MISCELLANEOUS NOTES ON AUSTRALIAN DIPTERA. XII.

CYRTIDAE, DOLICHOPODIDAE AND PHORIDAE.

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(Three Text-figures.)

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The Venation of Diptera.

Lundbeck (1907, p. 8) states that "the important observations of Adolph concerning the convexity and concavity of veins must absolutely be taken into consideration" when homologizing the venation in the various families of Diptera. Early authors also discussed the matter in papers of which only that of Brauer (1882) is before me. As Alexander has shown that two or more veins may be compounded and developed to look like a simple vein, notwithstanding its complex nature, those observations of early authors may be viewed in a new light and the explanation found that will account for many anomalies in wing venation.

Difficulty at times will be met in making out the convexity and concavity of veins where the wings have been flattened, especially at the apical margin of the wing; however, on newly emerged flies the contrasting convexity and concavity is strongly marked, as it is also in most specimens of the more primitive flies in the lower Brachycera. In the Nemestrinidae this feature may be entirely obscured in the median branches, making it advisable to leave without comment that family for the time being.

Judgment is made as to whether the veins are on the crest (convex) or in the furrow (concave) on the upper surface of the undulating wing membrane, but a vein may take the normal course along the crest and proceed into a furrow, thus taking in part the course of a cross-vein. A convex and a concave vein may coalesce in part, and the nature of the coalescing part will be determined as convex or concave by the vein which dominates, this usually being the convex vein. It is not clear yet how such complex veins are to be notated in a satisfactory manner, but it is considered necessary to take some action in these notes in order to clarify the position.

Tillyard (1926) has given the theoretical condition for each branch of the varied fields and Brauer (1882) has given the actual nature of the branches as found by him; these are tabulated below. The most recent discussion on the subject seems to be that by Lundbeck (1907), who includes a figure illustrating the character of all veins.

Table of Venation.

Name of Branch.	Theoretical Character (Tillyard).	Actual Character (Brauer).	Number (Brauer).
Costa	not stated	convex	—
Subcosta	concave	concave	H.
Radial 1st	convex	convex	1
„ 2nd	concave	(absent)	—
„ 3rd	„	concave	2
„ 4th	„	convex	3
„ 5th	„	„	3
Median 1st	„	„	3
„ 2nd	„	„	3
„ 3rd	„	concave	4
„ 4th	„	convex	5
Cubital 1st	convex	„	5
„ 2nd	concave	—	—
Anal 1st	convex	concave	6
„ 2nd	concave or convex	convex	7

Brauer has numbered his scheme of venation on a system that makes clusters of branches alternating convex (odd numbers) and concave (even numbers) in a manner as he found them to occur. As the anal area has both a convex and a concave vein, Lundbeck suggested that these should be given different names each applicable to the one which happens to be left in the wing of the Brachycera as both forms are present in the group and are standing under the one name. He made no reference to the anal vein which is partly of a convex and partly of a concave nature, but this may be compounded of the two, and there may be some evidence to support the contention.*

Family Cyrtidae.

It is uncertain if the Cyrtoidea have the first median vein coalescing with R_5, but if so then the second radial-median cross-vein becomes M_1 and, by subsequent numbering, the vein called M_3 becomes an intermedian cross-vein between M_3 and M_4, as already indicated in an alternative notation given for the venation in the Nemestrinidae.

The notation used here for the genus *Panops* is that usually used in the family and to it has been added, by mathematical signs, the nature of the vein, whether it be convex (+) or concave (−). This venation is the most complete known in the family, and the key to the Australian genera is largely based upon it.

Key to Genera of the Cyrtidae.

1. With a complete set of wing veins, or practically so. With the antennae long and situated high on the head 2
   With a much reduced venation. With the antennae short and situated very low on the head 3
2. With the eyes meeting above the antennae which are thus separated from the ocelli. With appendix present ..... *Leucospina* Westw.
   With the antennae adjacent to the ocelli; the eyes, being separated, leave a short square-shaped frons between them. With appendix sometimes absent ..... *Panops* Lamarck
3. With only one median vein reaching the wing border between the radial and cubital fields. With the median section lying between the two radial-median cross-veins eliminated .. 4
   With few veins retained; none of the median branches reach the wing margin ..... *Oncodes* Latreille
4. With the anterior margin of the wings strongly curved forwards at the apex of the costa ..... *Pterodontia* Gray
   With the anterior margin of the wings normal in shape ..... *Nothra* Westwood

Genus Panops Lamarck 1804.

Synonym.—*Epicerina* Macquart 1849; for reference to this and all other genera see Hardy, *Proc. Roy. Soc. Tasm.*, 1921: 75–80.

This synonymy has been suggested before, but now it seems certain. The type of *Epicerina* is said to be from Tasmania but it belongs to those flies mostly caught in the Sydney area and described by Macquart in his fourth supplement as being all from Tasmania. Three species now stand under this genus.

P. baudini Lamarck, ♂ and ♀, genotype, has no appendix and the abdomen is conical.

P. nigricornis Macquart, ♂ and ♀, has the appendix, and the abdomen is conical. This has not yet been detected in Australian collections and it may be doubted if the proboscis is short, as stated by Macquart.

P. flavipes Latreille, ♂ only known, has the appendix and the longer abdomen which is constricted at segmentations giving the "corrugated" shape. Tillyard (1926, Pl. 23, fig. 12) has illustrated it under the name of *baudini*.

Panops flavipes Latr. Fig. 1.

The presence of two adjacent ridges of thickened membrane is an aberrant character that occurs between R_{1+2} and R_3 of one wing only on one specimen before me, and it evidently marks the course of the obsolete branch R_2. The length of the appendix is variable and the convexity and concavity of the veins stand with remarkable clarity.

* I have not yet met with evidence, but Williston (1908) has illustrated the wing of *Acanthomera* with Brauer's veins 6 and 7 coalescing at their base (i.e., "stalked") and it is only necessary to eliminate the free part of vein 7 to bring about this case (noted on *Panops*) of a basally convex and apically concave anal vein, with the division between the convex and concave part quite abrupt.

The second radial-medium cross-vein, M_2 and *i-m* are, however, quite neutral, but M_3 carries with it a definite furrow which strongly suggests that it cannot be a cross-vein. The fourth radial branch and the first median are concave and the basally-convex and apically-concave anal vein all differ from the normal. Other veins are normal. An ambient vein is present, reaching to the apex of the cubital vein. Hair occurs on the membrane between the apices of Sc and R_{1+2}.

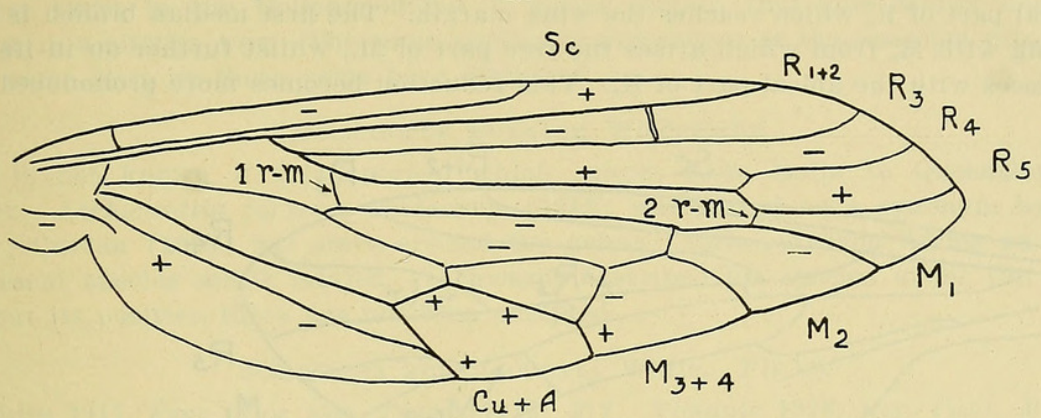

Fig. 1.—The venation of *Panops flavipes* Latr., illustrating those veins which are convex (+) and concave (−). The veins *2 i-r*, M_2 and *i-m* are neutral, being in a small flattened area of the wing membrane.

The proboscis reaches to the second abdominal segment and the abdomen has six observable segments complete; the seventh sternite and the hypopygium are also distinctly visible.

Hab.—New South Wales and southern Queensland. Three specimens examined. I have met with this species twice only, once near Sydney and once at the large swamp at Sunnybank, Qd., both occasions being in October. A specimen in the Queensland Department of Agriculture is labelled "Stanthorpe, 2.11.1927" and bears a supplementary label with "S. M. Watson". It is an unusually large specimen and the above notes are taken from this, as also the sketch of the venation.

Superfamily Asiloidea.

The manner in which the Dolichopodidae have derived their peculiar venation has given a clue to the formation of a phylogenetical treatment of families centred around the Empididae. The Lonchopteridae may have derived their venation from the Empid type as there is no evidence to suggest otherwise. In this case R_5 and M_1 do not coalesce as in the Dolichopodidae and presumably in the Platypezidae, too. It seems that *Sciadocera*, originally described as an Empid, has its veins reduced from the Dolichopod type and so belongs to that stem.

Key to the Empid-Dolichopod Complex.

1. The first median branch (M_1) never coalescing with the fifth radial branch (R_5). The subcosta reaching the costa independently, but sometimes it is reduced in length 2
   The first median vein coalescing apically with the fifth radial vein, with the course of R_5 broken between the point of meeting and the interradial cross-vein (*i-r*) 3
2. The arista two-segmented at most. The venation varies and only a few veins may be retained, but usually the median cell is present ..... Empididae
   The arista three-segmented. The venation is much reduced and the median cell is absent ..... Lonchopteridae
3. Arista two-segmented, but sometimes it arises from a tubercle which looks like another segment. Venation variable but the subcosta, when complete, coalesces apically with the first radial branch ..... Dolichopodidae
   The arista three-segmented 4
4. The subcosta coalesces apically with the first radial branch ..... genus *Sciadocera* White
   The subcosta normally reaches the costa but sometimes it is incomplete ..... Platypezidae

The genus *Sciadocera* is best appended to the Dolichopodidae as it agrees there in head, tarsi and leg adornment.

Family Dolichopodidae. Fig. 2.

The radial field has been reduced to three apparent branches and the way in which this has been accomplished is given in a series of figures that shows the stages developed

from the Empid type to that median character found on *Dolichopus zickzack* Wied. In this species, in the genus *Vaalimyia* Curran, and in various South American species of Chrysosomatinae, there is an appendix attached to the second bend of the so-called first median branch. This appendix marks where M_1 has coalesced with R_5 which itself is interrupted between the appendix and the interradial cross-vein. The radial sector is reduced to two apparent branches, R_3 and the basal part of R_5 in continuity with *i–r* and the apical part of R_4 which reaches the wing margin. The first median branch is basally coalescing with M_2 from which arises the free part of M_1, whilst further on in its course M_1 coalesces with the apical part of R_5. This reduction becomes more pronounced by the

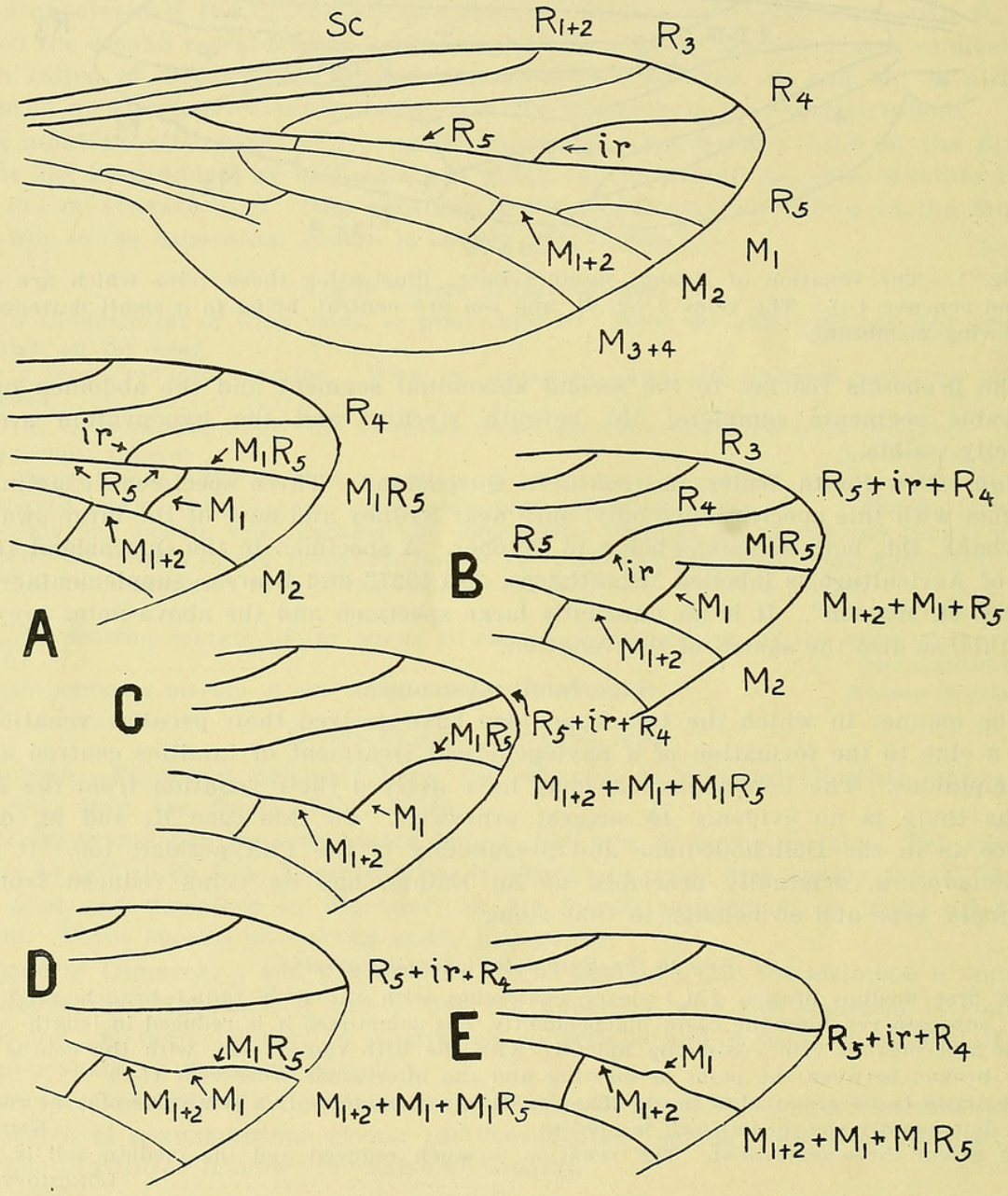

Fig. 2.—The venation of an Empid having the full complement of veins in the radial and median fields, but with M_1 and M_2 coalescing at their bases. From this can be traced the condition which occurs in the Dolichopodidae. In A, the branch M_1 coalesces with R_5 at its apex, and in B, the vein R_5 is interrupted between this point of coalescence and the interradial cross-vein, leaving a small appendix to mark the free part of R_5 at its union with M_1. Further stages in this development are seen in C, where the branch M_2 begins to disappear, whilst the compounded vein R_5 + *i-r* + R_4 tends to straighten out. In D, this reaches a stage where the compounded vein M_{1+2} + M_1 + R_5M_1 also tends to straighten, reaching the condition in E where a kink is left (and seldom absent) to mark the position of the free part of M_1. In extant forms the radial field is left with three more or less straightened veins, and the median field retains types illustrated in B to E, that of A being the hypothetical stage that accounts for the origin seen in the Empid type of venation.

elimination of the free part of M_2 and the appendix. The zig-zagging veins remaining tend to straighten out in the normal way, and in so doing, the last sign of this amalgamation is noted in the kink that represents the free part of M_1. This kink is rarely absent in the venation of advanced genera of the family. Thus it is seen that here the vein M_1 of taxonomists is the complex $M_{1+2} + M_1 + M_1R_5$. The vein R_{4+5} becomes the complex $R_5 + i\text{–}r + R_4$. Owing to the normal venation of the Platypezidae being like the more primitive types in the Dolichopodidae, it seems certain that this family derived its venation in a similar way. The same applies to *Sciadocera* as the venation retained lies in the same form as those veins here discussed.

DOLICHOPUS ZICKZACK Wiedemann.

It is not known if this species, which ranges from India to Queensland, is a complex. *Lichwardtia formosa* Enderlein (1912) was placed as a synonym by Becker (1922); Curran (1926) has since erected the genus *Vaalimyia* from Africa and to this the present species seems related. Lichwardt described his species under Chrysosomatinae but its position there has not been accepted.

SCIADOCERA RUFOMACULATA White. Fig. 3.

White 1917, *Proc. Roy. Soc. Tasm.*, 1916: 218. Tonnoir 1926, *Rec. Cant. Mus. N.Z.*, 3: 31–8, Pl. 4 (as *maculata* in error).

This unique fly was described from Tasmania under the Empididae by White, but Tonnoir regarded this position as unsatisfactory and so relegated it to the Phoridae with which he saw some resemblance in venation and terminalia. The venation, however, does not conform sufficiently, and the terminal part as drawn by Tonnoir is unsatisfactory, as he missed the aedeagus at least. Tonnoir concluded his discussion with: "I believe, therefore, that there is not the least affinity between *Sciadocera* and the Empidae; if some were looked for with a family of the Brachycera it would be rather with the Dolichopodidae, on account of the shape of the head, the posterior row of bristles, the structure of the antennae, and Sc fused distally with R_1." He used the term Brachycera in a restricted sense.

It now becomes possible to show that the venation is nearer to the Dolichopod type than that of the Phoridae and the drawing here given is that of Tonnoir's figure with the free part of M_1 restored by a broken line, the upper median main vein similarly completed and the intermedian cross-vein removed to a position more apically distant than actually found in the fly. At present it is not clear how this could possibly lead to the venation in a Phorid fly.

Following the sixth abdominal segment there is a small seventh tergite and beyond this an asymmetrical eighth tergite to which the hypopygium is attached. The hypopygium consists of the ninth segment reduced to a pair of side-plates dorsally placed,

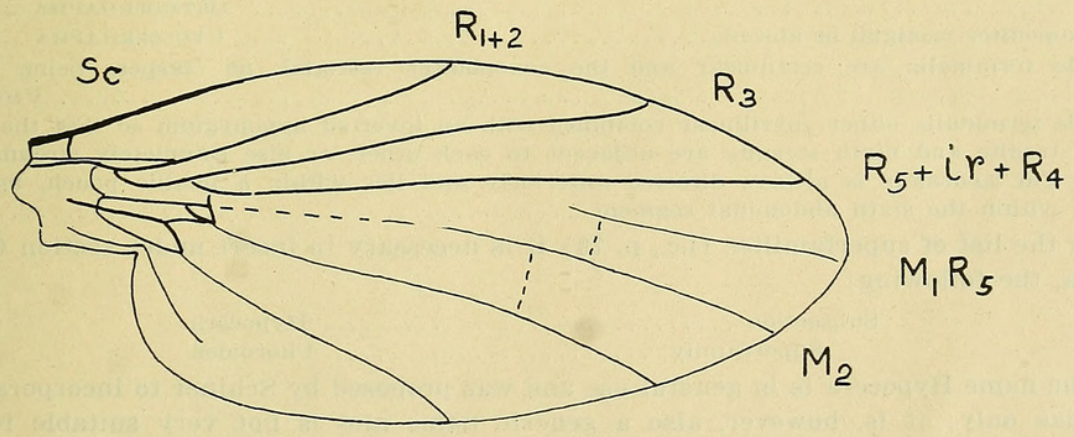

Fig. 3.—The venation of *Sciadocera* (after Tonnoir) added to which are broken lines representing veins needed to complete the figure to make its Dolichopod origin understandable. The added upper vertical vein is M_1 which coalesces with R_5, and the added horizontal vein borders the median cell above. The added lower vertical line marks the position of the apical border of the median cell, the vein normally there having retreated to a position in alignment with the radial-median cross-vein.

and below them the presumed anal papilla (Phorid in shape and position), but no aedeagus and no claspers are shown. There is a ventrally-placed single sclerite, that is slightly asymmetrical and indented at the apex, whereas in the Phoridae there is a pair of latero-ventrally placed plates. If the hypopygium drawn by Tonnoir be an inverted one, then the anal papilla would become the aedeagus and the pair of dorsally-placed plates is the vestigial basi-styles of taxonomists, and the rest of the hypopygium as drawn becomes understandable. There is no evidence, however, that this is the true rendering, but probably the drawing is incomplete, parts being broken down, perhaps, by the caustic treatment which Tonnoir used in his mounting of terminal parts.* Tonnoir states of the hypopygium that it is "not widely different to that of *Apiochaeta*". I have examined this Phorid and found a wide divergence from the drawings, but the anal papilla was reasonably like that of *Sciadocera*; Tonnoir, however, included the eighth segment with the hypopygium which added to the resemblance.

Family Phoridae.

The relationship of this family has been under constant dispute, but on larval and pupal characters it is generally included under the Cyclorrhapha. The terminal parts, however, are definitely Orthorrhaphous in type, and erect, as shown by the retention of the anal papilla lying above the aedeagus, and both these parts have the orifice directed rearwards. The venational characters are such as to suggest that either the radial and median fields coalesced, or the upper main branch of the median vein was eliminated in the part between two radial-median cross-veins, leaving the median branches joined to the radial field by incorporating these cross-veins in their development to form simple convex veins, the fifth radial being also incorporated perhaps with M_1. The radial field has the appearance of being three-branched but whether it passed through a process similar to that in the Dolichopodidae is problematical.

It would appear that the Phoridae were evolved from some pre-Syrphoidean type, and that they have developed too far to be classed with the Orthorrhapha and not far enough to have the circumverted hypopygium of the Syrphoidea. The aedeagus is unusual in form and incorporates an armature of a type unknown in either the Asiloidea or the Syrphoidea. The venation could have been derived from that of either the Tabanoidea or the Asiloidea. The similarity to the latter might be caused by convergence, but if the Cyclorrhapha be derived from the Dolichopod type, or from the Cyrtid type, as Crampton is inclined to think, is not yet clear. It may prove necessary to erect another superfamily for its reception, if the alliance of the Phoridae with Cyclorrhapha is to be maintained. This would render necessary another couplet in the key to superfamilies (Hardy, these Proceedings, 69: 80) and a slight alteration as follows:

A. Coxopodites (which include the primitive claspers) are present. Male terminalia rectilinear or else curvilinear with the eighth and ninth tergites adjacent to each other ..... Orthorrhapha 2

Coxopodites vestigial or absent ..... Cyclorrhapha 1

1. Male terminalia are rectilinear and the coxopodites vestigial, no claspers being formed ..... Phoroidea

Male terminalia either curvilinear combined with an inverted hypopygium so that the eighth tergite and ninth sternite are adjacent to each other, or else completely circumverted. The aedeagus is always directed anteriorly and lies within a phallic pouch, normally within the sixth abdominal segment 7

In the list of superfamilies (l.c., p. 79) it is necessary to insert under section Cyclorrhapha, the following:

Subsection ..... Hypocera
Superfamily ..... Phoroidea

The name Hypocera is in general use and was proposed by Schiner to incorporate the Phoridae only; it is, however, also a generic name and is not very suitable for the purpose, standing as it does, for the subsection and a genus under it. Coquillett (1891) proposed the superfamily name in which he also included the Lonchopteridae, but this addition has not been accepted. The superfamily Phoroidea now covers two families—

* This defect is also noticeable in his rendering of the terminalia on *Pierretia australis* J. & T. (see these Proceedings, 68 : 22).

the Phoridae and the closely-related Termitoxeniidae which is limited in distribution to Africa and India.

Tillyard placed *Braula* under Phoridae, but that genus has the typical circumverted aedeagus of the Muscoidea and therefore must be excluded.

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* References already given in parts x and xi of this series (these PROCEEDINGS, Vol. 69 : 76-86 and Vol. 70 : 135-146) are not repeated here.