elliptical in section. But the anterior border is differentiated from the posterior by the presence of two elongated patches of tissue covered with sensory pores. The two patches are both on the anterior border, one being on the dorsal surface and one on the ventral, separated from each other by a chitinous ridge. Upon the general surface of the peripheral joints of the antennæ are several other such patches, but none are so distinct as those of the anterior border. The abnormal left antenna has the form shewn in Fig. 178. So far as the 8th joint it does

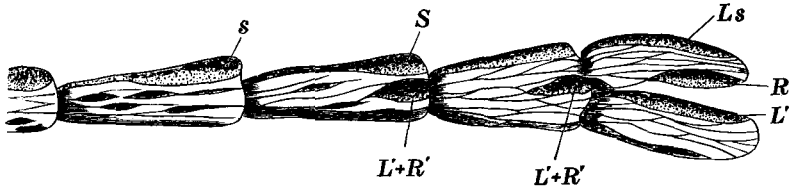


FIG. 178. *Navosoma*, No. 801. Left antenna seen from below. Lettered on the view that *R* and *L'* are the extra parts. *S*, sensory patch. (In Hope Collection.)

not differ from the normal. The 9th and 10th joints have besides their chief patches of sensory pores (*S*) on the anterior border, an additional patch (*L' + R'*) posterior to the chief patch. But up to the 10th joint there is no vertical division. The 10th joint however has two articular surfaces, anterior and posterior, in the same horizontal plane. The posterior bears an apical (11th) joint of normal form, having anteriorly a sensory patch. But the apical joint borne by the anterior articular surface has two such sensory patches, an anterior and a posterior. This joint therefore contains in itself parts of a pair of joints. It is not quite fully segmented off from the 10th joint.

Nevertheless it is difficult to suppose that the anterior joint is the extra pair in Secondary Symmetry, for its anterior patch, *Ls*, seems to continue the normal series of patches, *S*, *S*, &c. Therefore the patches *R* and *L'* seem to be the patches of the extra pair, though one of them is on a separate joint and the other is applied to the normal. Taken with the case of *Odontolabis* No. 799 and *Melolontha* No. 800, this

must, I think, be judged to be a possible account, and in this case *R* and *L* are, as regards symmetry, in Position P. It is of course possible that *Ls* and *R* are really the extra pair in Position A, but the presumption is rather the other way¹. Specimen in Hope Collection at Oxford.

(2) *Cases of double extra antennæ, Symmetry unknown.*

802. In none of the following can any confident statement be made as to the symmetrical relations of the parts. Several of the cases I have myself seen, but I noticed no clear indications as to their symmetry. A good many of them however were examined before I was fully alive to the importance of these matters in the case of filamentous antennæ, and perhaps if they were studied with proper regard to the question of symmetry more might be made of them. Many cases that follow are mutilated or partly amorphous, and of almost all the descriptions are very imperfect. For our purpose some value attaches to these records as evidence of the distribution of such abnormalities, and to any person who may hereafter pursue the subject a fairly complete list of the references may be of use. To this therefore I shall confine myself; for on reviewing the abstracts that I have made of these examples it is clear that they only give the results of superficial examination.

Speaking generally, in these cases, from some one joint of an antenna there arises either a pair of extra antennæ compounded for a greater or less extent of their proximal parts, or two extra antennæ distinct from their point of origin.

The letters *R* and *L* indicate the side affected, and the number following is approximately that of the joint from which the extra parts spring. In the greater number of sound cases the three branches lie in or nearly in a horizontal plane and are, I anticipate, in Positions A or P.

Cases which seem from the indications to conform to the Scheme are marked ||. Mutilated or partially amorphous cases are marked ‡.

Blaps attenuata (Het.)	R 3	MOCQUERYS, <i>Coléoptères anormaux</i> , 1880, p. 5, fig.
* Malachius marginellus (Mal.)	L 2	<i>ibid.</i> , p. 7, fig.
Timarcha tenebricosa (Phyt.)	R 9	<i>ibid.</i> , p. 13, fig.
* Clytus tricolor (Long.)	L 7	<i>ibid.</i> ² , p. 19, fig.
* ‡ C. arcuatus	L 1	<i>ibid.</i> , p. 20, fig.
Calopteron reticulatum (Mal.)	L 1	<i>ibid.</i> , p. 25, fig.
* Carabus monilis (Car.)	L 3	<i>ibid.</i> , p. 3, fig.
* C. auronitens	L 7	<i>ibid.</i> , p. 9, fig.
* Ptinus latro (Ptin.)	L 5	<i>ibid.</i> , p. 8, fig.
Elater murinus (Elat.)	L 2	<i>Ann. and Mag. of N. H.</i> , 1831, iv. p. 476.
Zonites præusta (Het.)	R 3	STANNIUS, <i>Müll. Arch. f. Anat. Phys.</i> , 1835, p. 303.

¹ This is perhaps too strongly put.

² Description and figure incorrect. Apical joint of extra branch is *bifid*.

Helops cæruleus (Het.)	R 5	SÉRINGE, <i>Ann. Soc. Linn. de Lyon</i> , 1836, <i>Pl.</i>
Dendarus hybridus (Het.)	L 4	ROMANO, <i>Atti Ac. sci. Palermo</i> , 1845, N. S., i. fig.
‡ Scraptia fusca (Het.)	L 5	ROUGET, <i>Ann. soc. ent. France</i> , 1849, S. 2, VII. p. 437.
‡ Carabus sacheri (Car.)	R 7	LETZNER, <i>Jahresb. schles. Ges. f. vaterl. Kultur</i> , 1854, p. 86.
Fimelia scabrosa (Het.)	R 2	BLACKMORE, <i>Proc. Ent. Soc.</i> , 1870, p. XXIX.
Anchomenus sex-punctatus (Car.)	L 6	KRAATZ, <i>Deut. ent. Zt.</i> , 1877, XXI. p. 56, fig. 19.
Calosoma investigator (Car.)	R 5	<i>ibid.</i> , 1889, XXXIII. p. 221, fig.
Dromæolus barnabita (Eucn.)	L 5	VON HEYDEN, <i>ibid.</i> , 1881, XXV. p. 108, fig. 16.
* ‡ Carabus arvensis	L 4	Specimen kindly lent by M. A. FAUVEL.

803. **Meloe violaceus** ♀: between right eye and the base of the right antenna arise two supernumerary antennæ from the head. Of these one has 3 joints and the other has one. KRAATZ, *Deut. ent. Zt.*, 1877, XXI. p. 57, *Pl. I. fig. 22.*

The following example is mentioned here, though its nature is quite obscure. In it there is a suggestion that parts of two extra antennæ are present, but the extra parts seem to be peripheral to the parts which they repeat.

As my stay in Rouen was short I was not able to give as much time to this specimen as I should have wished¹.

804. **Melolontha vulgaris** ♂: left antenna abnormal. This case differs wholly from any other that I know of. I can only describe it in a most tentative way. The appearance when the lamellæ were cleaned and separated was as shewn in Fig. 179. Joints 1—8 are fairly normal, but peripheral to this place there were

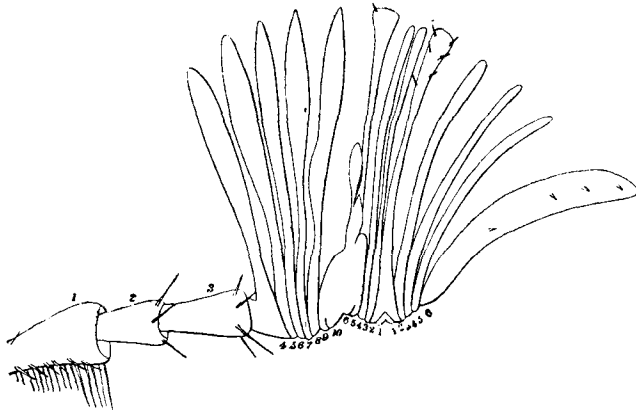


FIG. 179. Left antenna of *Melolontha vulgaris*, No. 804. The numbers are set in tentative suggestion of the possible nature of the parts. (In Rouen Mus.)

¹ This antenna was when I saw it covered with mould and dirt. In washing it I accidentally detached it from the head, but I mounted it again carefully with the specimen.

a number of lamellæ, some like normal lamellæ, others quite irregular. As far as I could make out, the divisions were as shewn in the figure, and I have affixed numbers to the several parts in illustration of their possible nature. The appearance suggests that there is an irregular repetition of a pair of clubs *peripheral* to the normal antenna, but I can form no opinion as to the morphology of the parts. Originally described by MOCQUERYS, *Col. anorm.*, 1880, p. 12, *fig.* [Description and figure altogether misleading.]

PAIRED EXTRA PALPI.

805. **Bembidium striatum** (Carabidæ): left maxillary palp arises by a first joint enlarged towards its apex, bearing *three* separate terminal joints instead of one. Of these joints one stands apart on a small process of the first joint, but the other two are placed close together, on either side of the apex of the first joint, and diverge from each other at about a right angle. JACQUELIN-DUVAL, *Ann. Soc. Ent. France*, 1850, Sér. 2, VIII. p. 533, *Plate* XVI.
806. **Helops sulcipennis** (Het.): supernumerary, partially double apical joint arises from the 2nd joint of right maxillary palp. It is set on *at right angles* to the plane of the normal palpus. JAYNE, H. F., *Trans. Amer. Ent. Soc.*, 1880, VIII. p. 161, *fig.* 14.
807. **Euprepia purpurea** (Arctiidæ): a specimen in which the right wings and antenna were male and the left wings and antenna female, is declared to have possessed *an extra pair of palpi*. [No sufficient description of this extraordinary occurrence is given; and as the repetition of the palpi is only incidentally mentioned, it may be doubted whether a full examination was made.] FREYER, C. F., *Beitr. zur Schmetterlingskunde*, 1845, *Vol.* v, p. 127, *Tab.* 458, *fig.* 4.