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A PRELIMINARY REPORT ON DACETINE ANT STUDIES IN AUSTRALIA

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From August 1950 to December 1951 the author was engaged in a study of the Australian ant fauna under the auspices first of a Parker Fellowship from Harvard University and later of a United States Educational Foundation (Fulbright Plan) Fellowship, with interim aid from the Museum of Comparative Zoology and from Dr. P. J. Darlington, Jr. Within the larger plan for a general study of the Australian ants, a concentrated study of the tribe Dacetini was given particular attention. In view of the fact that group-by-group revisions of the Australian dacetines are presently in press or being prepared, detailed biological observations will be reserved for publication with the systematic treatment of the genera and species concerned. From the mass of data gathered, however, it appears that certain generalizations concerning dacetine biology may safely be drawn at this time.

This is especially true when extensive studies by Mr. E. O. Wilson on the North American dacetine genera are taken into account. Mr. Wilson's paper, based on separate studies and published separately in this issue, carries pertinent references to earlier work in the field.

TheDacetini form an aberrant and sharply distinct group belonging to the subfamily Myrmicinae, as is demonstrated by the structure of the abdominal pedicel and the male genitalia. They may be grouped into four recent subtribes, characterized as follows:

Dacetiti

Palpal formula, maxillary 5, labial 3. Worker and female with 10 segments in the antennal funiculus. Includes *Daceton* Perty (Neotropical, one species) and *Acanthognathus* Mayr (Neotropical, 3 species).

Orectognathiti

Palpal formula, maxillary 5, labial 3. Worker and female with 4 segments in the antennal funiculus; second funicular segment greatly elongate. Includes *Orectognathus* Fred. Smith (Australasian-Papuan, 9 or 10 species) and *Arnoldidris* Brown (Papuan, 4 species).

Epopostrumiti

Palpal formula, maxillary 5, labial 3. Worker and female with 3 or 5 segments in the antennal funiculus. Includes *Epopostruma* Forel, *Hexadaceton* Brown, *Mesostruma* Brown, *Alistruma* Brown, *Colobostruma* Wheeler, *Clarkistruma* Brown (Australian Region) and *Microdaceton* Santschi (Ethiopian Region), each genus with only a few species.

Strumigeniti

Palpal formula, maxillary 1, labial 1. Worker and female with 3, 4 or, usually, 5 segments in the antennal funiculus. Includes the vast majority of Dacetini, including the large and widespread genera *Strumigenys* Fred. Smith, *Smithistruma* Brown, the African genus *Serrastruma* Brown, and many smaller genera making up the residue of names not mentioned above.

The Australian Region is inhabited by representatives of three of these four subtribes, whereas no other major zoogeographical region is known to have more than two. Though Australia appears to have

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fewer species than do some other major regions, it has a larger and more varied array of genera than does any other region. As it is clear that the four subtribes represent as many divergent phyletic lines, the advantages gained by making the present study in Australia are evident. It was hoped that the present study would provide comparative data that would help to explain the evolutionary background of the peculiar habit, observed in American genera of the Strumigeniti, of highly developed collembolan predation. The results obtained, at least for such comparatively large and primitive forms as those of *Orectognathus*, were totally unexpected.

Observations of varying completeness were made in the artificial nest and, wherever possible, in the field. The artificial nests used were of plaster, with glass tops, made and kept in "flat fifty" cigarette tins, so that they were readily portable on the longer trips. Unless otherwise mentioned, the observations were made on *feeding habits* of dacetine colonies secured from the Dandenong Ranges or from the eastern outskirts of nearby Melbourne, Victoria. In the feeding experiments, a wide range of arthropods was introduced into the artificial nests as soon as the ants had become established and at frequent intervals thereafter. The choice of potential prey included most of the groups employed by Wilson or corresponding Australian ones; Collembola of various families, *Campodea* spp., *Hanseniella* (Symphyla), termites, small millipedes and centipedes, small dipterous adults, beetle larvae and nymphs of Dermaptera, small spiders and a wide variety of mites. Japygidae were relatively scarce, and were used only in the case of the *Orectognathus* species most closely studied. Ant larvae were not introduced, as it was felt that the known behavior of both adult and larval ants regarding foreign larvae of the same or other species precluded the possibility of obtaining significant data through such introduction. Ants of other species at the adult stage were tried in all cases.

Field observations of feeding consisted mainly of watching the approaches to known nests of the epigaeic foragers for workers returning with prey. Practically all nests found were removed with the surrounding material and sorted in the attempt to find bodies of the prey in the brood chambers or elsewhere in the nest, but this method usually proved to have negative results or else was ambiguous in providing data, because of the disruption of the nests in opening and transporting them and also to the obvious abundance of live potential prey often observed *in situ* close to or even within the nest chambers as the latter were broken open.

Observations of feeding habits were made in the artificial nest, and for the most part supplemented by field observations, on the species listed immediately below. Several of these species are, as yet, unpublished, and so are indicated by the abbreviation "sp."

Orectognathiti

Orectognathus sp. (Common species in southeastern Australia, related to *O. versicolor* Donisthorpe.)

Epopostrumiti

Epopostruma spp. (Three apparently distinct and probably undescribed species fairly common in southeastern Australia.)

Alistruma sp. (One undescribed species widespread in the southeastern parts of Australia.)

Clarkistruma alinodis (Forel). (Observed in Victoria and southeastern Queensland.)

Strumigeniti

Strumigenys perplexa (Fred. Smith). (Widespread and common in southeastern and southwestern Australia; observations made in Victoria.)
Strumigenys australis Forel. (Observed in North Queensland.)

In determining the food preferences, the prey are placed in the usual "accepted" or "rejected" categories; the accepted prey is caught by the workers or females and placed on, among or near the larvae, and the latter then feed upon it. The rejected organisms are those, placed so as to directly confront the adult ants, which the ants ignore, avoid or attack, but which they neither carry into the brood chamber nor are observed to feed upon. In the case of the *Orectognathus* species, observed in the artificial nest, there occurred the only hint of a possible intermediate category. In this ant, the prey was usually attacked, killed and fed upon by the adult originally catching it and by a succession of other adults, both within and outside the brood chamber, but only rarely near enough to the brood so that the latter could feed upon the carcass. This is considered to represent incomplete acceptance of the prey due to disturbing factors in the artificial environment.

In all the forms of dacetines studied, the prey accepted was exclusively members of the collembolan families Entomobryidae, Isotomidae and Sminthuridae[1]. A wide variety of poduroid collembola produced not one single acceptance; rather, poduroids usually were ignored or definitely avoided, and none was ever attacked. Symphylans, campodeids and other relatively active arthropods either caused the ants to recoil violently on contact, or in rare cases, provoked them to a seemingly dilatory and timid, usually more or less ineffectual attack. Mites were generally ignored, and caused only languid antennal play when passing near the ants.

Field studies of *Strumigenys perplexa* and *Epopostruma* spp. found these forms commonly returning to the nest burdened with entomobryid collembolans or, in the case of the *Epopostruma*, with sminthurids.

Toward the end of the author's stay in Australia, he discovered that the workers and females of *Epopostruma* spp. and *Strumigenys perplexa* will feed on honey diluted with water, and that the former visit the extra-floral nectaries of certain plants, presumably for sugary substances. However, as no dacetine was ever observed to feed the larvae by regurgitation, feeding on sugary materials is considered to be a strictly adult habit, perhaps restricted to the more epigaeic foragers.

The important conclusion reached from the Australian observations is that, in the species observed, food delivered to and fed upon by the Australian dacetine larvae consisted only of Collembola of the groups named, though a wide choice of potential arthropod prey was offered. This is in substantial agreement with previously published observations on the American dacetines.

COMPARATIVE ECOLOGY OF AUSTRALIAN DACETINI

Aside from feeding habits, the species studied and listed above and others seen in the field, but not so thoroughly studied, showed inter-

[1]The family names are used in the broadest sense. No members of the family Neelidae were employed in the trials. Family identifications were made by the author unless otherwise noted.

esting variation in habitat preferences, foraging habits and other behavior that will be more intensively reviewed with the various revisionary papers to be published later. Some broad points may be considered here.

Habitat preferences. The species of *Orectognathus* are restricted to regions of high or fairly high rainfall. Those from Australia are confined to the eastern and southeastern regions in rainforest and sclerophyll forest down to the types intermediate in moisture conditions, such as are found near the base of the Dandenong Ranges and the approaches to the Otway Ranges in Victoria. Nests are built, according to species, either in rotten logs or in the soil under or beside half-sunken stones.

Epopostruma, so far as is known, nests in the soil and only rarely with a stone as cover; sites chosen are in eucalypt forest ranging from medium-dry types (Lofty Ranges, South Australia; Grampians Ranges, Victoria) to medium-wet types like the tracts between Melbourne and the Dandenong Ranges, or the western gullies on Arthur's Seat, Victoria. *Alistruma* nests in rotten wood, usually in wet sclerophyll or rainforest. *Clarkistruma alinodis* has been taken in moist or wet sclerophyll forest, often near or in clearings. On three occasions I took this ant, twice in the Dandenongs and once on Tamborine Mountain, southeastern Queensland, in each case under a stone also covering a flourishing nest of one of the common and dominant *Rhytidoponera* (*"Chalcoponera"*) species, commonly infested with unpigmented entomobryid collembolans. I have not myself seen, nor do I know of other records definitely stating, that *Clarkistruma* species display any preference for nest sites near or in *Chalcoponera* nests except as indicated by my three collections, which, however, were all I made of this genus (*Clarkistruma*) during my stay. *Clarkistruma ellioti* (Clark), the only other species in the genus, is known only from the type collection, made on Mt. Arapiles, western Victoria, a very dry locality on which the vegetation at its most luxuriant could not be described as more than low, stunted woodland.

Hexadaceton frosti was not taken during my stay, and remains known only from the unique type. Through the courtesy of Mr. F. E. Wilson and Mr. N. Tindale, however, I have been able to locate more precisely the spot at which this ant was taken. This "N. Mecklenburg" was a German colony before the first war, and the name has now been changed to Putpayerta; the locality is in the surveyor's Hundred of Nuriootpa, on the North Para River, South Australia, and is agricultural country at present. Originally, it is presumed to have been covered with low-rainfall vegetational types, such as mallee scrub and savannah woodland. The original collector was J. O. Tepper.

A number of *Strumigenys* species were taken in Australia, including several undescribed species. All of these show definite affinities with Indo-Papuan groups, and there are more species in Queensland than in the remainder of the Australian states combined, facts which lead me to the conclusion that *Strumigenys* is a relatively recent immigrant into the island continent. Most of the species prefer to nest in constantly moist sites, particularly in or under rotten logs or under stones in tropical rainforest. *Strumigenys perplexa*, however, shows surprizingly wide tolerance with respect to nesting sites, and has been found in dry, open woodland in South Australia and western Victoria,

as well as in the dark, moist fern gullies in the hills east of Melbourne. Another species, undescribed, appears to be restricted to even drier habitats in mallee scrub and savannah forest in Victoria and South Australia, and still another to dry open forest in Queensland.

Of particular interest is a new workerless parasite, the first among the dacetines, and the first social-parasitic ant known from Australia, of which the female lives in the nests of *S. perplexa*. This parasite was collected at three separate localities and was observed in the artificial nest; it is a *Strumigenys* species, and apparently is closely related to *S. perplexa*.

Foraging activities. Striking differences were noted among the genera studied as regards foraging. The *Epopostruma* species ran over the ground at a comparatively rapid pace, appearing like small *Tetramorium* to the naked eye, and did not hesitate to forage on grass blades or on the foliage of low herbage. Their appearance and behavior was quite a surprize for one used to the slow-motion stalking of American Strumigeniti. The various *Orectognathus* species obviously differ among themselves in foraging, as at least one species was found on the foliage of low rainforest shrubs, while another was found in the center of a large rotten log. *O. versicolor* and the common Victorian species may forage nocturnally, as they have not been seen outside their nests during the daylight hours and do not seem to be well situated for hypogaeic foraging in their usual nest sites.

Alistruma has not been taken outside its rotten-log habitat, and it seems probable that it hunts within the galleries and crevices of the log. *Clarkistruma* has not been seen except under rocks with *Chalcoponera*. The *Strumigenys* species have not been taken in the open, but only under rocks, logs, dead leaves and other objects lying on the ground surface. Except for *Epopostruma*, body movements are very slow as observed in the North American dacetines.

Sexual phases and colony foundation. The sexual phases appear as adults in southeastern Australia during the summer months, beginning about the first week in January. In all the colonies observed, only males or females, never both, were produced. This agrees with the previously collected series, although the total number of times sexual phases have been taken intranidally *in the field* is too small to permit of generalizations about nest unisexuality except, possibly, in the case of *Orectognathus* sp. Mating probably occurs in most cases at the end of January or beginning of February, but no actual flight has been observed. Isolated females of several species have been found in the field in the process of nest founding. That the females forage actively during the initial period is indicated by the fact that females, both isolated and established in populous nests, of *Strumigenys perplexa* and *Epopostruma* spp. can and do hunt actively and effectively in the artificial nest. In the case of two species of *Epopostruma*, the females have been seen foraging from well-established nests in the field on several occasions. In the nest of one species of *Epopostruma* in Victoria, *winged* females were found in the early spring, though this species normally does not produce sexual phases as adults until summer. It is thought that the single case observed of winged females in the spring may indicate that virgin females are kept over from one season to the next in certain

cases, though this species was observed on so few occasions that even the normal course of production of sexes is not certainly established. With the maturing of the sexual brood, a worker brood also comes to maturity, although worker pupation seems to be a bit delayed in the species observed, so that worker imagoes appear, on the average, a little after the bulk of the sexual forms have gained their full color and left the pupal state. This worker brood (in Victoria) appears to be the chief or only worker brood produced during a given year, if development schedules drawn from a combination of artificial nest and field observations are correct. The larvae develop with extraordinary slowness in the artificial nest, but appear at any given time of the year to be at about the same stage of development as those taken in the field at that time. Developmental data, however, are considered to be incomplete because of frequent enforced interruptions of the observation periods.

Nest populations. The numbers of workers were roughly of the same order in all species closely studied. *Orectognathus* nests were usually a bit less populous, with 10 to about 80 workers per colony, than were those of *Strumigenys perplexa*, with 40 to over 200 workers. Other genera and species had populations of intermediate sizes. In *Orectognathus* nests, there was usually only a single queen, whereas *Strumigenys perplexa* usually had three to five queens, and the other species two or three.

DISCUSSION AND CONCLUSIONS

The conclusions as to feeding habits are that the three divergent lines represented by the Australian dacetines all follow the basic pattern, previously observed in North and South American strumigenite genera, of predation on entomobryid, isotomid and sminthurid Collembola. My observations fail to agree with those of Wilson, recently made, only in that I have not been able to induce any of the Australian species to accept any animal food other than Collembola of the families mentioned (*sensu lato*). In view of the phylogenetic considerations and the good agreement by all investigations that Collembola form the chief item of the diet in the American species, the cases observed by Wilson in which campodeids, mites and other non-collembolan prey were accepted and fed upon by the larvae may probably be considered as evidence of secondarily-acquired weaknesses in the strictness of the prey-specificity pattern. Collembolan predation is considered as the generalized pattern of behavior in the Strumigeniti, Epopostrumiti and Orectognathiti, although it is by no means suggested that the even more primitive Dacetiti will prove to hold strictly to this pattern when their habits become known. The Australian observations are original in showing that the workers of at least some genera will feed upon sugary substances, but this type of feeding is believed to apply only to the adults, since adult-larval trophallaxis has not been observed in any dacetine species to date.

Other observations, mainly ecological, show that the biology of the Australian dacetines is roughly comparable to that of the various North American species in respect to foraging (except for *Epopostruma* and epigaeic or subarboreal *Orectognathus* species), production of sexual forms in temperate areas, and nest populations. Nesting sites chosen

compare with those of the American species, except that certain Australian species show strong tendencies to adapt themselves to drier areas. This tendency to xeric adaptation, however, is present in all major dacetine faunas, but has not been recognized in most cases. The first workerless dacetine, a species of *Strumigenys*, was collected and observed in the artificial nest in circumstances leaving little doubt that it is a social parasite of *Strumigenys perplexa*.

ADDENDA

Shortly before receiving the proofs of this paper, Father Thomáz Borgmeier, O.F.M., Jacarepaguá, Brazil, notified me of the first report of predation by a member of the subtribe Dacetiti. He received from Dr. Helmut Sick, ornithologist, a worker specimen of *Daceton armigerum* (Latreille) with a male specimen of *Acanthocera longicornis* Fabricius, collected together by Dr. Sick on August 16, 1951, at Jacaré-acanga, Alto Tapajoz, Pará, in forest undergrowth. The *Daceton* had caught the fly by the abdomen in its mandibles, and although the fly vibrated its wings most vigorously, producing a loud buzz while trying to escape through flight, it was unable to rise away from the ant. The indications from this note are that *Daceton* will attack a variety of small, living insects. Dr. Sick made his collection on a "thin branch," presumably above the forest floor; this agrees with previous reports that *Daceton* forages arboreally, at least to some degree.

INTRODUZIONE ALLO STUDIO DELLA ENTOMOLOGIA, by Guido Grandi. Two vol., xxii+950 pp., 780 figs., and xvi+1332 pp., 1198 figs. Edizione Agricole, Bologna, Italy. 1951. Price, L. 18,00.

This ponderous work, with its more than two thousand quarto pages and its richness in illustration should take a place as one of the important texts in the field. The author, whose title is Professorè Ordinario di Entomologia at the Università di Bologna, obviously intended it as a text in an "introductory" course which, following the European tradition, is considerably more intensive than is usual in the United States. It covers the general subject: anatomy and morphology, embryology, postembryological development, and ecology (vol. I, pp. 1–468), with a very brief mention of the relationship of insects to human welfare; the rest of the work is devoted to a discussion of insects by orders and families. There is no section on physiology, but physiological material is included in the part dealing with morphology and elsewhere. Insect paleontology, as such, is not given a systematic treatment, but is mentioned only cursorily. These omissions were probably regarded by the author as justifiably not a part of the basic "introductory" field, but rather, like the agricultural, medical, and veterinary phases, subject matter for more specialized courses.

The overall impression which one receives from perusing the book is good. The paper is of good quality, the margins moderately wide, and the printing clear and in good type; the illustrations are for the most part well chosen and well reproduced. The compilation was obviously done with care, and the documentation indicates that the author has kept well abreast of the important development of his science. In spite of copious documentation, however, there is no bibliography; is it to be published under separate cover? Also there is no index, except a very complete one to orders, families, tribes, genera and species, at the end, and a detailed table of contents at the beginning, of each volume.

The taxonomic classification is a relatively conservative one; in the reviewer's opinion, too conservative so far as the primitively apterous groups are concerned. In the Diptera, there is mixed usage of the Meigen 1800 and 1803 names. The various categories seem to be adequately characterized, in spite of the lack of keys. Examples are drawn largely, but by no means exclusively, from the European fauna.

The American entomologist who can read or wade through passages in Italian will find this a very useful reference work. The amount of labor that has gone into its compilation and synthesis is tremendous, and the acquisition of certain concepts and the development of some ideas found in the text will well repay the trouble taken to read a foreign language.—M. T. J.