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## ON SOME SPECIES OF *PENTACORA*, WITH THE DESCRIPTION OF A NEW SPECIES FROM AUSTRALIA (HETEROPTERA, SALDIDAE)

by

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With 18 text-figures

### INTRODUCTION

In the catalogue of Saldidae (Drake & Hoberlandt, 1950), ten species of *Pentacora* are listed, but only six of these actually belong in this genus. For one species, viz., *mexicana* (Van Duzee) (see Lattin & Cobben, 1968), a separate genus has been erected (*Enalosalda* Polhemus & Evans, 1969; further details in Polhemus, 1972). *P. rubromaculata* (Heidem.) has been synonymized with *P. sphaelata* (Uhler) (Drake & Hottes, 1954; Cobben, 1965). Two other species listed by Drake & Hoberlandt (1950) were transferred to *Pseudosaldula* (Cobben, 1961), a genus which should be placed in the Saldinae. *Pentacora* is a member of the more generalized subfamily Chiloxanthinae. Later descriptions of *Pentacora* species (Drake, 1955a) refer mainly to *Pseudosaldula*, a genus widely distributed in South America.

The predominantly halophilous genus *Pentacora* presently contains ten species. Four of them (*P. hirta*, *ligata*, *saratogae*, *signoreti*) are known only from the West-Indies, USA and Canada. One species, *P. sphaelata* occurs in the southern areas of Mid and North America, West Indies, Surinam (Wiawia, xi.1972, leg. St. Panday-Verheuvél, new country record), Peru (Drake, 1955a), Galapagos Isl. (Polhemus, 1968), and in the West Mediterranean (Cobben, 1960). The remaining five species are recorded only from the southeastern parts of the Old World. A new *Pentacora* species from Australia is described here and compared with other oriental species. Type material of the latter species was also examined. A survey of the known species of the Oriental and Australian regions is given below.

***Pentacora salina*** (Bergroth, 1893) (figs. 3, 8, 15b, 17b, 18)

This species was described by Bergroth as *Acanthia salina* in 1893 and transferred to *Pentacora* by Drake & Hoberlandt (1950). I studied 3 ♂ and 3 ♀ of the Bergroth material (Mus. Zool. Helsinki). One male and one female, glued on the same card, have a label underneath with hand-written type indication, without reference to one of the two specimens. I separated the two individuals, pinned them separately and provided the male with a lectotype designation. This specimen bears the yellow Helsinki Museum label no. 15565. The type locality is Admiralty Gulf, N.W. Australia, in saltwater pools on rocks.

General characteristics: length of males: 3.4-3.6, of females: 4.2-4.3 mm. All six specimens are remarkably similarly dark coloured (figs. 3, 15b, 17b). In the Drake collection (Washington), there are two males identified as *P. salina* from Groote Eylandt in the W. Gulf of Carpentaria (18.vii.1952, leg. J. L. Wassel). My notes made during my visit to Washington in 1973 reveal that these specimens might belong to another species. Corium and membrane are predominantly light, whereas the clavus is for the greater part black. A more detailed study was not possible at the time.

***Pentacora sonneveldti*** Blöte, 1947 (figs. 2, 12, 15a, 16a)

*P. sororia* Drake, 1955. n. syn.

Blöte described the species after two females collected at Makassar (now Ujung Pandang), Celebes (Sulawesi), between x.1927 and iv.1928. Drake (1955b) mentioned *P. sonneveldti* also from Malaya, but this must be based on a misidentification. I saw 1 ♂ and 2 ♀ of *P. malayensis* (from the type locality) in the British Museum (Natural History) and 1 ♂ and 1 ♀ from the same type-series, in the Drake collection (Washington), which were erroneously labeled as *P. sonneveldti* by Drake. I could not find any difference between *P. sonneveldti* and *P. sororia* (holotype, paratypes and additional series from the Solomon Islands could be studied). Drake (1955) stated that *P. sonneveldti* is clothed with distinctly longer hairs than *P. sororia*, but I cannot confirm this. The type material of *P. sonneveldti* contains no male, so that no comparison of male genital structures of the Sulawesi and Solomon Island population could be made. However, I expect no differences since the male genitalia of other oriental *Pentacora* species, closely allied with *P. sonneveldti*, are very much alike. Therefore, I conclude that *P. sororia* and *P. sonneveldti* are conspecific.

General characteristics: length of males 3.5-4, of females 4.3-4.5 mm. Light-dark pattern of head, pronotum and forewing as in figs. 15a, 17a and 2,

respectively. The variation in pigment design is not great, varying slightly around the picture presented in fig. 2.

***P. malayensis*** (Dover, 1929) (figs. 5, 11, 15c, 16b, 17c)

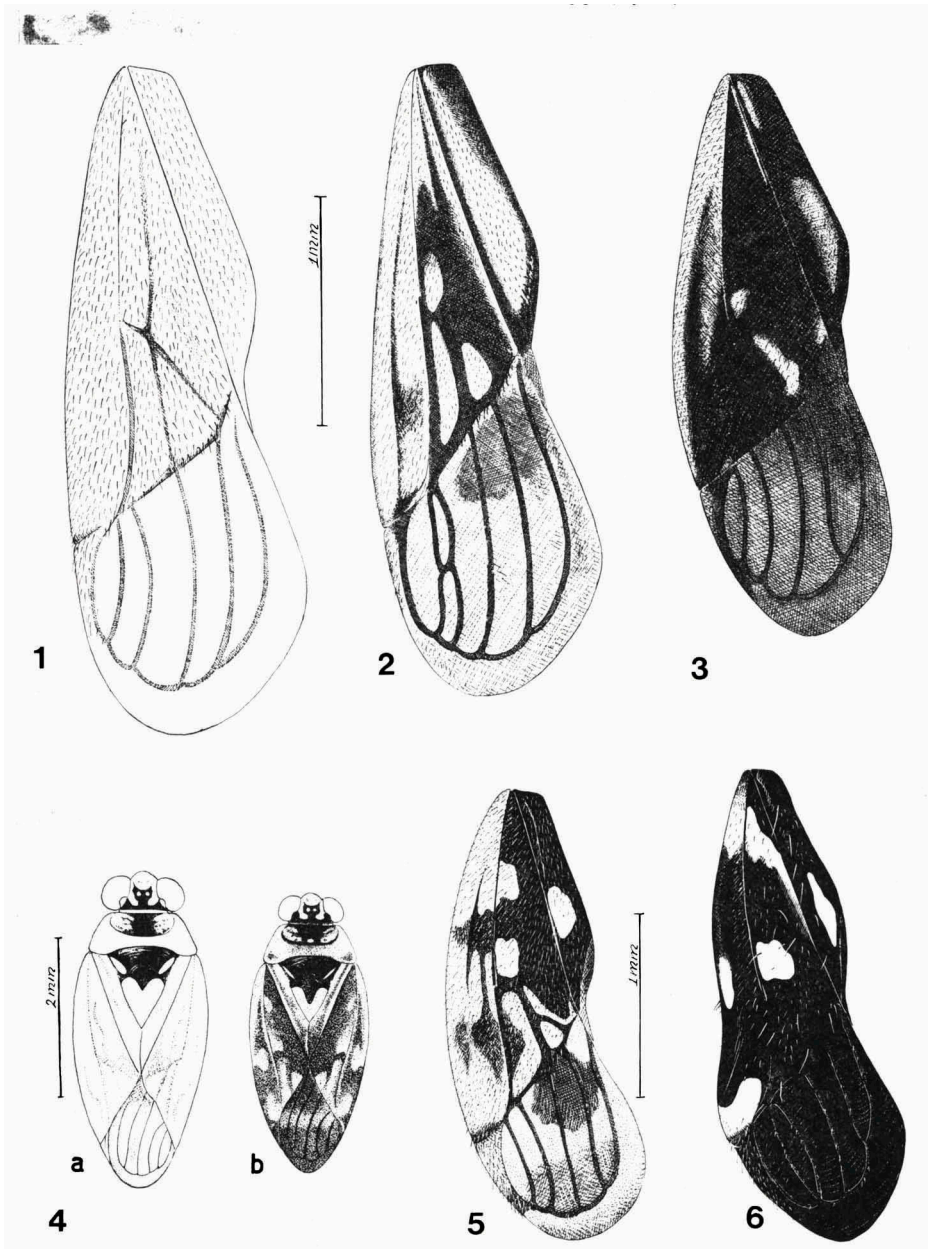
*Saldula korangiensis* Hamid & Sultana, 1972. **n.syn.**

Originally described by Dover (1929) in the genus *Salda*, this species was placed in the genus *Saldula* by Drake & Hoberlandt (1950). The type locality in Malaya is Kuala Langat, W. Coast, Morib, where it is reported to be common at the edges of pools in mangrove swamp about half a mile from the sea-beach. Except for the type-series, I studied a female from Thailand (East Point, 27.xi.1927, leg. W. R. S. Ladell). The species may have a wide distribution along the coasts of the Arabian Sea, Bay of Bengal and the South China Sea. There are 1 ♂ and 1 ♀ from Taiwan (Amping, leg. H. Sauter) in the Drake Coll. (Washington, D.C.) which indeed may be identical with *P. malayensis*. The same appears to be true for *Saldula korangiensis*. Hamid & Sultana (1972) described the latter species from West Pakistan (Karachi, 5 mi before Korangi Creek), but both the description and drawing clearly point to *Pentacora*. I studied the holotype of *P. korangiensis*, without dissection, when visiting the National Museum, Washington D.C., in 1973, and concluded that it certainly belongs to *P. malayensis*.

General characteristics: length of males 3.6-3.9, of females 4.0-4.5 mm. Head, pronotum and forewing of a paratype ♂ are depicted in figs. 15c, 17c and 5, respectively. The species can be separated easily from the *salina-sonneveldti-grossi* complex in that it is less shining and by the more convex lateral sides of pronotum and forewings; the ratio width of pronotal collar/pronotum length is about 1, but 1.2-1.3 in the other species; the extent and location of the claval light spot is characteristic and constant in the 7 specimens seen; the embolar locking device of the ♀ has a pubescence continuous with the normal hair-cover of the wing (fig. 16b), whereas in the other species, including *P. sphaelata*, this locking area is glabrous. The spines on the ♂ coupling plate are more regularly arranged in one row than in the other species.

***Pentacora leucographa*** Rimes, 1951 (figs. 6, 13, 15d, 17d)

This species has probably a very wide coastal distribution in Australia. The type locality is at the south coast, but specimens are now available from the opposite north and from the west (Normanton, Queensland, at light, 3-5.vi.1963, leg. P. Aitken & N. Tindale; Darwin, N. T., Swamp, 10.xii.1977, leg. J. T. Polhemus; Meckering, 62 miles east of Perth, brackish pools along small stream, 14.xii.1971, leg. J. A. Slater). It is a strikingly black- or brown-



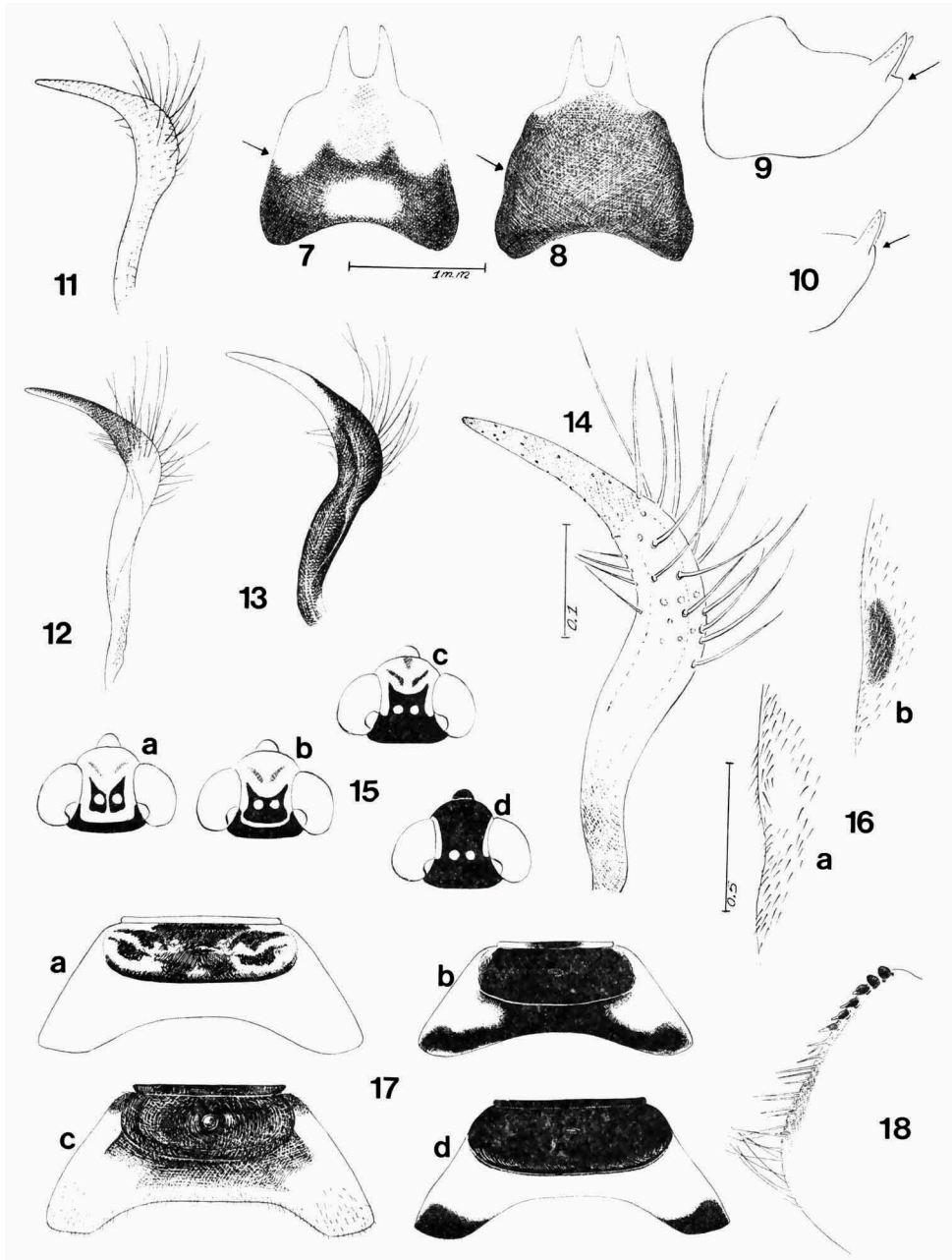
Figs. 1-6. Forewings of *Pentacora* spp. 1, *P. grossi*; 2, *P. sonneveldti*; 3, *P. salina*; 4, *P. sphacelata*; a, male from St. Martin; b, male from Curaçao (Caribbean region); 5, *P. malayensis*; 6, *P. leucographa*.

white pictured species (figs. 6, 17d), which is easily recognized from the other oriental species dealt with here. A further difference mentioned by Rimes (1951) refers to the greater length of the last antennal segment. My measurements reveal that the 4th segment is nearly two times the length of the first segment in *P. leucographa* and only 1.3-1.4 times in the other Australian species. Although *P. leucographa* belongs to another species group, I see no reason to place it in a new genus, as Drake (1962) did when erecting *Pelachoris* to accommodate it. He separated it from *Pentacora* "by the general habitus, callus (transverse and extending sideways almost to outer margins of pronotum), shallowly excavated hind margin of pronotum, deeply notched hind margin of seventh abdominal sternum in female". The deep notch in the female subgenital plate also occurs in the other Oriental *Pentacora* species. According to Polhemus & Evans (1969), in their key to genera of the Chiloanthinae, absence of this deep notch is said to characterize *Pentacora* and its presence *Pelachoris*. A deep median notch should also be present, according to these authors, in the genera *Paralosalda* and *Enolasalda*, but my examination revealed absence of such a notch. The transverse development of the pronotal dome (fig. 17d) is equalled in some *Chiloxanthus*, and within the Saldinae in various genera and species groups. Thus it is evidently brought about by parallel development. The consequences of placing *P. leucographa* in a separate genus would be that the American species of *Pentacora* also should be divided into at least two genera on the basis of only small differences and characters, which evolved again and again independently in other saldid groups.

***Pentacora grossi* sp. n.** (figs. 1, 7, 14, 17a)

Since this species differs only in minor details from the closely allied species *P. salina* and *P. sonneveldti*, I refrain from giving a full morphological description. It is the most light-coloured species of the trio. Forewing, inclusive of clavus, unicolourous ochreous with only the veins brown (fig. 1). Pronotum with straight lateral sides and only the dome irregularly dark-patterned (Fig. 17a). Dark-light pattern of head as in fig. 15a. Other details figured are: hemielytral locking device of ♀ (fig. 16a), male coupling plate (fig. 18), male genital capsule, ventral (fig. 7) and paramere (fig. 14). Length/width of 10 ♂: 3.8-4.3/1.6-1.8; 10 ♀: 4.7-5.0/2.0-2.1 mm.

Material: 25 ♂, 43 ♀, Normanton, Queensland, 3-5.v.1963, at light (leg. P. Aitken & N. B. Tindale); 3 ♂, 4 ♀, Mornington, Queensland, 5.v.1963, at light (leg. P. Aitken & N. B. Tindale); 1 ♀, Darwin (leg. G. F. Hill). Holotype ♂ (from Normanton, Queensland) in the Australian Museum, paratypes idem and in the British Museum (Natural History) Collection, the



Figs. 7-18. Various details of *Pentacora* species. 7, 8, ventral view of male genital capsule of *P. grossi* (7) and *P. salina* (8); 9, 10, left side view of male genital capsule of *P. sphacelata* (9) and other Old World species (10); 11-14, left paramere of *P. malayensis*, *P. sonneveldti*, *P. leucographa*, *P. grossi*, respectively; 15, dorsal view of head of *P. grossi* and *P. sonneveldti* (a), *P. salina* (b), *P. malayensis* (c), *P. leucographa* (d); 16, embolar locking device of ♀ of *P. malayensis* (b), *P. sonneveldti* and *P. grossi* (a); 17, dorsal view of pronotum of *P. grossi* and *P. sonneveldti* (a), *P. salina* (b), *P. malayensis* (c), *P. leucographa* (d); 18, male grasping plate of *P. salina* and *P. grossi*.

Rijksmuseum van Natuurlijke Historie, Leiden, Polhemus Collection and the authors collection.

I name this species in honour of Dr. Gordon Gross (Australian Museum) for his important research on Australian Heteroptera.

#### Comparison with other species.

The whole sample of *P. grossi* at hand, 76 specimens, is remarkably uniform as regards the almost complete lack of a dark wing pattern. In only a few individuals, the inner edge of the exocorium and membrane is light-brownish. I hesitated initially to describe this population as new because of lack of clear-cut distinct differences with *P. sonneveldti* and *P. salina*.

Comparing the dark pigmentation of head, pronotum and forewing, *P. grossi* (figs. 15a, 17a, 1) and *P. salina* (figs. 15b, 17b, 3) represent the lightest and darkest extremes, respectively, of an eunomic series as it often occurs intraspecifically in other species (e.g., *P. sphacelata*, (fig. 4a, b)). However, in other species showing eunomic variation, this variation is manifest at least to a limited degree in individuals of one and the same population. In contrast, the three *Pentacora* populations considered here are remarkably uniform. There are nevertheless small morphological differences, though of a gradual nature, and thus they have to be checked in future catches from other localities. The discrepancies so far are as follows: (a) the length of *P. grossi* is above 3.8 mm (♂), 4.7 mm (♀), of *P. salina* and *P. sonneveldti* below 3.6 mm (♂) and 4.4 mm (♀). Material from other localities may bridge this size-gap; the long series of *P. grossi* was collected at light and has the maximum size of wing development; (b) the lateral sides of the male genital capsule are straight in *P. grossi* (fig. 7), weakly sinuate in *P. sonneveldti*, strongly sinuate in *P. salina* (fig. 8); (c) the ratio of pronotal length/scutellum length is  $\leq 2$  (1.7-2.0) in *P. sonneveldti* and  $\geq 2$  (2.0-2.3) in *P. grossi* and *P. salina*; (d) the dorsal pubescence, especially of the pronotum and scutellum (exclusive of some erect semi-long hairs) is shortest in *P. sonneveldti*, longest in *P. grossi* and of intermediate length in *P. salina*; (e) the terminal process of the paramere is more slender in *P. sonneveldti* (fig. 12) than in *P. grossi* (fig. 14) and *P. salina*.

The three species considered here meet the definition of a superspecies complex. However, the scant locality records suggest that *P. grossi* and *P. salina* might occur more or less sympatrically, since the Admiralty Gulf (*P. salina*) is only at a distance of about 400 km from Darwin, where *P. grossi* has been collected. Consequently we may expect that some ecological displacement between both species has arisen.

## DISCUSSION ON THE OLD WORLD SPECIES

The Chiloxanthinae, to which *Pentacora* belongs, is a generalized subfamily; its ancestry is reflected by a more restricted pattern of distribution than the more evolved and relatively more recent subfamily Saldinae which is world-wide. I agree with Polhemus (1977) that the modern distributional picture of Chiloxanthinae can best be explained by assuming origination somewhere in Laurasia. The main argument of Polhemus (1977: 227, 484) is that the few known fossil Chiloxanthinae occurred in fresh water habitats in the northern hemisphere of both the Old and the New World, and that all modern cold-adapted Chiloxanthinae (mostly belonging to *Chiloxanthus*) occur in the holarctic. He considers the genus *Pentacora* the most advanced of the Chiloxanthinae. Arguments for this latter supposition are presented in Polhemus' cladogram (fig. 31, p. 248). I question some of the apomorphies selected in this cladogram in order to split *Pentacora* from *Chiloxanthus*. I would like to comment here on the five apomorphic characters of *Pentacora* which Polhemus used to delimit it from *Chiloxanthus*. My comments are given between brackets after each character.

Character 14: 'second hypocostal ridge (hrs) present'. (hrs is very weakly developed in *P. leucographa*, more distinct in *P. sonneveldti*, *grossi* and *salina*, and well developed in *P. malayensis* and the American species. Polhemus himself (1977: 125) concluded that within the Saldidae, the hrs apparently evolved independently a number of times. This being the case, and being aware of the steps of anagenesis within *Pentacora*, I assume that we may expect to find a *Pentacora* species without hrs (certainly it has existed once), and a *Chiloxanthus* species with an indication of hrs, or developing such a ridge in future evolutionary time).

Character 16: 'female embolar wing coupling region strongly modified, manifested in a sculptured dorsal tumescens (ebm) medially' (this differentiation in *P. hirta*, *P. malayensis* and *P. leucographa* is weak, without tumescence and hardly different from conditions in *Chiloxanthus*).

Character 19: 'ocelli approximate' (in *Chiloxanthus kozlovi*, the ocelli are separated less than the width of ocellus, approaching the condition in *Pentacora*).

Character 23: 'Callus of pronotum set off from disc by a row of distinct pits' (the 'distinct' pits are discernible with difficulty with 500 × magnification in *P. signoreti* and *P. hirta*, not in the other species; similar pits have arisen independently in various genera of Saldinae).

Character 25: 'posterior tibia with distal comb (however, all seven species of *Chiloxanthus* studied by me possess such a comb!).



It is clear from these comments that none of the five characters discussed above may be used to define the splitting point for *Pentacora* and *Chiloxanthus*. The only apomorphy given by Polhemus for *Chiloxanthus*, namely the reduction of the sublateral cell of the membrane, is also liable to anagenetic change. Reduction of this cell may have occurred or will occur in *Pentacora*; complete loss, as I had predicted in 1961, indeed has been realized in the chiloxanthine genus *Paralosalda* Polhemus & Evans (1969).

Whatever the limits may be of the cold-adapted *Chiloxanthus* and the warm-adapted *Pentacora*, they certainly form sistergroups; the question which of the two is more advanced is then not relevant for the problem which of the alternative habitats (either cold region-freshwater or warm region-saline water) has been originally occupied by this monophyletic group. However, an out-group comparison leads to the assumption of the latter alternative. The forerunners of *Chiloxanthus-Pentacora*, represented by the genera *Paralosalda* and *Enalosalda*, live, like other conservative taxa outside the Chiloxanthinae (e.g., *Orthophrys*, *Salduncula*), exclusively in warm regions along seacoasts.

Ancestors of Chiloxanthinae probably arose somewhere in the western part of Laurasia along the southern coastlines and spread eastward before the end of Mesozoic, before Africa made contact with Eurasia. Such events could account for the almost complete absence of Chiloxanthinae in South America and Africa. *P. sphacelata* is the only intruder along the northern borderlines of these two southern continents. In the West Mediterranean (Morocco, Spain), it appears to represent a recent introduction somewhere from the New World, where the species occurs widely. The first record from the Old World dates back to 1934 (Wagner, 1953, described as *P. iberica* n. sp., synonymized by Cobben, 1959). Both the Old and New World populations of *P. sphacelata* have the ♂ genital capsule projected behind the base of the parandria (fig. 9), a character which separates this species from all other species of the genus *Pentacora*. If the present occurrence of *P. sphacelata* reflects Gondwanaland distribution, some differences between the western and eastern populations would likely have evolved after the continental drift.

Geotectonic and climatic changes during the Cenozoic have influenced the distribution of Chiloxanthines. *Chiloxanthus stellatus* (Curt.), presently restricted to northern Fennoscandia, Siberia, Alaska and Canada, lived under subarctic conditions in England (near the present site of Birmingham) during the last glaciation (Coope & Sands, 1966). On the other hand, warm-adapted chiloxanthines occurred during upper-oligocene in Germany near Rott (presently 'Siebengebirge'). Statz & Wagner (1950) described three new species from this locality and placed them in the new genus *Oligosaldina*.

The differences between the remnants of these latter fossil species are very slight, and the simultaneous occurrence almost certainly suggests only a single species. Although the general facies of *Oligosaldina* resembles *Pentacora* very much, the dimensions (5.2-5.8 mm) are larger than of any of the present Old World *Pentacora* species. Anyhow, during the formation from which the fossil deposits originate the climate was warm and subtropical (Theobald, 1952; Knetsch, 1963). The locality mentioned was considered to be a freshwater habitat, but it should be remembered that *Pentacora ligata* (Say), one of the five *Pentacora* species living in the USA, also made a shift towards life around fresh water.

As mentioned previously, the fact that Chiloxanthinae in the Old World and the New World lived in fresh water situations during Cenozoic time, was one of the reasons why Polhemus (1977) assumed that this subfamily arose in non-saline habitats. The New World fossil considered by him is *Pseudosaldula* (= *Oreokora*) *froeschneri* (Lewis) from the Latah formation of the Miocene. This species is most probably, however, a saldine and is placed in *Pseudosaldula* because the most lateral of the five cells of the membrane is strongly reduced. In 1961, I presented evidence that the fifth cell of the membrane in the Saldinae was lost during evolution, whereas in Chiloxanthinae, there is a tendency for reduction and possibly ultimate loss of the fourth cell. *P. froeschneri* seems to have a longer costal fracture than recent *Pseudosaldula*, which presently forms a freshwater group in South America. On the basis only of this longer fracture, Polhemus (1977: 225) transferred *P. froeschneri* to the Chiloxanthinae and erected a new genus for it: *Propentacora*. His argument for this procedure is the belief that the fracture is a stable subfamily characteristic, such in contrast to my view (Cobben, 1961) that the costal fracture has been liable to anagenetic reduction throughout the family. Indeed, the fracture is fully developed in *Chiloxanthus pilosus*, but the long-winged *Chiloxanthus corporaali* Lindb., *C. kozlovi* Kir. and *C. lami* Kir. have a short fracture as in typical Saldinae, and this fracture is almost entirely absent in *C. poloi* Kir. Steps to assign fossil saldids to new genera or higher categories should be undertaken with great care, since observable critical morphological details are limited. <sup>1)</sup>

<sup>1)</sup> In 1971, I described the fossil *Leptosalda chiapensis* from tertiary amber of Chiapas, Mexico. For a number of reasons I placed it in a new subfamily, provisionally, as the most early offshoot within the Saldidae. Polhemus (1977: 121-223) considers it to be a leptopodid, but in my view this is based on some misconceptions: "the antennae are of the same general facies as those of saldids, but have very long sensillae typical of leptopodids" (not true for Leptopodidae!; the antennal pilosity of *Leptosalda* is very much like in *Aepophilus*); "the short beak and lack of hook-like parameres, parandria and costal fracture are typical leptopodid features" (the short beak exactly matches the

In conclusion, there seems to be evidence that *Pentacora* and its ancestors evolved along the southern coastal margins of Laurasia. The evolution of the predominantly cold-adapted arctic or high-altitude *Chiloxanthus* species must have been the result of a secondary ecological shift, paralleled by the Saldini of Saldinae.

#### SUMMARY

A review is given of the characteristics, relationships and distribution of the *Pentacora* species of the Old World: *P. grossi* n. sp., *P. leucographa* Rimes, *P. malayensis* (Dover) (= *Saldula korangiensis* Hamid & Sultana, nov. syn.), *P. salina* (Bergroth), *P. sonneveldti* Blöte (= *P. sororia* Drake, nov. syn.), *P. sphaelata* (Uhler). It is argued that the Chiloxanthinae, to which *Pentacora* belongs, originated in warm and saline habitats along the southern fringe of Laurasia. Some comments are made upon recent usage of saldid characteristics for tracing cladistic branching and delimitation of taxa.

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plesiomorphous condition of the anagenetic trend of lengthening in the Saldidae; the parameres are not visible in the fossil, nevertheless I expect they are not hook-like, but rather club-like as in *Aepophilus*; the confirmation of presence or absence of a costal fracture would be of critical value to affiliate *Leptosalda* either to the Saldidae or the Leptopodidae; I was rather convinced to have observed the very long fracture as a very neat white line, whereas Polhemus thinks the line is an artefact due to entrapment of air in the amber next to the M vein. However, the apical lateral curve of this 'vein' (see my fig. 2, 1971) is quite unusual in Leptopodomorpha; it conforms more with the course of a fracture; Polhemus calls the wing brachypterous and he states that the fracture is rarely developed in brachypterous forms in modern saldids; however, the wing of *Leptosalda* is slightly semibrachypterous and in such similar condition of wing reduction the fracture is fully present in, e.g., *Chiloxanthus pilosus*).

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