

A MADEIRAN ASSEMBLAGE OF COLEOPTERA DEVELOPING IN DEAD WOODEN ROOTS

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With 30 figures

ABSTRACT. The emersion of coleoptera out of some dead pieces of dead wooden roots from a Madeiran locality was followed in the laboratory for about two years. In all ten species emerged, some of them in abundance, which gave possibilities of completion of previous descriptions, records of variation, views on the taxonomical interest of some usually neglected inner organs. The periodicity of the appearance of adults discussed.

RESUMO. A emergência de coleópteros de bocados de madeira morta, provenientes da Madeira, foi seguida em laboratório durante dois anos. Ao todo emergiram dez espécies, algumas delas abundantemente, o que possibilitou o aperfeiçoamento de descrições anteriores, registos de variação e a avaliação da importância taxonómica de alguns órgãos internos normalmente negligenciados. É discutida a periodicidade do aparecimento das formas adultas.

Key words : subterranean fauna, *Langelandia*, *Parastyphloderes*, *Cossoninae*, *proventriculus*.

INTRODUCTION

At the end of November 1980 during an excursion to Garajau, Wollaston's "Brazen Head", a famous beetle locality some five km, as the crow flies, to the east of Funchal on Madeira my wife called my attention to the presence of insects under the bark of the basalmost part of a pulled-up specimen of *Echium nervosum*. The sight of a weevil I had never seen before did not abate my curiosity. A couple of dead roots of other *Echium* bushes were dug up to a depth of about 2 1/2 dm and were brought home to my laboratory where they were preserved in glass jars with a not hermetically fitting lid.

The material was kept in the dark at room temperature and normal air humidity, with a small quantity of water now and then added to com-

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pensate to some extent the evaporation. During the following slightly over two years the jar was repeatedly searched for emerged insects which were removed, killed if alive, counted and stored. The search-intervals had to be widely varying, from one or two days to exceptionally as long as four months.

In March of the following year we took another opportunity of visiting the Garajau locality. A few more pieces of root were collected and later added to the previously collected ones. The combined length of all the pieces reached about 18 dm and their diameter varied between two and three cm. The total wood volume would then be in the region of four cubic dm.

Towards the end of 1982 the yield of emerged beetles went down dramatically and in January 1983 the experiment was ended. The rotten wood was partly covered with the fruitbodies of a resupinate fungus but could not be found to contain any more insects.

Several species were considered rare and sparse and were consequently little known. The comparatively rich material now available made it possible to complete the previous descriptions, among other things also to include some internal organs hitherto completely neglected but, with the at present increased interest in phylogeny, often being suitable targets in the hunt for synapomorphies. An example is the proventriculus, by Nüsslin (1911-12) regarded to be of pre-eminent value in the systematics of scolytids but also being of great interest in other Curculionidea according to Aslam (1961).

The variation of the local populations was studied and views on the conventional taxonomy of some species were offered.

The quantitative results of the experiment were summarized in a table from which some conclusions are drawn.

LIST OF SPECIES, WITH TAXONOMIC AND BIOGEOGRAPHIC NOTES

Fam. *Colydiidae*

Prostheca aspera Wollaston

This is a small, reddish, apterous and anophthalmous species, described from a single specimen collected in the Funchal area and rediscovered there by Vit (1986) and excellently redescribed and illustrated. Vit also established the synonymy of the species with *Dodyronymus lusitanicus* Binaghi, erected on a Peninsular Portuguese specimen and recently recorded from the Azores by Gillerfors (1986), thus possessing a rather wide distribution, incidentally within the political boundary of Portugal.

Langelandia mauli Franz

Franz (1970) was the first to record representatives of this Mediterranean genus of blind and apterous beetles from Madeira. Two new species were described : *mauli*, based on four specimens from the vicinity of Funchal, and *portosantoi* on a specimen from Porto Santo, together, with some hesitation, with one more specimen collected on Gran Canaria of the Canaries.

In 1974 I found some specimens referable to *mauli* at some 600 m, above Monte near Funchal. They, together with the present Garajau series, provide an idea of the variation of the species. The total variation in body size was found to be 2.21 - 3.28 x 0.65 - 0.90 mm, showing that the body is about 3.3 - 3.6 times longer than broad. The size of *portosantoi* was given as 1.85 x 0.72 mm, that is the body would be about 2.6 times longer than broad, an absurdly low figure for a *Langelandia* s. str.. Nor does anything indicate that Franz would have noticed the body to be of unusual stature, such as "very short" or "broad". We therefore conclude that the indication of the size was probably due to some misprint. Franz's figures for *mauli*, on the other hand, fit nicely into the frame found by me.

The head is 1.7 times as broad as long in *portosantoi* but would be nearly twice as broad in *mauli* according to Franz whose figures tally with his illustrations, but then it should be noted that the heads were not entirely correspondingly oriented (*op. cit.* : figs. 1a and 1b) which could well account for the difference. In my material the index is about 1.7.

Daffner (1983) described *L. brachati*, a closely related form from Tenerife. The character particularly emphasized was the side edge of the elytra, if visible from above, only anteriorly or nearly to the apex. There is no reason to doubt his observation but his material was very scanty and this feature is in fact very variable in the Madeiran material.

The aedeagus of the Garajau *mauli* is similar to that drawn by Dajoz (1977 : fig. 158) from the continental *anophthalma* Aubé. It is of the vaginate type with the basal piece separated from the tegmen by a distinct line and fine lateral constrictions. Both species have a weakly sclerotized subbasal process, on each side protruding towards the apex (Figs. 1 - 3). These are the "languettes" of Dajoz interpreted by him as parameres. In fact these structures are glabrous, hyaline processes from a loosely attached, finely reticulate membrane, in part surrounding a subbasal portion of the penis, forming some associations with the basal piece of Lawrence (1975 : fig. 85) found in Cisidae, except that the latter membrane completely surrounds the basalmost portion of the penis and lacks processes and reticulation. Considering the *Langelandia* populations discussed specific differences can be questioned. It certainly takes a larger material than presently available to decide if the Macaronesian Islands house more than one species of the subgenus. Dajoz thinks that the Madeiran forms could be races of *anophthalma* or *reitteri* which seems reasonable enough.

Fam. **A n o b i i d a e****Nicobium villosum** (Wollaston)

This species is extremely close to *villosum* (Brullé), described from the Canaries. Several authors, Wollaston (1865) ultimately included, have expressed some doubts as to the specific separation. The structure of the aedeagus seems to be rather similar.

Wollaston (1854) found it to be not very uncommon in cultivated areas and particularly mentions vineyards. Later records are sparse. Jansson (1940) found one specimen from Rabaçal at 1080 m, perhaps transported by winds or in timber.

Anobium punctatum (De Geer)

The notorious "furniture beetle" was certainly introduced into Madeira as well as so many other areas of the earth. According to Wollaston it was widely but sparsely distributed on the island at lower altitudes. Post-Wollaston records out of doors are few.

Fam. **T e n e b r i o n i d a e****Boromorplus tagenioides** Lucas

Wollaston found this Mediterranean species to be common at lower levels, particularly in winter. Later finds are sparse.

Fam. **C u r c u l i o n i d a e**Subfam. **M o l y t i n a e****Parastyploderes** (Roudier) stat. nov.

Syn. : *Styploderes* Wollaston subgen. *Parastyploderes* Roudier (1963 : 143).

P. lindbergi Roudier

The single type was collected on Porto Santo, 12.vii.1957 by Håkan Lindberg. It is deposited in the Zoological Museum of the University of Helsinki. No more details are available and up to now there are no further records.

The antennal funicle has five segments instead of seven as in *Styploderes*. It seems, therefore, appropriate to propose the elevation of this species to the rank of genus. Some additional information to Roudier's description, some illustrations included, is following.

Body (Fig. 10) 3.3-4.1 x 1.5-2.1 mm. Eyes small, with 20-25 facets, at the margin a few more but rudimentary ones. Apterous.

Anterior constriction of the prothorax overbridged by three dorsal carinae ; an outer carina on each side begins at the constriction and is much shortened posteriorly.

Elytral striae with a row of very small punctures, each with a hardly noticeable seta. Interstriae with scattered setae of about 30 μm in length.

Terminal fourth of protibia on the inside (Fig. 6) slightly behind a minute mucro with a short, simple, very dense fringe of spine-like setae (more or less as in the cossonids) and two long setae on each side about reaching the top of the claw.

Underside not glabrous but with distinct but short pubescence very fine and scattered corresponding to the very coarse punctuation.

Procoxae rounded, very narrowly separated, mesocoxae likewise rounded but separated by little less than their diameter. Mesocoxae sub-rhomboidal, reaching the well developed metepisterna and separated by their transverse diameter. First abdominal segment, the nearly truncate apophyse included, as long as second but somewhat shorter than third to fifth together. Suture between first and second segments indistinct.

Males have their rostrum somewhat broader, shorter and more strongly curved than females.

Proventriculus (Fig. 9) about 300 μm in length, anteriorly rounded with no grinding plate but with numerous long and narrow bristles, prolonged into the crop by a narrow bundle of similar bristles, about as drawn by Nüsslin (*op. cit.* : fig. 26) ; intermediate fringe poorly developed. Terminology as in Aslam. Metendosternite (Fig. 14) reduced, with short furcal and no lateral arms.

Aedeagus as in Figs. 7 and 8. Penis shorter than its apophyses ; internal sac with a small but characteristic sclerite, L-shaped in profile ; tegmen with two dorsal, apically finely setose apophyses and a very long manubrium. Spiculum gastrale (Fig. 5) short, not longer than the apophyses and with a strong posterior branch.

Ovipositor with a few, moderately long setae on the coxite and a group of short terminal setae on the apex of the stylus. Spiculum ventrale (Fig. 13) with a short, anteriorly forked manubrium and a transversely elliptic shape and a large non-sclerotized central area. Spermatheca (Fig. 12) relatively small.

Obviously this species is closely related to, but at the same time amply different from, *Oromia hephastos* Alonso-Zarazaga (1987), described from a lava cave on Tenerife. Adaptation to a life in the dark has, however, gone further in the latter species, as appears from the fact that it is totally blind. The description of *Oromia* contains drawings of some, even by modern taxonomists, more or less neglected sclerotized organs, which offers a rare opportunity of comparison.

The tegmen and aedeagus are similar in both species (except that the armature of the inner sac is strikingly different), so are the spiculum gastrale and ventrale. The ovipositor and spermatheca on the contrary show some differences. The metendosternite and proventriculus of *Oromia* remain unknown so far, but it would be surprising if they were not very reminiscent of those of *Parastyploclerides*.

Subfam. **Cossoninae**

Caulotrumpis Wollaston

A total of eight species were described by Wollaston. A key to them was compiled by Folwaczny (1973).

All are black, wingless, apparently glabrous and developing in dead wood, often also in dead tissues of herbs, such as thistles. Several characters are very variable as can be concluded from the numerous varieties distinguished.

C. lucifaga Wollaston

Body illustrated by Wollaston (1854 : pl. 6, fig. 7), Voss (1854 - 55 : fig. 6), and Folwaczny (1972 : fig. 11), 3.30 - 4.30 x 1.48 - 1.72 mm. Surface black, finely reticulated. Eye 140 - 175 μm in length, with 25 - 40 facets. Elytra subfusiform, somewhat shiny, often with a weak metallic tinge. Protibiae (Fig. 26) apically armed with the usual strong claw on the outside, a small but distinct, somewhat inward produced spine on the inside, and a tooth-like protrusion of the margin between the outer claw and the inner spine, as drawn for *Leipommata* by Osella (1986 : fig. 13).

Proventriculus an enlarged copy of that of *Barretonus* (Fig. 22), blades about 500 μm in length. The anterior grinding plates are well developed, as often in cossonids (Chararas, 1956), with smooth surface except for a series of granules on each side of the median suture, resembling that of *Orthotomicus* and some other scolytids as illustrated by Nobuchi (*op. cit.* : several figures) but lacking the transverse basal row characteristic of this and related genera. Likewise as in *Barretonus* (Fig. 23) the blades are separated by a well developed intermediate fringe.

Metendosternite (Fig. 24) with long furcal arms but abortive lateral ones.

Aedeagus (Figs. 16, 17) moderately narrowly pointed with apophyses as long as penis. Internal sac with two large, elongate sclerites hardly half as long as the penial body, followed by two dense, more or less parallel bundles of very fine spines and anteriorly with a few inconspicuous filiform sclerites. Spiculum gastrale (Fig. 15) as long as the aedeagus and posteriorly with a weak tooth.

Ovipositor (Fig. 20) with the elongate coxite glabrous and the parallel-sided stylus with a few terminal setae. Spiculum ventrale (Fig. 19)

transversely dilated, very asymmetrical, with central posterior portion non-sclerotized. Spermatheca (Fig. 28) normal.

C. lacertosa Wollaston

Body illustrated by Wollaston (*op. cit.* : pl. 6 fig. 6), 2.86-3.58 x 1.34-1.55 μm . Surface black, except in front mats, very strongly reticulated, never with a metallic tinge. Eye length 230-275 μm with 65-85 facets. Elytra nearly parallel-sided, with fine but on the anterior portion clearly impressed striae.

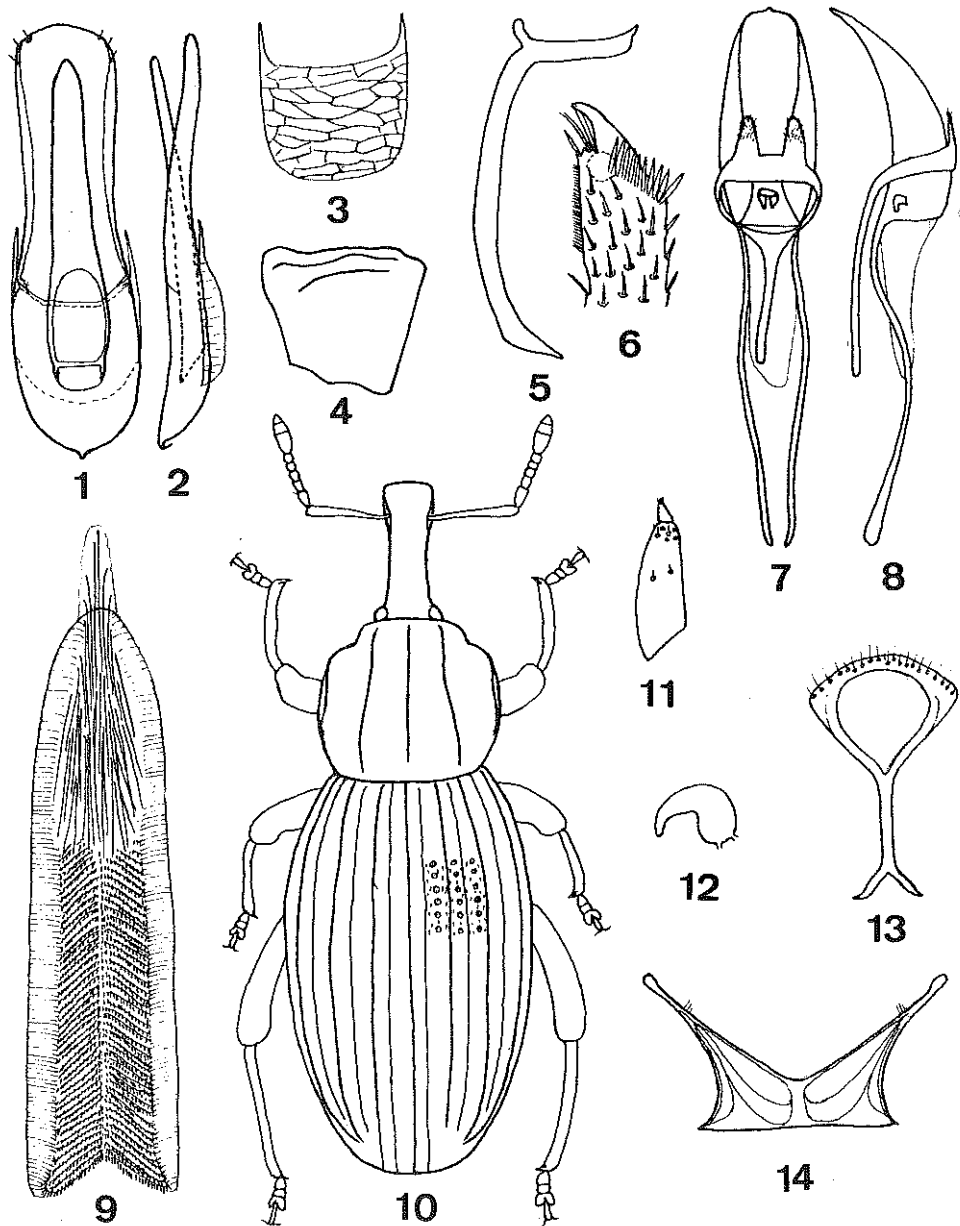
Otherwise like *lucifaga* except that the penis is more narrowly pointed and shorter than its apophyses and that the large internal sclerites are much more than half as long as the body of the penis.

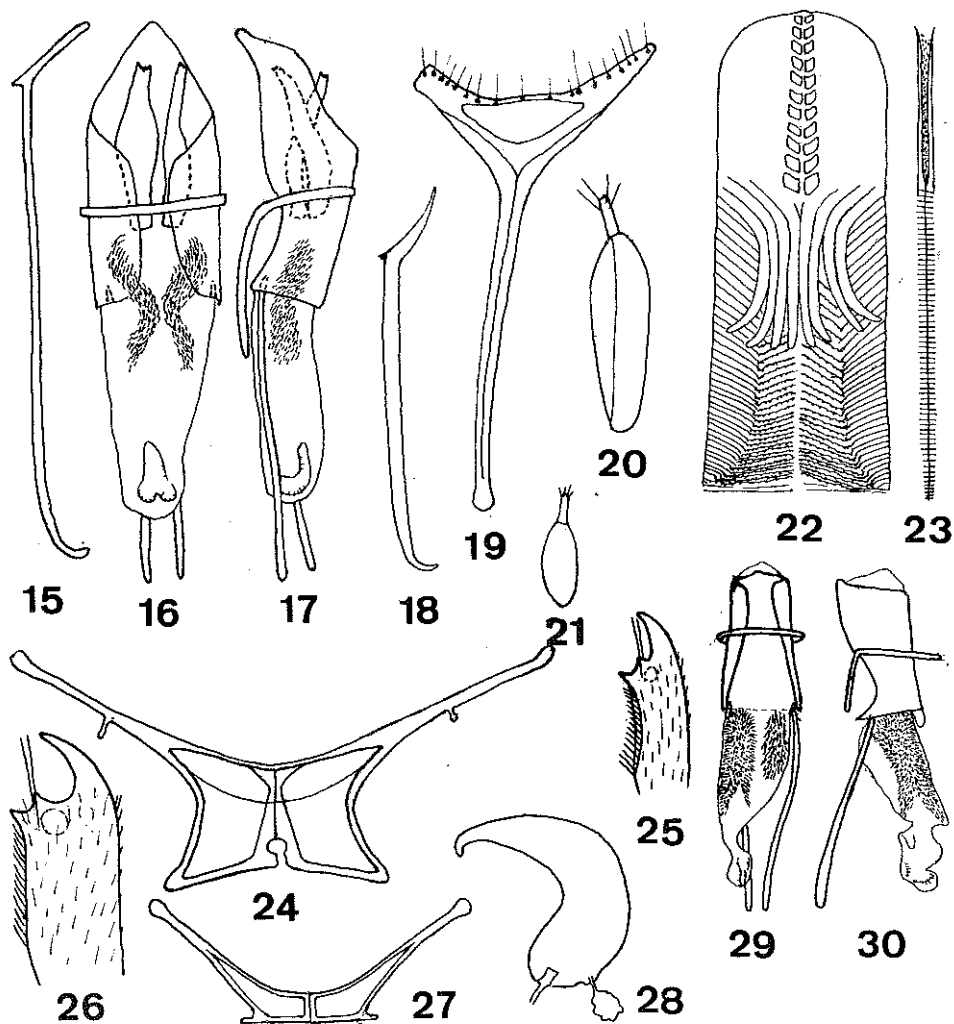
Though smaller on an average than *lucifaga* its eyes are larger with more numerous facets suggesting that the latter has taken another step on the way of adaptation to a life in darkness.

Barretonus hinterseheri Folwaczny

On four more or less mutilated and/or immature specimens Roudier (1958) described *Barretonus desertae*, type species of a new endemic Madeiran genus of blind, poorly pigmented and wingless beetles from Deserta Grande of the archipelago. Later the species was also recorded from Porto Santo by Folwaczny (1973) who had previously (1972) added two more species : *minor* from Porto Santo and *major* from Ilhéu Chão, each known from unique specimens. Finally, based on six specimens from near Funchal, the capital of Madeira, he (1975) erected *major* ssp. *hinterseheri*, which, in turn, after the examination of some more material from the same area was promoted to the rank of species by Osella (1976). This latter idea was not accepted by Erber & Hinterseher (1988) who rediscovered this form likewise in the neighbourhood of Funchal. The same authors also recorded *desertae* from Porto Santo and Deserta Grande (type locality) and a second specimen of *major* from Ilhéu Chão. Thus there are at present four described species of *Barretonus*.

Frequently used and certainly important characters are the shape of the pronotum and elytra. The latter are in *hinterseheri* 2 1/2 times as long as broad, according to Folwaczny. This index is too high for any *Barretonus*. Osella gives no information in words but refers to the original description ; on the other hand a beautiful figure was reproduced ; from direct measurements on this the index is found to be hardly more than 1 2/3. A corresponding treatment of Roudier's figure of *desertae* gives the same result, a calculation based on his own stated measurements somewhat more : 1.8. *B. major* was recorded to have its elytra 2 1/4 times longer than broad, measurements taken on Folwaczny's figure (1973 : fig. 5) again about 1.8 times. In my own material the index (the total length of





Figs. 1-30. — 1-3, *Langelandia maui* Franz ; 4-14, *Parastyphloderes lindbergi* Roudier ; 15-20, 24, 26, 28, *Caulotrupis lucifuga* Wollaston ; 21-23, 25, 27, 29, 30, *Barretonus hinter-scheri* Folwaczny.

10, body ; 4, prothorax, left side view ; 6, 25, 26, right side protibia, distal portion ; 7, 22, blade of proventriculus ; 23, intermediate fringe of proventriculus ; 8, 24, 27, metendosternite ; 1, 7, 16, 28, aedeagus, dorsal view ; 2, 8, 17, 30, ditto, lateral view ; 3, subbasal membrane of aedeagus ; 5, 15, 18, spiculum gastrale ; 11, 20, 21, ovipositor ; 13, 19, spiculum laterale ; 12, 28, spermatheca.

the elytra along the suture, the scutellum — if visible — included, divided by the maximum width) was found to be 1.80 - 1.93 at a body size of 2.4 - 3.2 x 0.9 - 1.1 μm . The conclusion would be that the three species can hardly be separated on the elytral index. For *minor* no figures, measurements or indices seem to have been recorded. I possess a single specimen in good condition and collected at the very type locality. The elytral index is 1.62, suggesting that this may be a particular taxon.

The keys to the species provided by Folwaczny and Osella have in common that the first couplet is based on eye remains, if completely absent or present (though always difficult to find). It is interesting that Osella places *hinterseheri* in the first group (no remains) while Folwaczny states that this taxon has its eyes mostly replaced by a single facet but occasionally by two. In the original description of *major* it is stated that the eyes are extremely small, consisting of about 8 facets. This interesting information is omitted in the key. Both authors agree on the presence of rudiments in *minor*. In my specimen I notice a very faint oval line, with size, position and form of the eye as in a more or less similarly sized specimen of *Caulotrupid impia*. The line surrounds a surface with normal microreticulation and a couple of minute granules, neither of which restricted to the oval area. This is true of the left side of the head but on the right side I have not been able to find the oval line. The conclusion of this is that presence or absence, respectively, of eye rudiments is a character to be avoided for the purpose of identification.

The aedeagus (Figs. 29 and 30) and spiculum gastrale (Fig. 18) are essentially of the same structure as in *Caulotrupid*. Drawings were presented by Folwaczny (1975) and already by Osella and appear very similar to one another. If a third attempt is now made it is because I found the penis to be much less strongly pointed. This difference might perhaps indicate some taxonomic distinction. The armature of the internal sac is omitted by the previous authors but it is distinguished from that of the *Caulotrupid* species by the complete absence of the larger, subterminal sclerites. Possibly they are retained in some of the other, unexamined *Barretonus* spp. which would confirm their specific status. The penis of *minor* is quite similar to that of my *hinterseheri*, however.

Of the characters considered to distinguish *minor* I can confirm the shape of the elytra which is more oval than in *hinterseheri*. Possibly this is a particular taxon, perhaps a race of *desertae*. It must be left to further examination of a larger sample from the smaller islands to decide if there are any sharp taxonomic boundaries in *Barretonus*.

Further characters of *hinterseheri* are the following:

Protibiae (Fig. 25) completely as in *Caulotrupid*.

Proventriculus with blade (Fig. 22) and intermediate fringe (Fig. 23) as described for *Caulotrupid lucifuga*; length about 330 μm .

Metendosternite (Fig. 27) more reduced than in *Caulotrupid*, with no trace of lateral arms.

Male genitalia discussed above.

Ovipositor (Fig. 21) essentially similar to that of *Caulotrupidis* but relatively shorter. Spiculum ventrale and spermatheca both drawn by Osella (*op. cit.* : figs. 4, 5) and very much resembling those of *Caulotrupidis*.

On the phylogeny of some Cossoninae

Osella (*op. cit.*) thinks, basing himself on the structure of the aedeagus, that *Barretonus* and *Leipommata*, pubescent, monotypic endemic of Porto Santo, living subterraneously in sand, should be grouped together with *Pselectus* Broun. With missing apical protrusion on the protibiae and asymmetric penis this genus is hardly the best alternative ; *Caulotrupidis* would fit better as a third member of a probably monophyletic group, say the *Caulotrupidis* group, with several interesting characters in common, such as the structures of the protibiae, penis and spiculum laterale. All are apterous, with reduced metendosternite. See also Osella (*op. cit.*). The two larger sclerites of the penis are also present in *Leipommata*. Therefore *Barretonus* can be interpreted as more reduced, which does not imply that it evolved from *Leipommata* because the two genera have adapted themselves to quite different habitats. Behind the group should be some alate ancestor, probably something like *Pseudophloeophagus*.

Structure of the proventriculus

The proventriculus was highly ranked in phylogenetic systematics by Nüsslin with his forerunner K. Lindemann and contemporary G. Fuchs. Reitter (1913) had constructed useful systems from study of the external skeleton alone and concluded that microscopical studies were not very urgent but might well be put off to a later date. Most taxonomists have followed Reitter there, except that description of the aedeagus seems new to be more or less standard in most Curculionidea (Scolytidae so far excepted), as is the case in other Coleoptera. Nowadays the proventriculus is never used in taxonomy.

This may appear surprising but is explained by a quotation from Balachowsky (1949 : 20), actually concerning the penis of scolytids but doubtless equally applicable to the proventriculus of curculionids : 'Les difficultés d'extraction et de préparation sont les principaux obstacles à l'utilisation de ces caractères ...' !

Some authors such as Chararas (1956) have tried to explain differences in the structure of the proventriculus as adaptations to different kinds of food. Phloeophagous species would, for example, have other types of structure than xylophagous ones. This hypothesis has, however, not been confirmed by later specialists such as Nobuchi and Aslam.

The striking difference between the proventriculus of *Parastyplophoderes* (Fig. 9) and that of *Barretonus* (Fig. 22) is of particular interest

because both species developed at the same time and under exactly the same circumstances from the same substrate, and both evidently thriving excellently (see table below).

Rearing result

The table below shows the numbers of individuals emerged from the root pieces during four consecutive periods ; I. 29.x.1980 - 13.iv.1981 (5 1/2) ; II. 16.iv.1981 - 31.xii.1981 (8 1/2) ; III. 1.i.1982 - 31.vii.1982 (7) ; IV. 1.viii.1982 - 30.i.1983 (6). Approximate number of months in parentheses. Thus the duration of each period is roughly half a year.

Names	Period				Total
	I	II	III	IV	
<i>Prostheca aspera</i>	34	17	3	—	54
<i>Langelandia maui</i>	2	15	—	—	17
<i>Nicobium velatum</i>	1	6	—	—	7
<i>Anobium punctatum</i>	1	—	—	—	1
<i>Boromorplus tagenioides</i>	—	2	—	—	2
<i>Pseudostyphloderes lindbergi</i>	—	26	3	23	52
<i>Caulotrupes</i> spp.	—	115	52	127	
<i>C. lucifuga</i>	—				221
<i>C. lacertosa</i>	—				73
<i>Barretonus hinterseheri</i>	16	28	26	64	134
Overall Total	54	209	84	214	561

Boromorplus tagenioides, normally found among debris on the ground is an apparent stranger in this assemblage. Probably larvae, ready for pupation, had found a suitable crack somewhere in the root pieces.

The majority of species are saprophloeophagous or xylophagous. The former are represented by the two colydiids. In the present material they emerged during the first year and then rapidly disappeared together with the phloem. Fungal hyphae may be an important part of their food. The root-wood, hard before decaying, was hardly penetrable. The series of *Langelandia* collected in 1974 lived in a white-rotten stump of some broad-leaved tree and the beetle was, partly at least, living in the soft wood itself.

Among the xylophagous species the anobiids played a negligible part. Both are typically developing in dead wood above the ground. *Nicobium* evidently performed its development in the root pieces during the first year.

The sole specimen of *Anobium punctatum* was found already in May 1981 but the egg may have been deposited in the uppermost portion of the piece, which was probably not covered by earth, long before the pieces were collected. Its appearance is enigmatic. Like other introduced anobiids it has difficulties in matching indigenous competitors. After all it might have found some suitable niche but more probably the generally scarce finds of *Anobium* in the archipelago resulted from repeated attempts from an urban stock to get a foot-hold in natural environments.

Unlike the anobiids the curculionids encountered are all apterous endemics with their sight tending to be reduced, thus adapting themselves to a life in darkness. The latter is less evident in *Caulotrumpis lacertosa*, more so in *C. lucifuga* which, though on average of larger body size, has its eyes smaller with fewer facets, still more so in *Parastyphloderes*, while *Barretonus* finally is blind. The two *Caulotrumpis* were not kept apart from the beginning of the sampling because it was believed that there might be more than two species of the genus, an assumption which was later found to be unfounded. Nothing was, however, noticed to suggest that their rhythm of appearance would have been fundamentally different.

In all four weevils the appearance of adults had its maxima in Periods II and IV and its minima in I and III, indicating two generations annually. Broadly speaking the vast majority of individuals emerged in autumn, summer of the first whole year (1981) included.

It is evident from the large general yield that the conditions offered were very favourable. What may appear remarkable is that the production of emerged specimens was not less in Period IV than in II, but then it must be kept in mind that the root pieces were considerably fewer during more than half the Period I than they were later.

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