THE PRESENT DISTRIBUTION AND PAST HISTORY OF OUR AUSTRALIAN BUTTERFLIES.

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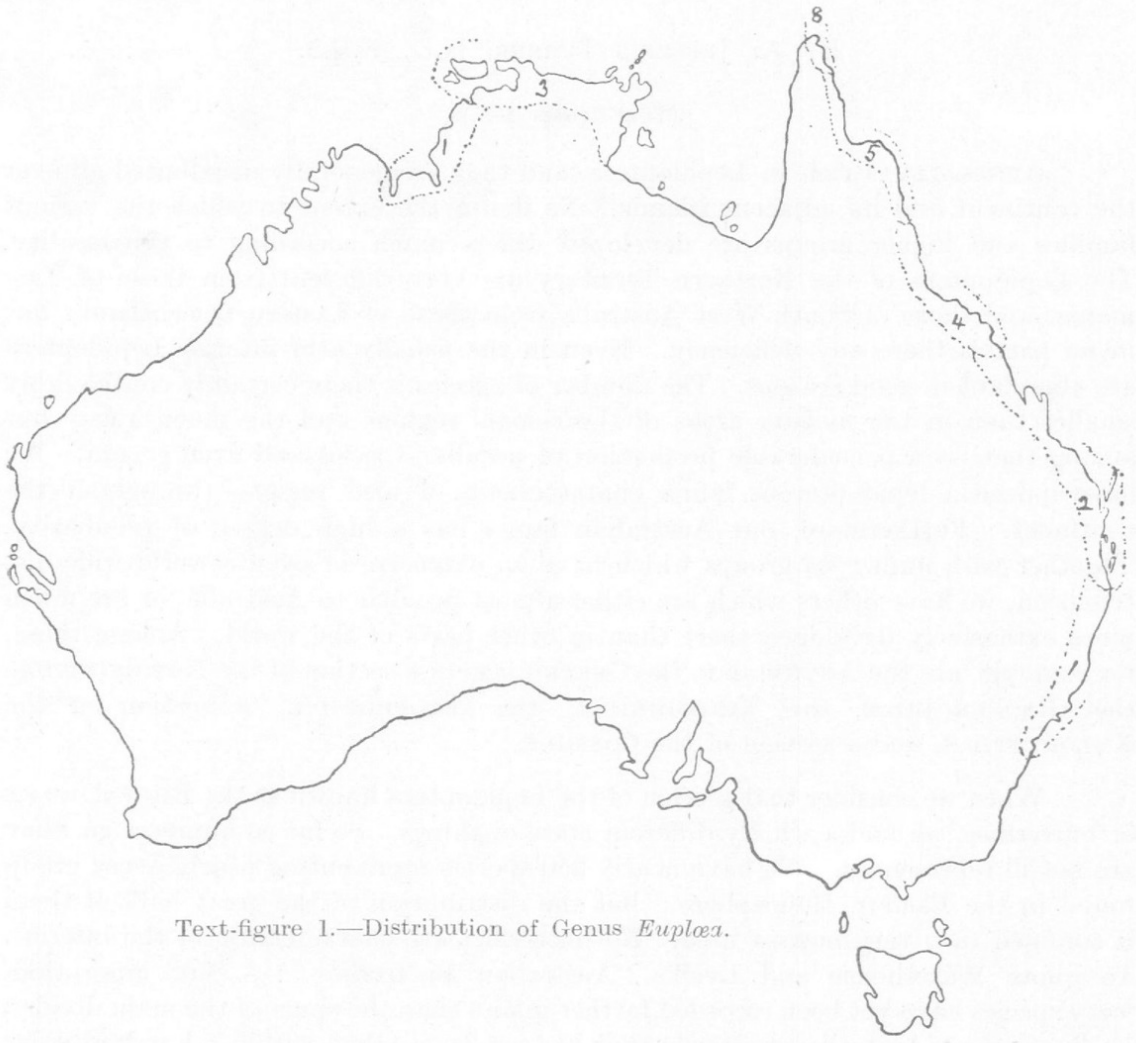
(Text-figures 1–5.)

Australia is rich in Lepidoptera, and they are generally distributed all over the continent and its adjacent islands. No doubt the extent to which the various families and higher groups are developed differs much according to the locality. The Lepidoptera of the Northern Territory are very different from those of Tasmania, and those of South-West Australia from those of Eastern Queensland : but in no part is there any deficiency. Even in the usually arid interior Lepidoptera are abundant in good seasons. The number of species is there certainly considerably smaller than in the moister areas of the coastal regions and the mountains ; but among them is a considerable proportion of peculiar species and even genera. We have indeed a lepidopterous fauna characteristic of arid regions throughout the continent. Furthermore, our Australian fauna has a high degree of peculiarity. Together with numerous groups which have an extensive or even a world-wide distribution, we have others which are either almost peculiar to Australia, or are much more extensively developed there than in other parts of the world. Among these, for example, are the Anthelidæ, the Cnethocampinæ section of the Notodontidæ, the Œnochromidæ, the Tineodinidæ, the Œcophoridæ, a section of the Xyloryctidæ, and a section of the Cossidæ.

When we consider that section of the Lepidoptera known as the Rhopalocera or butterflies, we find a wholly different state of things. So far as numbers go, they are not ill represented. We have nearly 350 species representing nearly every group found in the Eastern Hemisphere ; but the distribution of the great bulk of them is confined to a very narrow area. No butterflies are characteristic of the interior. To quote Waterhouse and Lyell's "Australian Butterflies" :—"Not more than forty species have yet been recorded farther inland than the spurs of the main divide : we know of no Australian butterfly that has not been taken within a hundred miles of the coast." Butterflies are most abundant in species in the coastal region of Queensland and New South Wales, and the number of species diminishes as one proceeds southwards along this comparatively narrow coastal strip. From Victoria only some 86 species are recorded, from Tasmania 32, from South Australia probably 36, from South-West Australia 39. Nor is the Australian butterfly fauna of peculiar type ; taken apart from our other Lepidoptera it can only be regarded as an unimportant division of the Indo-Malayan fauna. It may be stated broadly, that, with but few exceptions, our butterflies are descended from immigrants from the North across

the shallow sea of Torres Strait, probably not an impassable barrier even now, and replaced in Pleistocene times by continuous land. The great bulk of this immigration appears to have been comparatively recent, though some is of older date. Of the latter we may cite *Papilio macleaynus*, which alone of its genus has reached Tasmania. This species has only one close ally now living, *Papilio weiskei*, which is confined to the mountains of New Guinea above 5,000 ft. Another early immigrant, which

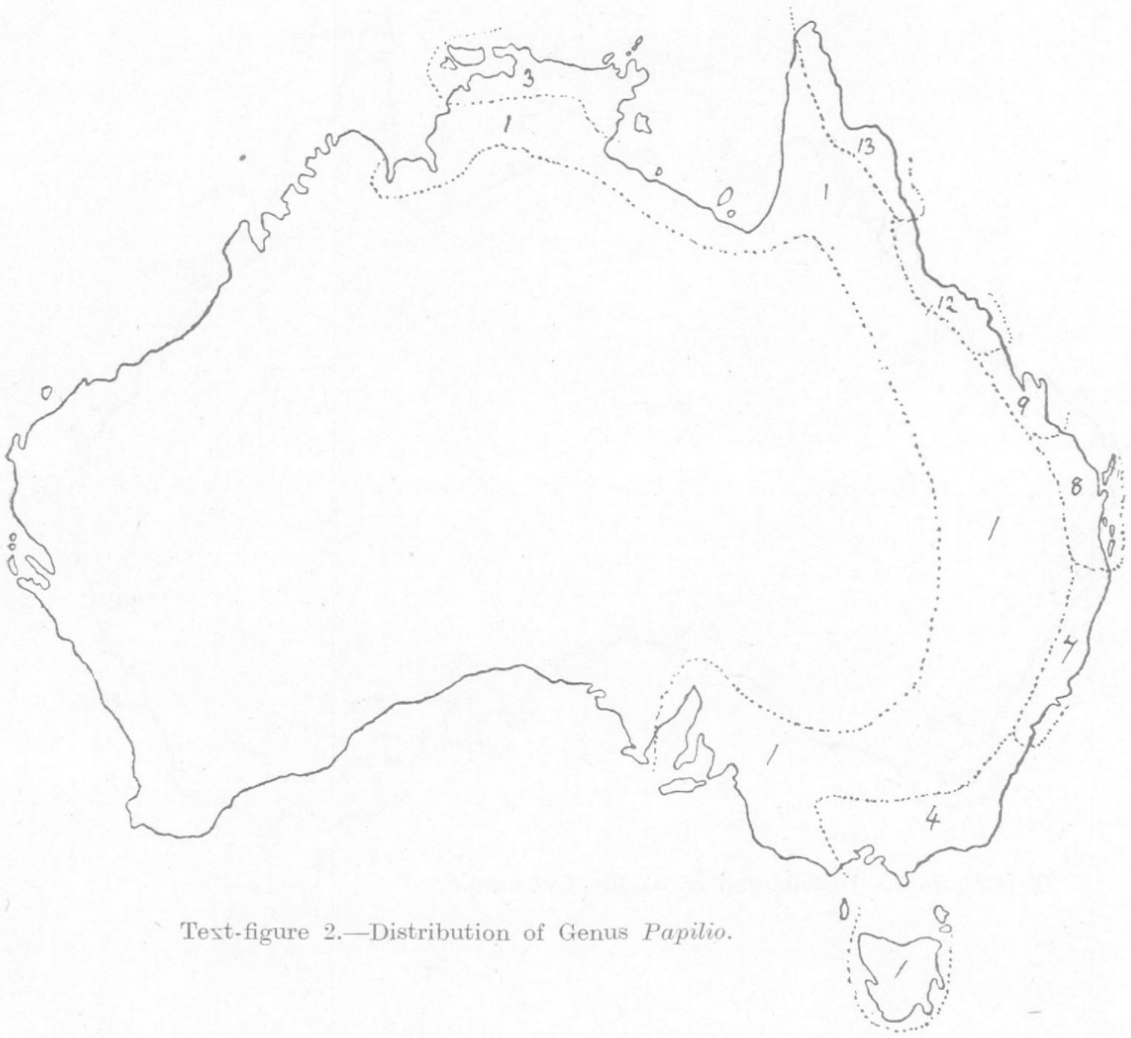


Text-figure 1.—Distribution of Genus *Euplœa*.

has also reached Tasmania, is the Lycænid *Pseudalmenus chlorinda*. The TRAPEZITINÆ subfamily of the HESPERIDÆ also probably arrived early, as it is largely developed in South-East Australia. Of the later arrivals many penetrate no further south than the Cairns district, others have reached Mackay or Yeppoon, and only a minority extend beyond the Manning River.

In order that the evidence for this conclusion may be appreciated we have selected certain groups for the construction of "Specific Contours" as suggested

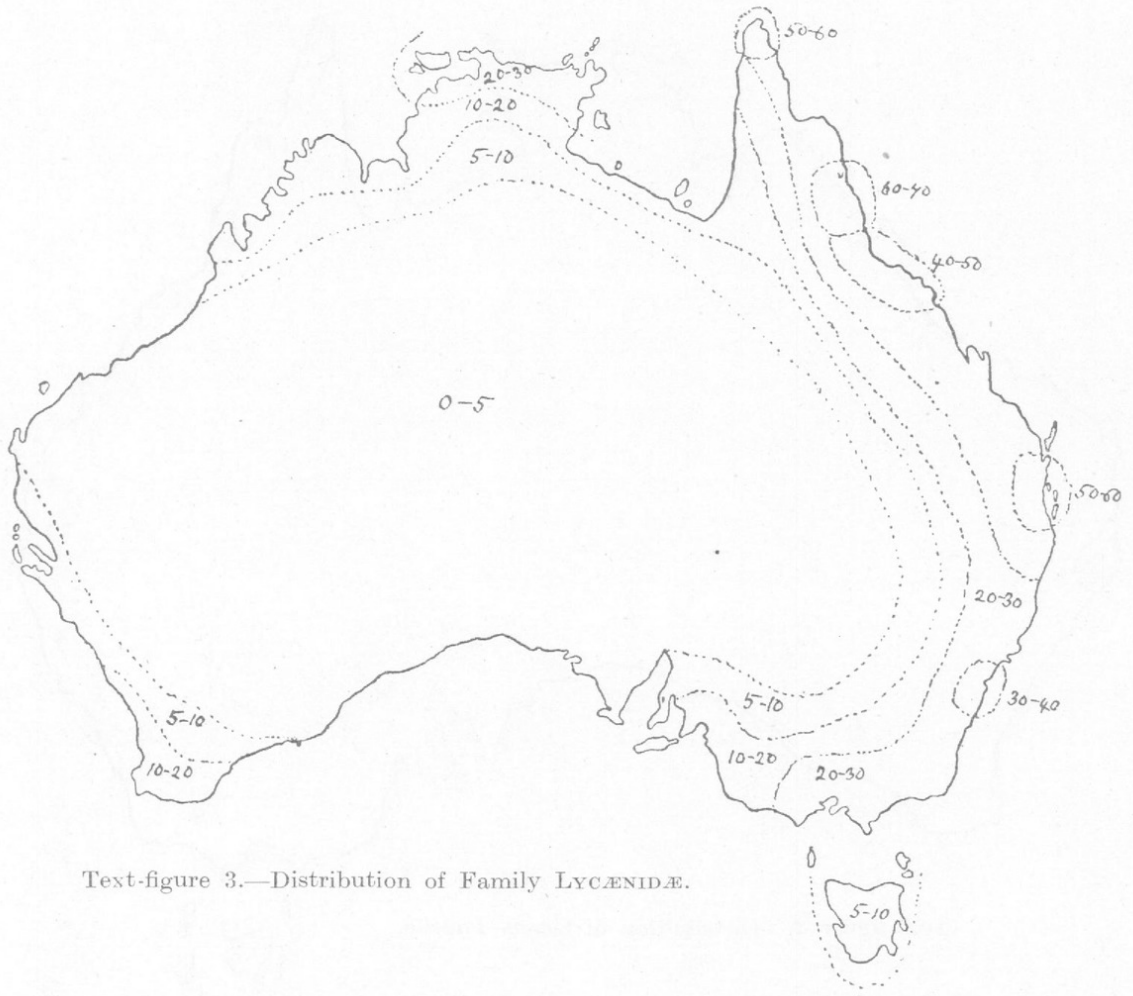
by Tillyard (Proc. Linnean Soc. N.S.W., 1914, p. 21). In Text-figure 1 is shown the distribution of the genus *Euplœa*, with the number of species in each area. It will be seen that the distribution is purely coastal, and the numbers decrease rapidly as one proceeds southwards. Eight species are known to occur at the apex of Cape York Peninsula, 5 in the Cairns district, 4 in the Townsville-Mackay district, 2 are found as far south as Brisbane, only one extends as far as Sydney. The genus



Text-figure 2.—Distribution of Genus *Papilio*.

has also a western extension along the northern coast ; 3 species reach to Darwin and one to Wyndham. Text-figure 2 is devoted to the genus *Papilio*. From Cape York to Cairns there are 13 species, thence to Mackay 12, to Yeppoon 9, to Brisbane 8, to Sydney 7, 4 are found in Victoria, and one in Tasmania. On the northern coast 3 species are found at Darwin, while one, *P. sthenelus*, is spread over a large extent of the interior from Wyndham to Adelaide. In the remainder of the continent the genus is unrepresented.

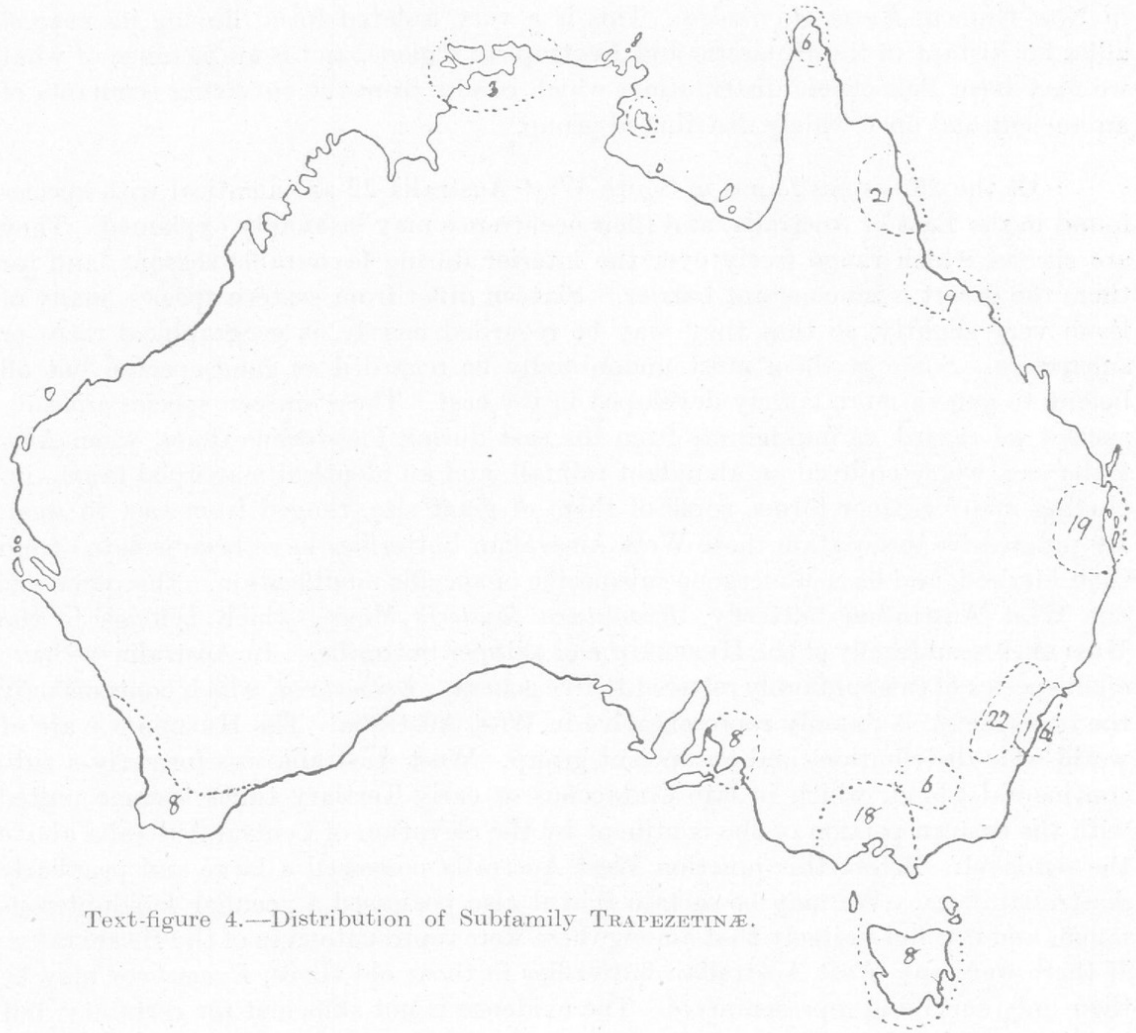
The LYCÆNIDÆ is the largest family of butterflies in Australia, comprising some 115 species. They are generally distributed all over the continent, but in very unequal numbers. Our records are not sufficiently complete as to the range of the various species to allow us to draw the specific contours in the same manner as those of the preceding two genera, but by grouping the species in tens in Text-figure 3 a very fair approximation can be secured. It will be observed that as a whole the results are closely comparable to those already obtained, in spite of the existence of



Text-figure 3.—Distribution of Family LYCÆNIDÆ.

many species of which the known range is limited to a small area. The species are by far more abundant on the east coast and diminish gradually from north to south. Apparent exceptions are the larger numbers recorded from the Sydney, Brisbane, and Cairns districts, facts which may be mainly attributed to these districts having received special attention from collectors. In the latter two districts it may also be partly due to their inclusion of high altitudes, allowing the occurrence of mountain species in addition to those found at lower levels.

We now come to a more difficult case, the TRAPEZETINÆ subfamily of the HESPERIDÆ. Their distribution is not known in sufficient detail to permit of more than a modification of our method of contours, in which the number of species found in certain areas only is shown. We observe in Text-figure 4 that the largest number of species are found in five areas, all near the coast on the east of the continent. They are Central Victoria (18), the Blue Mountains (22), Sydney district (16), Brisbane district (19), Cairns district (21). So far as the map goes we observe that the group



Text-figure 4.—Distribution of Subfamily TRAPEZETINÆ.

is an eastern one in Australia, but tolerably equably divided between north and south, and from this no definite conclusion can be drawn as to its place of origin. We may say, however, that it is known to occur in the islands to the north of Australia, that a large proportion of the species are confined to mountain areas, and that in our opinion the mountains of Papua will probably, when sufficiently explored, indicate that it has been indigenous there, and probably also in the Eastern Australian cordillera, since a very remote period.

We do not propose to extend this analysis to every group of the RHOPALOCERA. For the most part the results would be very similar to those given in our first three Text-figures. We shall, however, now consider certain exceptions. There is some evidence that half-a-dozen butterflies have reached Northern Australia, not by the Torres Strait route, but from Timor (Waterhouse and Lyell). As might be expected these are all strong-flying species. This route of immigration appears to have been of very subordinate importance. On the eastern coast from Sydney northwards to Cape York and thence westward to Darwin occurs the peculiar Papilionid, found also in New Guinea, *Eurycus cressida*. This is a very isolated form, having its nearest allies far distant in the Holarctic and Neotropical regions, and is an instance of what we may term Palæogenic distribution, which results from the surviving remnants of an ancient and once widely distributed group.

Of the 39 species found in South-West Australia 22 are identical with species found in the East of Australia, and their occurrence may be simply explained. They are species which range freely over the interior during favourable seasons, and for them the desert is no constant barrier. Sixteen differ from eastern species, many of them very slightly, so that they may be regarded merely as geographical races or subspecies. Some of them must undoubtedly be regarded as good species, but all belong to genera more largely developed in the east. These sixteen species and subspecies we regard as immigrants from the east during Pleistocene times, when Australia as a whole enjoyed an abundant rainfall, and an identical marsupial fauna, including many extinct forms, some of them of giant size, ranged from east to west. By progressive desiccation these West Australian butterflies have been isolated from their kindred, and have undergone subspecific or specific modification. There remains one West Australian butterfly, *Exometœca mysteris* Meyr., which belongs to the HESPERINÆ subfamily of the HESPERIDÆ or skipper butterflies. In Australia we have eight species of this subfamily referred to five genera. *Exometœca*, which contains only the one species, is its only representative in West Australia. The HESPERINÆ are of world-wide distribution, and an ancient group. West Australia was formerly a subcontinental island, which in late Cretaceous or early Tertiary times became united with the eastern portion of the continent by the elevation of Central Australia above the sea-level. Before this junction West Australia possessed a large and peculiarly Australian flora. We may be certain that it also possessed a peculiar lepidopterous fauna, and it is not unlikely that among these were representatives of the HESPERINÆ. If there were any West Australian butterflies in those old times, *Exometœca* may be their only surviving representative. The evidence is not sufficient for certainty, but it is a tempting hypothesis.

A more important exception to the general rule of the distribution of our Australian butterflies is presented by a small number of genera, containing in all 21 species, which may be called the *Heteronympha-Xenica* group. Their headquarters are in South-East Australia and Tasmania, and they are essentially a temperate group, diminishing rapidly in numbers toward the north, in which direction they are attached mostly to the mountains, and not reaching the tropics. This is plainly shown in Text-figure 5, which is constructed on a similar plan to Text-figure 4. Ten

species are known in Tasmania, 11 in Central Victoria, 10 in the Australian Alps and Blue Mountains, 7 in the Sydney district, 9 in New England. Only 2 species reach beyond the Macpherson Range and penetrate only a short distance into Southern Coastal Queensland. To the westward 4 species are found in South Australia and 3 in South-West Australia. It is possible that the *Heteronympha-Xenica* group may, like some other groups of our plants and insects, have an Antarctic origin. We know that a comparatively warm climate and tree-forests were present in Antarctica during the Tertiary period, and it is not unlikely that then Tasmania extended further south,

Text-figure 5.—Distribution of *Heteronympha-Xenica* Group.

and Antarctica further north. An actual land connection would not be necessary, as insects may under favourable conditions, such as strong winds and storms, be conveyed overseas for long distances. The only other possibility is that these temperate-loving butterflies crossed from north to south along our eastern cordillera during a glacial epoch. If their nearest relatives are found in the Papuan mountains, this latter hypothesis will be strengthened ; if however they are found in Chile, the Antarctic theory will receive confirmation.

An interesting special case arises among these SATYRINÆ. The very common eastern species *Xenica klugi* is found also in South-West Australia, and with it a closely allied species, *X. minyas*, which is peculiar to that area. Now *minyas* and *klugi* must have had a common origin, and it seems difficult to explain why *klugi*, so constant in all the rest of its wide range, should in this area have branched into two species. Light is thrown on this problem by the third West Australian species *Heteronympha duboulayi*, which is extremely close to the eastern *H. merope*. Here the explanation is easy. *H. merope* crossed the continent to the west probably during moist Pleistocene times. Isolated by subsequent desiccation, it diverged slightly from the parent form, so slightly that by some it is regarded as only a subspecies. *X. minyas* arose, I believe, in the same way from *X. klugi*, and would certainly have been regarded as a subspecies if *klugi* were not found in the same area. *Klugi*, I consider, managed after a long interval to cross the desert a second time. This may have occurred during an exceptionally wet season, or series of wet seasons, unless we suppose, which is conceivable, that it was accidentally conveyed in fodder since the settlement of Australia. However that may be, its descendant *minyas* had by that time become sufficiently modified to prevent its interbreeding with the parent species.