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SOLITARY BEES AND WASPS (HYMENOPTERA ACULEATA) IN KENT, IN THE SUMMER

By Jean Leclercq

Here is the survey of the 598 Aculeate Hymenoptera that I was able to collect in Kent, mainly in July, between 1946 and 1964. The work started by collecting on the chalk hills, in sandy places and along cultivated areas of the Sevenoaks district. In July 1961 and 1964, it was decided also to visit other districts of the county and to look for Hymenoptera very carefully, to obtain a significant sample showing the pattern of abundance of the solitary bees and wasps associated with the Kentish landscape.

The fauna of Kent is of particular interest to a continental, more so to a Belgian, entomologist because this county is the nearest to the mainland and therefore deserves special attention from the point of view of comparative regional zoogeography. It has been explored during about 150 years by many entomologists. Nevertheless there is no up to date list of the Hymenoptera of this 'Garden of England', not even one of the better known bees and wasps. In bringing a contribution to such a county list, I wish to stress the need for thorough information on the patterns of abundance of British insects.

The final check-list of the insects of Kent will undoubtedly be very similar to the list of insects found in French and Belgian Flanders, differing only in the absence of some species. But the pattern of abundance may reveal more profound differences on both sides of the Straits of Dover, because the soil and use of the ground are different, also because the absence of some species is likely to affect the whole balance of natural populations. So it is hoped that the statistical facts presented here as a result of my survey, will become useful in further attempts to compare the fauna of Kent with that of other regions of Western Europe.

Williams (1964) has shown how promising it is to introduce quantitative relationships and to try measuring diversity in ecology and systematics. His outlook and methods should improve considerably the study of zoogeography in providing the latter with the opportunity to change into a true comparative science. However one may question the reliability of frequencies and patterns suggested by the counting of flying insects, caught with an ordinary net, at random, in areas as large as Kent.

Anyhow there is no trapping method available to provide estimates of the numbers of Aculeate Hymenoptera in the field. To count them in their nests, per unit of surface, is practically impossible, except in the case of ants and in very small homogenous habitats such as a sand bank. In larger areas, their populations are so low and distributed so irregularly, that the only way of finding them and thus of counting them, is to look for them at random, and to catch representative samples of every species. Work in these conditions is liable to be biased in three main directions. The collector may look for rarities and for as many peculiar species as possible, and consequently refrain from catching common species. He may not see so easily the smallest forms, those which fly less

than others, and those which have more or less cryptic habits. He may concentrate his observations in exceptionally favourable grounds, neglecting most parts of the area.

These errors are human, but they can be reduced to a minimum by human intent. The collector may react against the preference for rare species and purposely catch fair numbers of the common ones. This is not too difficult in the case of solitary Aculeata for these are rarely very abundant in one place at a time, and it is often impossible to know while collecting, whether what is seen in flight or on flowers is common or rare. With some experience, the collector will search adequately for the smallest species and inspect the niches (dead trees, posts, walls, small banks) where he may discover those which are not readily conspicuous. He will be careful to visit many places, not only good ones, and will keep in mind that he is busy surveying the fauna of the landscape as it is. He can reflect upon what he finds. There is no reason why a keen collector with experience and self-discipline, should obtain samples of so much less significance than those produced by mechanical trapping. Anyway his estimates should be more accurate than the purely subjective judgments expressed by attributes such as 'very common', 'common', 'rather common', 'rare' and 'very rare' given in the ordinary faunal lists. This will indeed be improved by the introduction of numbers and cumulative counts.

During the last 20 years, I have done my best, in Kent and elsewhere, to collect bees and wasps in compliance with the rules outlined hereabove. I fail to see what else could be done in the case of these insects, except increasing the size of the sample—598 specimens are perhaps far from enough—and having the recorded patterns checked by other observers.

SURVEY OF THE SPECIES PRESENTED IN TAXONOMIC ORDER

Apoidea (determined with Schmiedeknecht, 1930), and listed following the classification suggested by Šustera (1958). A few individuals taken in April are also recorded between brackets.

COLLETIDAE COLLETINAE.—*Colletes daviesanus* Smith, Seal, 5 ♀, 23/27.viii.57 on *Tanacetum*; Dunton Green, 2 ♀, 15/19.vii.61 on *Matricaria inodora* L.; Sevenoaks, 3♂, 27.vii.64; Wrotham Heath, 3 ♀, 24/27.vii.64 on *Achillea millefolium* L.

COLLETIDAE PROSOPINAE.—*Prosopis annularis* (Kirby), Kemsing, ♂, 6.vii.52; Seal, ♀, 8.vii.52. *P. brevicornis* (Nylander), Brasted, ♂, 19.vii.61; Ulcombe, ♀, 25.vii.61 on *Heracleum*; Challock, 2 ♀, 25.vii.64 on *Angelica*; Crouch, ♀, 26.vii.64. *P. communis* (Nylander), Kemsing, 2 ♀, 5/6.vii.52; 5 ♂, 2 ♀, 19/20.vii.54; ♂, 31.vii.56; ♀, 13.vii.61 on *Heracleum*; Shipbourne, ♂, 23.vii.61; Lenham. ♂, 25.vii.61; Ulcombe, ♀, 13.vii.61 on *Heracleum*; Wrotham Heath, ♀, 17.vii.64; Penshurst, 2 ♀, 22.vii.64; 2 ♂, 25.vii.61 on *Heracleum*; Wrotham Heath, ♀, 17.vii.64; Penshurst, 2 ♀, 22.vii.64; Elmsted, ♀, 25.vii.64; Crouch, 3 ♂, 26.vii.64. *P. confusa* (Nylander), Kemsing, ♂, 20.vii.54; Wrotham, ♂, 17.vii.64 on *Campanula trachelium* L. *P. hyalinata* (Smith), Wye, ♂, 25.vii.64. *P. pictipes* (Nylander), Kemsing, ♀, 1.viii.56; Lenham, ♂, 25.vii.61; Sheppey, Minster, ♂, 16.vii.64 on *Pastinaca*; Hythe, ♂, 28.vii.64 on *Daucus*.

HALICTIDAE.—*Halictus albipes* (F.), Kemsing, 3 ♀, 5.vii.52, ♀, 20.vii.54; Eynsford, ♀, 23.vii.64 on *Blackstonia perfoliata* Hud.; Hythe, ♂, 28.vii.64. *H. calceatus* (Scopoli), Kemsing, ♂, 5.vii.52; ♀, 23.vii.52; ♀, 20.vii.54; (♀, 8.iv.55); 3 ♂, 31.vii.56; ♂, 2 ♀, 3.viii.56; 2 ♂, 27.viii.57; ♂ ♀, 20.vii.58 on *Sonchus*; Bexley, 2 ♂, 10.vii.52; (Shoreham, ♀, 11.iv.55); Canterbury, 2 ♀, 18.vii.61; Dunton Green, ♀, 19.vii.61; Wrotham, ♀, 17.vii.64 on *Knautia*; Sevenoaks, ♀, 29.vii.64. *H. fulvicornis* (Kirby), Kemsing (♀, 8.iv.55), 7 ♂, 31.vii/4.viii.56; Otford, ♂, 5.viii.56; Eynsford, ♂ ♀, 23.vii.64 on *Campanula rotundifolia* L.; Elmsted, ♀, 25.vii.64. *H. laevigatus* (Kirby), Bexley, ♂, 10.vii.52; Kemsing, ♀, 31.vii.52. *H. leucopus* (Kirby), Lenham Heath, ♂, 15.vii.64; Elmsted, ♂, 25.vii.64; Hythe, ♂, 28.vii.64. *H. leucozonius* (Schrank), Kemsing,

♀, 5.vii.52; Sevenoaks, ♂ ♀, 26/29.vii.64. *H. minutus* (Schrank), Sevenoaks, ♂, 26.vii.64. *H. morio* (F.), Kemsing, 2 ♀, 31.vii/4.viii.56. *H. nitidiusculus* (Kirby), Seal, 2 ♂, 5.viii.56. *H. rubicundus* (Christ), Seal, ♀, 27.viii.57 on *Tanacetum*; Eynsford, ♂, 23.vii.64; Elmsted, ♂ ♀, 25.vii.64. *H. smeathmanellus* (Kirby), Kemsing, ♀, 1.viii.56; Otford, 2 ♂, 18.vii.64; 9 ♂ ♀, 25/27.vii.64, the ♀ on *Linaria cymbalaria* L.; Penshurst, 2 ♀, 22.vii.64. *H. tumulorum* (O.), Lenham Heath, ♀, 15.vii.64; Otford, ♀, 17.vii.64 on *Reseda lutea* L.; Elmsted, ♀, 25.vii.64; Sevenoaks, ♂ ♀, 26/27.vii.64; Hythe, ♂, 28.vii.64. *H. villosulus* (Kirby), St Mary Cray, 2 ♂ ♀, 16.vii.52; Sheppey, Minister, ♀, 16.vii.64; Hythe, ♂ ♀, 28. vii.64 on *Crepis capillaris* Wal.; Sevenoaks, ♀, 29.vii.64 on *Crepis capillaris*.

PARASITIC HALICTIDAE.—*Sphecodes crassus* Thomson (*s.l.*), Bexley, ♂, 10.vii.52; Molash near Chilham, ♂ ♀, 18.vii.61; Sevenoaks, ♂, 27.vii.64. *S. hyalinatus* von Hagens, Kemsing, ♂, 4.vii.52. *S. monilicornis* (Kirby), Kemsing, ♀, 3.viii.52 on *Pastinaca*. *S. puncticeps* Thomson, Lenham, ♂, 25.vii.61.

ANDRENIDAE ANDRENINAE.—*Andrena bicolor* F., Bexley, ♀, 10.vii.52; (Kemsing, 2 ♂, 9.iv.55); (Otford, ♀, 11.iv.55); Dunton Green, ♀, 15.vii.61; Sheppey, Minster, ♀, 16.vii.64; Crockenhill, ♂, 26.vii.64; Crouch, ♂, 26.vii.64; Wye, ♀, 25.vii.64 on *Campanula trachelium* L.; Hythe, 4 ♀, 28.vii.64 one on *Crepis capillaris* Wal., one on *Malva silvestris* L., two on *Bryonia*. *A. coitana* (Kirby), Ulcombe, 8 ♀, 21/27.vii.61 on *Heracleum*, but one on *Senecio jacobaea* L.; Challock, 5 ♀, 25.vii.64 on *Angelica* and *Heracleum*. *A. denticulata* (Kirby), Darenth, 3 ♀, 24.vii.61, one on *Cirsium arvense*, two on *Senecio jacobaea* L.; Sevenoaks, 5 ♂ 6 ♀, 27/29,vii.64 on *Senecio jacobaea*—the males fly around the flowers of *Senecio jacobaea*, then visit them for nectar, holding their abdomen upright. *A. dorsata* (Kirby), Otford, ♀, 18.viii.46; ♂, 6.vii.52; (8 ♂, 11.iv.55); ♀, 5.viii.56; (Kemsing, ♂, 11.iv.55); (Seal, ♂, 14.iv.55); Crockenhill, ♀, 26.vii.64; Sevenoaks, 2 ♀, 29.vii.64 on *Heracleum*. *A. flavipes* Panzer, Otford, ♀, 22.ix. 46 on *Senecio jacobaea* L.; Kemsing, ♂ ♀, 5.vii.52; St Mary Cray, ♀, 10.vii.52; Ightham, ♀, 19.vii.61 on *Heracleum*; Borough Green, ♀, 25.vii.61; Sheppey, Minster, 2 ♂, 16.vii.64 on *Picris echioides* L.; Folkestone, ♀, 28.vii.64 on *Daucus*. (*A. haemorrhoa* (F.), Otford, ♂, 11.iv.55; Seal, 2 ♂, 14.iv.55). (*A. jacobi* Perkins, Kemsing, ♂, 8.iv.55; Otford, ♂, 11.iv.55; 6 ♂, 14.iv.65; Seal, 2 ♂ 14.iv.56). *A. minutula* (Kirby), Kemsing, 2 ♀, 4.vii.52; ♀, 13.vii.61 on *Heracleum*; Otford, ♀, 5.viii.56; Dunton Green, ♀, 10.vii.62 on *Daucus*; Molash, near Chilham, ♂, 18.vii.61; Shoreham, 2 ♀, 23.vii.64; Crockenhill, ♀, 26.vii.64. *A. ovatula* (Kirby), Sevenoaks, ♀, 26.vii.64. (*A. rosae* Panzer, Otford, ♀, 11.iv.55). *A. saundersella* Perkins, Kemsing, ♀, 20.vii.58; Lenham Heath, ♀, 15.vii.64; Crockenhill, 4 ♀, 26.vii.64. *A. subopaca* Nylander, Bexley, 3 ♀, 10.vii.52; (Shoreham, 2 ♂, 11.iv.55 on *Taraxacum*; Otford, ♀, 14.iv.55; Seal, ♀, 14.iv.55). *A. thoracica* (F.), Folkestone, 2 ♀, 28.vii.64, one on *Daucus*, the other on *Olearia haastii* Hook. (Compositae, introduced from New Zealand), in a park. *A. wilkella* (Kirby), Sheppey, Minster, ♀, 16.vii.64 on *Lotus corniculatus* L.

ANDRENIDAE PANURGINAE.—*Panurgus calcaratus* (Scopoli), St Mary Cray, ♀, 10.vii.52.

ANDRENIDAE NOMADINAE.—*Nomada fucata* Panzer, St Mary Cray, 3 ♀, 10.vii.52.

MELITTIDAE MELITTINAE.—*Melitta haemorrhoidalis* (F.), Kemsing, ♂, 13.vii.61; 2 ♂, 23. vii.61;these males were found resting inactive on flowers of *Malva moschata* L., in cool weather; Otford, ♂, 15.vii.64 on *Campanula trachelium* L.; Wrotham, 2 ♂, 17.vii.64 on *Campanula trachelium*. *Melitta leporina* (Panzer), Charing Heath, 6 ♂ 3 ♀, 25.vii.61 on *Medicago sativa* L.; Otford, ♂, 18.vii.64.

MELITTIDAE DASYPODINAE.—*Dasypoda hirtipes* (F.), St Mary Cray, 2 ♂, 10.vii.52; Seal, ♂, 5.viii.56; Wrotham Heath, 4 ♂ 4 ♀, 13/14.vii.61, ♂ 17.vii.64.

MEGACHILIDAE.—*Anthidium manicatum* (L.), St Mary Cray, 2 ♂ ♀,10 .vii.52 on *Ballota nigra* L.; Shoreham, ♀, 20.vii.52 on *Ballota*; Otford, 8 ♂ 2 ♀, 15/17/25/29.vii.64, one ♂ on *Chicorium intybus* L., another on *Linaria cymbalaria* L., the others on *Stachys sylvatica* L.; Folkestone, 3 ♂, 28.vii.64, on *Ononis spinosa* L. *Chelostoma campanularum* (Kirby), Molash near Chilham, ♂, 18.vii.61; Otford, 3 ♂ 4 ♀, 14/25.vii.64 *Campanula trachelium* L.; Wrotham, ♂, 17.vii.64, *Campanula trachelium*; Wrotham, ♂, 17.vii.64, *Campanula trachelium*; Addington, ♂ 2 ♀, 17.vii.64, *Campanula rotundifolia* L. *Osmia coerulescens* (L.), Kemsing, ♀, 20.vii.54; Sheppey, Minster, ♀, 16.vii.64. *O. ventralis* (Panzer), Kemsing, ♀, 18.viii.57; Dunton Green, ♀, 15.vii.61. *Megachile centuncularis* (L.) Otford ♀, 6.vii.54, 2 ♀, 19.vii.64 on *Cirsium*, ♀, 29.vii.64, on *Dipsacus silvestris* Hud.; Kemsing, ♂, 20.vii.54; ♀, 3.viii.56; ♀, 20.vii.58 on *Sonchus arvensis* L., ♀, 23.vii.61 on *Centaurea*. *M. ligniseca* (Kirby), Offham, ♀, 25.vii.61 on *Cirsium arvense* Scop. *M. maritima* (Kirby), Charing Heath, ♀, 15.vii.64, on *Teucrium scorodonia* L. *M. willughbiella* (Kirby), Molash near Chilham, ♀, 18.vii.61, on *Lotus*;

Lenham ♀, 25.vii.61, on *Lotus*; Dymchurch, 2 ♀, 20.vii.61 one on *Lathyrus silvestris* L., the other on *Ononis spinosa* L.; Charing Heath, ♂, 15.vii.64, on *Teucrium scorodonia* L.; Sheppey, Minster, 2 ♂ ♀, 16.vii.64, on *Lotus corniculatus* L.

PARASITIC MEGACHILIDAE.—*Coelioxys conoidea* (Illiger), Kemsing, ♂, 3.viii.52, on *Centaurea*.

PARASITIC ANTHOPHORIDAE.—*Epeolus variegatus* (L.), Lenham, 3 ♀, 25.vii.61; Charing Heath, ♂ ♀, 15.vii.64, on *Senecio jacobeae* L.; Wrotham Heath, ♂ 2 ♀, 17.vii.64, the ♂ on *Senecio jacobaea*, the ♀♀ on *Achillea millefolium* L.

ANTHOPHORIDAE.—*Anthophora bimaculata* (Panzer), St Mary Cray, 3 ♂, 10.vii.52; Lenham Heath, 2 ♂ 2 ♀, 15.vii.64 on *Ballota nigra* L. *A. furcata* (Panzer), Seal, ♀, 6.vii.52; Otford, ♂, 15.vii.64 on *Stachys sylvatica* L. *A. quadrimaculata* (Panzer), Bexley, ♀, 10.vii.52; Sheppey, Minster, ♂ ♀, 16.vii.64 on *Ballota nigra* L.

SPHECIDAE.—(Determined with De Beaumont, 1964, and listed following the taxonomic order adopted in that work). A few specimens found in the British Museum (Nat. Hist.) collection are also recorded between brackets. Those from Ashford and Wye, July, 1946, were collected by R. B. Benson.

SPHECINAE.—*Ammophila sabulosa* (L.), St Mary Cray, 2 ♀, 10.vii.52; Seal, ♂, 27.viii.57.

PHILANTHINAE.—*Cerceris arenaria* (L.), St Mary Cray, ♂ ♀, 10.vii.52; Charing Heath, ♂, 15.vii.64. *C. rybyensis* (L.), Kemsing, ♀, 5.vii.52; Seal, ♂, 6.vii.52; St Mary Cray, ♂ ♀, 10.vii.52; Charing Heath, ♂, 25.vii.61. Not seen in 1964, seems to have become much rarer than earlier, during the two last decades in Belgium; also in England?

NYSSONINAE.—*Nysson dimidiatus* Juringe, Seal, ♀, 27.viii.57. *N. trimaculatus* (Rossi), Sevenoaks, 2 ♀, 26/29.vii.64. *Mellinus arvensis* (L.), Seal, 3 ♂ 3 ♀, 23/27.viii.57; Wrotham Heath, ♂, 13.vii.61; Brasted, 7 ♂, 19.vii.61; Borough Green, 15 ♂ ♀, 25.vii.61; Lenham, 2 ♂, 25. vii.61; Sevenoaks, ♂, 26.vii.64. In 1961, this species was particularly abundant in all the visited sandy places, but it was not so in 1964; only one ♂ caught and none seen in the sites where so many were present in July, 1961!

LARRINAE.—*Tachysphex pompiliformis* (Panzer), Dymchurch, ♂, 20.vii.61.

TRYPOXYLONINAE.—*Trypoxylon attenuatum* Smith, Seal, ♂, 23.viii.57; (also one ♀ emerged in May, 1950, from *Rubus* stems collected in Kemsing at Christmas, 1949). *T. clavicerum* Lepeletier de St-Fargeau, Kemsing, 2 ♀, 5.vii.52; ♀, 29.vii.52; Ivy Hatch, ♀, 22.vii.52; Otford, ♀, 15.vii.64; Wrotham, ♂ ♀, 17.vii.64; Penshurst, ♂, 22.vii.64; Crouch, ♂, 26.vii.64. *T. figulus* (L.), Kemsing, ♂, 5.vii.52; Otford. ♂, 6.vii.52.

PEMPHREDONINAE.—*Psen dahlbomi* (Wesmael), St Mary Cray, ♂, 10.vii.52; Sevenoaks, ♀, 26.vii.64. *Psen equestris* (F.), Brasted, ♂, 19.vii.61. *Psenulus concolor* (Dahlbom), Sevenoaks, ♀, 25.vii.52. *P. pallipes* (Panzer), Lenham, 2 ♀, 25.vii.61; Sheppey, Minster, ♀, 16.vii.64; Wrotham Heath, ♀, 17.vii.64; Penshurst, ♀, 22.vii.64. *Pemphredon lethifer* (Shuckard), Kemsing, 2 ♂, 18/19.vii.54 (also 6 ♂ emerged in May, 1950, from *Rubus* stems collected there at Christmas, 1949); Otford, ♀, 5.viii.56; Ramsgate, ♀, 18.vii.61; Dymchurch, ♀, 20.vii.61; Sheppey, Minster, 3 ♂, 16.vii.64; Wrotham Heath, ♀, 17.vii.64. *P. shuckardi* (Morawitz), Seal, ♀, 27.viii.57; Eynsford, ♂, 23.vii.64. *Passaloecus corniger* Shuckard, Penshurst, ♂, 22.vii.64. *P. gracilis* (Curtis) (*tenuis* in De Beaumont, but there is no reason to reject Curtis's earlier name, as already stated by Richards, 1935: 165), Addington, ♀, 17.vii.64; Elmsted, ♀, 25.vii.64; Ightham, ♀, 27.vii.64 *P. insignis* (Van der Linden) (*turionum* in De Beaumont, but here again I agree with Richards, *loc. cit.*, and I shall discuss the matter elsewhere), Kemsing, ♂, 13.vii.52; Sheppey, Minster, ♀, 16.vii.64; Wye ♀ 25.vii.64. *Diodontus minutus* (F.), Lenham, 8 ♂, 25.vii.61; Wrotham Heath, 3 ♂, 17.vii.64. *D. tristis* (Van der Linden), Wrotham Heath, 3 ♂, 24.vii.61; Sevenoaks, 2 ♂, 26.vii.64. *Stigmus solskyi* Morawitz, Kemsing, ♂, 5.vii.52; Wrotham Heath, ♀, 17.vii.64; Sevenoaks, 2 ♀, 27.vii.64; Hythe, ♂, 28.vii.64. *Spilomena beata* Blüthgen, Wrotham Heath, ♂, 17.vii.64. *S. differens* Blüthgen, Penshurst, ♀, 22.vii.64. So far, only *Spilomena troglodytes* (Van der Linden) has been recorded from Great Britain, so two species have to be added to the British list. All the British *Spilomena* should be revised since Blüthgen (1953, 1960) has shown that the genus includes at least eleven species in the Palaearctic Region. It is probable that all the British species may be distinguished using De Beaumont's key, p. 115).

CRABRONINAE.—*Ectemnius continuus* (F.) (Ashford, ♂, 7.vii.46); Otford, ♀, 20.viii.47; ♂, 26.vii.52; Kemsing, ♂, 5.vii.52; St Mary Cray, ♂, 10.vii.52; Dunton Green, ♀, 15.vii.61; Dymchurch, 2 ♂, 20.vii.61, one the of ♂ on *Cirsium*; in 1964, hundreds of umbels of common Umbelliferae were inspected as usual, but no specimen was seen. *E. dives* (Lepeletier de St-Fargeau et Brullé), Seal, ♂, 6.vii.52 on *Heracleum*; Kemsing, ♂, 3.viii.56. *E. lapidarius* (Panzer), Otford, ♀, 5.viii.56, remained on an umbel of *Heracleum* during a shower of rain; Kemsing, ♂, 20.vii.58; Ightham, ♂, 19.vii.61. *E. lituratus* (Panzer), Kemsing, ♂, 5.vii.52, ♂ ♀, 1/3.viii.56; Sevenoaks, ♀, 25.vii.52; Molash near Chilham, 4 ♂, 18.vii.61 on *Heracleum*; Wye, ♂, 25.vii.64 on *Heracleum*; also in the British Museum (Nat. Hist.) collection: Eynsford, ♂, 25.vii.26). *E. rubicola* (Dufour et Perris), Kemsing, ♂, 18.vii.1954. *Crabro cribrarius* (L.), Seal, ♀, 22.vii.52; Ivy Hatch, 2 ♂, 22.vii.52; Wrotham Heath, ♀, 17.vii.64 (*C. peltarius* (Schreber), Ashford, 3 ♂ ♀, 7.vii.46). *Crossocerus ambiguus* Dahlbom, Otford, ♀, 5.viii.56; Downe, 2 ♀, 15.vii.61; (also in the British Museum (Nat. Hist.) collection: St Mary Cray, ♀, 4.ix.1900). (*C.capitosus* (Shuckard), Wye, ♀, 5.vii.46). (*C. confusus* (Schulz), Wye, ♂, 4.vii.46). *C. elongatulus* (Van der Linden), Kemsing, 4 ♂, 3/6.vii.52; ♂, 19.vii.54; Seal, 2 ♂ ♀, 23/27.viii.57; Brasted, ♂, 10.vii.61; Borough Green, ♂, 25.vii.61; Sheppey, Minster, 3 ♂, 16.vii.64; Wrotham Heath, ♂, 17.vii.64; Otford, ♂, 25.vii.64; Sevenoaks, ♂, 26.vii.64; Hythe, ♂ ♀, 28.vii.64. (*C. leucostomoides* Richards Wye, ♀, 5.vii.46). (*C. ovalis* Lepeletier de St-Fargeau et Brullé, Chiddingstone, ♀, 1.vi.56). *C. podagricus* (Van der Linden), Lenham, 4 ♂, 25.vii.61; Otford, 2 ♀, 18/25.vii.64; Crouch, ♂ ♀, 26.vii.64; Hythe, ♂ ♀, 28.vii.64. (*C. pubescens* (Shuckard), Ham Street, ♀, 3.vii.46; Wye, 2 ♀, 5.vii.46). *C. quadrimaculatus* (F.), Otford, ♂, 6.vii.52; Kemsing, ♀, 6.viii.52; Seal, 3 ♂ ♀, 23.viii.57; Wrotham Heath, ♂ ♀, 24.vii.61; 2 ♀, 17.vii.64; Trottiscliffe, ♂ 2 ♀, 24.vii.61, one of the ♀ carrying a small Muscid fly as prey; Borough Green, ♀, 25.vii.61; Sevenoaks 5 ♂, 26/29.vii.64; the two first specimens were found on chalky soil, at the bottom of the North Downs, in Otford and Kemsing, thus far from any sandy place; this is surprising for a true arenophilous species. *C. tarsatus* (Shuckard), Otford, ♂, 6.vii.52; Borough Green, ♂, 25.vii.61; Lenham, ♂, 25.vii.61; Sheppey, Minster 2 ♂ 16.vii.64; Sevenoaks, 2 ♂, 26/29.vii.64. *C. varus* (Lepeletier et Brullé, who spelt the trivial name *varus* and not *varius*), Seal, ♂, 27.viii.57; Ide Hill, ♂, 21.vii.61; Harrietsham, 2 ♀, 21.vii.61; Wrotham Heath, 2 ♀, 24.vii.61; 2 ♀, 17.vii.64; Otford, 3 ♀, 15.vii.61; Hollingbourne, ♀, 15.vii.64. *C. wesmaeli* (Van der Linden), Brasted, ♂, 19.vii.61; Trottiscliffe, ♂, 24.vii.61; Borough Green, 4 ♂, 25.vii.61. *Lindenius albilabris* (F.), St Mary Cray, ♂, 10.vii.52; Bexley, ♀, 10.vii.52; Seal, ♀, 6.viii.56; Kemsing, ♀, 12.vii.61; Trottiscliffe, ♂, 24.vii.61. *Entomognathus brevis* (Van der Linden), Kemsing, 5 ♂ ♀, 5.vii.52; ♀, 18.vii.54; St Mary Cray, ♂ 2 ♀, 10.vii.52; Ivy Hatch, ♂, 22.vii.52; Sevenoaks, ♂, 26.vii.52; Seal, ♀, 5.viii.56; Molash near Chilham, ♂, 18.vii.61; Knockholt, ♂, 24.vii.61; Charing Heath, ♂, 15.vii.64; Lenham Heath, 5 ♂ 3 ♀, 15.vii.64; Wrotham Heath, ♂. 17.vii.64; Otford, ♀, 18.vii.64; Wye, 2 ♂, 25.vii.64. *Oxybelus uniglumis* (L.), Seal, ♀, 28.viii.57; Dymchurch, 4 ♀, 20.vii.61, one on *Cirsium*, another carrying a ♀ of *Calliphora erythrocephala* (Meigen) (Diptera, Calliphoridae) as prey; Lenham, ♂, 25.vii.61; Wrotham Heath, ♀, 15.vii.64; Lenham Heath, ♀, 17.vii.64.

BETHYLIDAE (O.W. Richards det.).— *Bethylus fuscicornis* (Jurine), Otford, ♀, 6.vii.52.

CHRYSIDIDAE (S. Zimmermann det.).—*Chrysis ignita* (L.), Elmsted, ♀, 25.vii.64. *Hedychridium ardens* (Latreille), Lenham, 3 ♂, 25.vii.61. *Notozus panzeri* (F.), Trottiscliffe, ♀, 24.vii.63. *Omalus violaceus* (Scopoli), Kemsing, ♀, 20.vii.52.

TIPHIIDAE (s.l.).—*Myrmosa atra* Panzer, Sevenoaks, ♂ ♀, 26.vii.64. *Tiphia femorata* F., Kemsing, ♂, 16.vii.47; not found afterwards, is this becoming rarer in Britain as it has done very obviously in Belgium since 1950?

POMPILIDAE (R. Wahis det.).—*Anoplius infuscatus* (Van der Linden), Borough Green, ♀, 25.vii.61; Lenham, ♀, 25.vii.61. *Episyron rufipes* (L.), Dymchurch, ♂, 20.vii.61. *Pompilus anceps* Wesmael, Brasted, ♂, 19.vii.61. *Priocnemis exaltata* (F.), Kemsing, 2 ♀, 18.viii.57 on *Pastinaca*, 2 ♀, 20.vii.58 on *Heracleum*, ♂, 13.vii.61; Otford, 2 ♀, 15/18.vii.61 on *Daucus*; Dymchurch ♀, 20.vii.61, on *Pastinaca*; Offham, ♂ ♀, 25.vii.61 on *Daucus*.

VESPIDAE (determined with Blüthgen, 1961, but generic names kept in agreement with Bohart 1951).—*Ancistrocerus gazella* (Panzer), Crockenhill, ♂, 26.vii.64. *A. nigricornis* (Curtis), Crouch, 2 ♂, 26.vii.64. *Odynerus laevipes* Shuckard, Kemsing, ♀, 16.viii.47 on *Pastinaca*. *Symmorphus sinuatissimus* Richards, Kemsing, ♀, 20.vii.58 on *Heracleum*.

Numerical Data at Higher Category Levels

The above survey shows that in July and a part of August, the fauna of Kent includes a minimum of 53 active species of solitary bees and of 55 species of solitary wasps. It is not certain that surveys made in other European areas would produce such curiously equal numbers of bees and wasps. Table 1 summarizes the numerical data and shows among other things, that the dominant constituents of the populations are Crabroninae, Halictidae and Andrenidae. This should be characteristic either of Kent or of southern England or of a larger part of western Europe with atlantic climate. At the same period of the year, in the mediterranean areas of France, one would find greatly increased numbers of Eumeninae,

Table 1.—higher categories of solitary bees and wasps in Kent, during the summer.

	Number of Genera	*Number of Species*	*Number of Individuals*
Halictidae	2	17	89
Andrenidae	3	13	78
Megachilidae	5	9	52
Colletidae	2	7	49
Anthophoridae	2	4	20
Melittidae	2	3	27
Apoidea (total)	16	53	315
Crabroninae	6	16	141
Pemphredoninae	7	14	50
Nyssoninae	2	3	36
Trypoxyloninae	1	3	13
Philanthinae	1	2	8
Sphecinae	1	1	3
Larrinae	1	1	1
Sphecidae (total)	19	40	252
Pompilidae	4	4	16
Vespidae Eumeninae	3	4	5
Chrysididae	4	4	6
Tiphidae	2	2	3
Bethylidae	1	1	1
Other Wasps (total)	14	15	31
All Wasps (total)	33	55	283
Bees and Wasps (total)	49	108	598

Sphecinae and Megachilidae, and quite different proportions of the other groups (see Leclercq, 1959). In the centre and north of France, one would surely find more Nyssoninae particularly representatives of the Gorytini group which is entirely missing in my collection from Kent (though some species were previously recorded from there). However, what was found in Kent is, at the level considered, very similar to the collections I made in Belgium, mainly in Eastern Belgium, at the same periods of the year:

I have recorded (1964) the supra-generic distribution of the solitary

bees and wasps I collected in Belgium in 1960, 1961, 1962 and 1963, using the same collecting methods as in Kent. A total of 5042 individuals were caught, but for our purposes here, we shall only consider the 1103 found between July 4th and August 12th each year, i.e. during the same period as for my Kent survey. We shall also limit the comparison to the numbers of individuals (expressed in percentages) of both surveys, for not all the Belgian material is sorted at generic and specific levels. Table 2 shows how data from Kent compare with data from Belgiam. There is hardly any difference worth mentioning. Undoubtedly both faunas are balanced according to the same general pattern. It would seem that there is a reverse situation in the case of the Andrenidae and Megachilidae. In fact I had the impression, while collecting in Kent, that summer *Andrena* are somewhat more abundant there than generally in Belgium. The increased percentage of Megachilidae in Belgium is essentially due to the abundance of the *Chelostoma* species which nest in posts and visit the flowers of *Campanula* at least in the part of the country where I have collected the most. This may be a purely recent and local phenomenon as I shall explain elsewhere.

Table 2.—higher categories of solitary Apoidea and of Sphecidae in Kent and in Belgium, during the summer

Kent: total individuals=315 Apoidea + 252 Sphecidae = 567
Belgium: total individuals = 706 Apoidea + 397 Sphecidae = 1103

	Percentage of Individuals	
	KENT	*BELGIUM*
Halictidae	28.0	33.3
Andrenidae	24.8	17.3
Megachilidae	16.6	23.0
Colletidae	15.6	17.0
Anthophoridae	6.4	3.4
Melitidae	8.6	5.7
Xylocopidae	0	0.3
Crabroninae	56.0	52.9
Pemphredoninae	19.8	25.4
Nyssoninae	14.3	10.1
Trypoxyloninae	5.2	4.5
Philanthinae	3.2	4.8
Sphecinae	1.1	0.8
Larrinae	0.4	1.5

The Pattern of Abundance of the Species

The survey provides three criteria useful for assessing the relative abundance of each species. They are: *i*: the number of individuals caught; *l*: the number of localities in which the species was found; *f*: the frequency of occurrences.

By one locality, I understand a village or a similar area bearing a name and indicated as such on an ordinary map and on sign posts on the roads, i.e. the geographic name any entomologist would write on the labels of his insects.

By frequency of occurences, I understand the number of times the species was seen and caught, forgetting that eventually more than one

specimen was caught in the same place, on the same day.

Examples: for *Prosopis pictipes* a total of 4 individuals (*i*) are recorded and each was caught in a different locality, so here $f=i=4$; for *Prosopis brevicornis* a total of 5 individuals (*i*) are recorded, but 2 of them were caught together on the same day, in the same locality (Challock), so here $f = 4$ also; for *Nysson trimaculatus*, $i = 2$ specimens found in a single locality, but one on July 26th, the other one two days later, so here $f = i = 2$.

The question arises: is any one of the three criteria more significant than the others?

Clearly yes: the frequency of occurrences is more reliable as it is not biased by the fact that the species is or was particularly abundant in one particular place. It is also more discriminating than the number of localities because it affords a greater scale of values and includes the benefit of repeated observations made in more thoroughly explored localities. The total number of individuals then comes third, it still has a meaning owing to the willingness of collecting fair numbers of every species seen, also because it reminds that at least on certain occasions some species were abundantly represented.

The best way of suggesting a pattern on the basis of these criteria will therefore be to arrange the species according to the values of *f*, ranking those which have the same value for *f* according to the values of *l*, and those which have the same value for *l* according to the values of *i*. This is done in Tables 3 and 4.

Of course other calculations could be imagined; some were actually tested, but it was found that little is gained, if anything, in complicating the picture. It would be interesting to submit the data to mathematical treatment, to measure diversity and to attempt to express the pattern by a single index. But this would go beyond the scope of this paper and would be best undertaken when data for other areas, or for other periods of the year, or from other observers, become available and make closer comparisons possible.

Tables 3 and 4 show a good fit for the values of criteria *f* and *l*. There are some remarkable discrepancies with *i*, but these are extremely interesting because nearly all of them can be explained.

Anthidium manicatum has $i = 17$ while one would expect about 9. This bee is in fact not commoner than its neighbours on Table 2, if we think of the Kentish landscape generally. It is only found in habitats where flowering *Ballota nigra* and *Stachys sylvatica* are available, thus by no means everywhere in the county. But if one of those habitats is discovered, several individuals are easily caught, up to a number suggesting that the species is commoner than it is. The same applies to *Colletes daviesanus* ($i = 13$) which is found on *Tanacetum*, and to *Chelostoma campanularum* ($i = 12$) locally abundant on the flowers of *Campanula*. More striking even are the cases of *Andrena denticulata* and *coitana*. Here are two species I had never seen before collecting in Kent; they were at once recognized as interesting and more time than usual was spent in catching a sample of them. It was a mistake from the point of view of population sampling, as I realised when I saw the bad fit in Table 3! I also remembered having been particularly zealous in looking for some more specimens of *Epeolus variegatus*, *Melitta leporina* and *Anthophora bimaculata*, as these species are lacking or difficult to find in the Belgian areas I know the best.

Among the Sphecidae the case of *Diodontus minutus* ($f = 2$, $i = 11$) is easily explained because the species was indeed very abundant locally in Lenham, so I took there up to 8 specimens, hoping that one at least would be *insidiosus* Spooner (I was deceived). I can offer no explanation for the $i = 10$ of *Crossocerus podagricus*, save that here the discrepancy is not too serious. The case of *Mellinus arvensis* is interesting too. Here the very high $i = 33$ recalls that there was a rich population in Borough Green in 1961, it was a temporary phenomenon for no individual could be seen in the same place when I visited it purposely again in 1964.

TABLE 3.—LIST OF SPECIES OF SOLITARY BEES IN KENT, ARRANGED IN ORDER OF FREQUENCY AS SUGGESTED BY THREE CRITERIA:
f : total number of occurences; l : number of localities; i : total number of individuals.

	f	l	i		f	l	i
1 *Prosopis communis*	13	8	22	29 *Melitta leporina*	2	2	10
2 *Halictus calceatus*	12	6	20	30 *Anthophora bimaculata*	2	2	7
3 *Andrena bicolor*	7	7	10	31 *A. quadrimaculata*	2	2	3
4 *A. flavipes*	7	7	9	32 *A. furcata*	2	2	2
5 *A. minutula*	7	6	9	33 *Osmia coerulescens*	2	2	2
6 *Anthidium manicatum*	7	4	17	34 *O. ventralis*	2	2	2
7 *Colletes daviesanus*	7	4	13	35 *Prosopis annularis*	2	2	2
8 *Megachile centuncularis*	7	2	8	36 *P. confusa*	2	2	2
9 *M. willughbiella*	5	5	8	37 *Halictus laevigatus*	2	2	2
10 *Halictus tumulorum*	5	5	6	38 *H. morio*	2	1	2
11 *Chelostoma campanularum*	5	4	12	39 *Andrena subopaca*	1	1	3
12 *Halictus fulvicornis*	5	4	11	40 *Nomada fucata*	1	1	3
13 *H. smeathmanellus*	5	3	15	41 *Andrena thoracica*	1	1	2
14 *Dasypoda hirtipes*	5	3	11	42 *Halictus nitidiusculus*	1	1	2
15 *Andrena dorsata*	5	3	6	43 *Andrena ovatula*	1	1	1
16 *Halictus villosulus*	4	4	7	44 *A. wilkella*	1	1	1
17 *Prosopis brevicornis*	4	4	5	45 *Coelioxys conoidea*	1	1	1
18 *P. pictipes*	4	4	4	46 *Halictus minutus*	1	1	1
19 *Halictus albipes*	4	3	6	47 *Megachile ligniseca*	1	1	1
20 *Melitta haemorrhoidalis*	4	3	6	48 *M. maritima*	1	1	1
21 *Epeolus variegatus*	3	3	8	49 *Panurgus calcaratus*	1	1	1
22 *Andrena saundersella*	3	3	6	50 *Prosopis hyalinata*	1	1	1
23 *Halictus rubicundus*	3	3	4	51 *Sphecodes hyalinatus*	1	1	1
24 *Sphecodes crassus*	3	3	4	52 *S. monilicornis*	1	1	1
25 *Halictus leucopus*	3	3	3	53 *S. puncticeps*	1	1	1
26 *Andrena denticulata*	3	2	14				
27 *A. coitana*	3	2	13				
28 *Halictus leucozonius*	3	2	3				

So we see how useful the criterion *i* may be in drawing attention to facts likely to be explained, but also that *f* provides a better picture of what is characteristic of the landscape generally.

Even prior to any mathematical analysis, it is obvious that the pattern of abundance exhibited in Tables 3 and 4 is essentially the same for bees and wasps, also that it is of the same type as those presented by Williams (1964) and expressed by log series distributions. As usual, we have a few species with rather many individuals. So among the bees

2 species (4% of all the species) accumulate 42 individuals (13.3 % of the sample). Conversely 28 species (53%) have not more than 4 individuals.

Restricted Species in the Fauna of Kent

There are at least four main physical features in the landscape of Kent: chalk-hills, sandy places, the Weald and coastal cliffs. There are also the various man-controlled features, including some recent developments not very compatible with the survival of a rich fauna of solitary Aculeata, but also the old-fashioned hedges which, as Way & Davis (1963) and Richards (1964) rightly stress, are very typical of the southern English countryside and an important refuge for insects. My data are not sufficient to attempt subdividing the survey into populations truly characteristic of some of these features, except in one case: the sandy places.

Table 4.—List of species of solitary wasps in Kent, arranged in order of frequency as suggested by three criteria:
f : total number of occurences; l : number of localities; i : total number of individuals.

Sphecidae	f	l	i
1 *Entomognathus brevis*	13	12	28
2 *Crossocerus elongatulus*	12	9	18
3 *C. quadrimaculatus*	9	7	19
4 *Mellinus arvensis*	7	6	33
5 *Crossocerus varus*	7	6	12
6 *Trypoxylon clavicerum*	7	6	10
7 *Pemphredon lethifer*	7	6	9
8 *Ectemnius continuus*	6	5	8
9 *Crossocerus tarsatus*	6	5	7
10 *Ectemnius lituratus*	6	4	9
11 *Oxybelus uniglumis*	5	5	8
12 *Lindenius albilabris*	5	5	5
13 *Crossocerus podagricus*	5	4	10
14 *Cerceris rybyensis*	4	4	5
15 *Psenulus pallipes*	4	4	5
16 *Stigmus solskyi*	4	4	5
17 *Crossocerus wesmaeli*	3	3	6
18 *Crabro cribrarius*	3	3	4
19 *Ectemnius lapidarius*	3	3	3
20 *Passaloecus gracilis*	3	3	3
21 *P. insignis*	3	3	3
22 *Diodontus minutus*	2	2	11
23 *D. tristis*	2	2	5
24 *Ammophila sabulosa*	2	2	3
25 *Cerceris arenaria*	2	2	3
26 *Crossocerus ambiguus*	2	2	3
27 *Ectemnius dives*	2	2	2
28 *Pemphredon shuckardi*	2	2	2
29 *Psen dahlbomi*	2	2	2
30 *Trypoxylon figulus*	2	2	2
31 *Nysson trimaculatus*	2	1	2
32 *N. dimidiatus*	1	1	1
33 *Passaloecus corniger*	1	1	1
34 *Psen equestris*	1	1	1
35 *Psenulus concolor*	1	1	1
36 *Spilomena beata*	1	1	1
37 *S. differens*	1	1	1
38 *Tachysphex pompiliformis*	1	1	1
39 *Trypoxylon attenuatum*	1	1	1
40 *Ectemnius rubicola*	1	1	1
Other wasps			
1 *Priocnemis exaltata*	7	6	9
2 *Anoplius infuscatus*	2	2	2
3 *Hedychridium ardens*	1	1	3
4 *Ancistrocerus nigricornis*	1	1	2
5 *Myrmosa atra*	1	1	2
6 *Ancistrocerus gazella*	1	1	1
7 *Odynerus laevipes*	1	1	1
8 *Symmorphus sinuatissimus*	1	1	1
9 *Episyron rufipes*	1	1	1
10 *Pompilus anceps*	1	1	1
11 *Tiphia femorata*	1	1	1
12 *Chrysis ignita*	1	1	1
13 *Notozus panzeri*	1	1	1
14 *Omalus violaceus*	1	1	1
15 *Bethylus fuscicornis*	1	1	1

The collecting ground, large or small, was always sandy in the following localities: Borough Green, Brasted, Charing Heath, Lenham, Lenham Heath, St. Mary Cray, Sevenoaks, Trottiscliffe and Wrotham Heath (not Wrotham alone). A part of the specimens from Dymchurch and Seal were also caught on sandy patches. If we now check in the survey the findings from these places, we see that 26 species were not

found elsewhere and thus are confirmed as arenophilous species. They are: *Sphecodes puncticeps, Panurgus calcaratus, Nomada fucata, Dasypoda hirtipes, Megachile maritima, Epeolus variegatus, Anthophora bimaculata, Ammophila sabulosa, Cerceris arenaria, Nysson dimidiatus* and *trimaculatus, Tachysphex pompiliformis, Psen dahlbomi* and *equestris, Diodontus minutus* and *tristis, Spilomena beata, Crabro cribrarius, Crossocerus wesmaeli, Oxybelus uniglumis, Hedychridium ardens, Notozus panzeri, Myrmosa atra, Anoplius infuscatus, Episyron rufipes* and *Pompilus anceps*. All are not exclusively arenophilous. Nevertheless it seems that about 20 per cent of the solitary Aculeata of Kent are more or less restricted to sandy places or find there a particularly suitable habitat.

Kent has not many large areas of heath-land like other adjacent counties, so its fauna is probably less rich than these in Aculeate Hymenoptera. Indeed my survey includes 11 only out of the 33 species recorded by Richards (1964, p. 24) as typical elements of the heath-fauna of south-east England. Unfortunately these already restricted sandy patches are threatened with disappearance. In all the localities visited in 1964, sand areas were much reduced or more damaged compared with 1961 or earlier.

Outstanding Species in Kent

Anybody having experience of the Belgian Aculeate Hymenoptera will find it curious that across the Straits of Dover, one of the three commonest, and perhaps the commonest Sphecid in July is *Entomognathus brevis*. It is not rare in Belgium, but surely far from being as abundant as *Crossocerus elongatulus*.

From the same point of view, three species are outstanding in the way that they are definitely rarer in Belgium than in Kent, at least now: *Anthidium manicatum, Megachile willughbiella, Ectemnius literatus*. It would also seem that the second generation of *Andrena bicolor* is more abundant in Kent than in Belgium.

There are also four species I was surprised to find so easily, as they are very rare or restricted to a few places in Belgium; all belong to the genus *Andrena: coitana, denticulata, dorsata* and *thoracica*.

Is the Fauna of Kent poor?

In his valuable outline of 'The Entomological Fauna of Southern England', Richards (1964) states that 'to the visitor from the continent the most obvious characteristic of the fauna of the south-eastern corner of England will be its extreme poverty'. This is definitely so if the English Aculeata Hymenoptera are compared with those of the Paris Basin and generally of any French department south of the 49° latitude. But as all the British Isles are north of the 50° latitude, the comparison should be made with nearer areas of Northern France (Departments of the Nord and Pas-de-Calais only), and of Belgium and Holland.

On the basis of the available information, it seems that the list of the Aculeate Hymenoptera of these countries contains from 20 to 30 per cent more species than the British Isles. However, it must be pointed out that most of the missing species are very rare in the Benelux countries, sometimes one or two specimens only were ever found, others are restricted to particular areas such as the extreme south of Holland or of

Belgium. Anyway the visitor from the continent, as I was in Kent, was never struck, *in the field*, by the 'extreme poverty' of the fauna. The numbers of species and individuals I have recorded are certainly about the same as those I normally obtain through collecting in Belgium at the same period of the year, within the same length of time. Often I had the impression that the fauna of Kent is richer than the fauna of Belgium as it is now. In other words, it is probable that the productivity in Aculeate Hymenoptera of the Kentish landscape as a whole is identical if not a little higher than the productivity of Belgium.

This conclusion is not surprising. Richards (*loc. cit.*) recalls three main reasons why the fauna of Britain is poor, in short: past history, climate and destruction of natural habitats. I must emphasize that there is no detail in the climate of Kent which could account for differences between the faunas there and in Belgium. As to the density of human settlements and the spoilation of natural habitats, the situation is worse in Belgium. After all, the Belgians have been more systematically utilitarian in their management of the landscape. They have not kept old-fashioned hedgerows so long. They controlled more strictly all that grows in woods, and planted more conifers. Their ways of gardening were generally less fanciful. Hence the feeling that the insect fauna of Kent is not so poor as the comparison of whole faunal lists suggests.

We are left with older historic causes only to account for the lack of a number of species in south England. Many things become clear if it is assumed that the faunas were about the same in south-eastern England and in Benelux when Britain was cut off from the continent about 6,000 years ago. Since then, a number of additional species have been able to reach Benelux and the north of France, spreading from the warmer and much richer areas of south and south-east Europe. Most of them were prevented from reaching England not only by the sea, but for two other reasons not always fully acknowledged. The first is that these invasions often would have involved a crossing against the prevailing western winds. The second is that pioneer populations newly established in the extreme north of France or in Benelux could not increase seriously in these margin areas with variable climate. They were not even able to extend their range to the whole of Belgium or Holland. Some must have come and then disappeared, perhaps repeatedly. There is evidence that this process is still going on in our time, in connection with recent climatic changes (Leclercq, 1960).

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