Ragge DR. 1956. A Revision of the Genera *Phaneroptera* Serville and *Nephoptera* Uvarov (Orthoptera: Tettigoniidae), with Conclusions of Zoogeographical and Evolutionary Interest. Proc. Zool. Soc. London 127: 205-283. Excerpt (p. 223-239) of pages dealing with six taxa that qualify as subspecies in today's systematic treatments.

Redescription

♂. Lateral pronotal lobes as in Figs. 53–55. Spine of fore coxae well-developed. Hind tibiae with more than 40 external dorsal spines. Hind wings extending beyond fore wings by almost (subsp. *nana* Fieber) or quite (subsp. *sparsa* Stål) half length of latter. Exposed parts of both pairs of wings with rough surface ; membrane of archedictyon not transparent.

Tenth abdominal tergite unmodified. Supra-anal plate as in Fig. 73, showing tendency to form three posterior angles. Subgenital plate as in Fig. 31. Cerci as in Figs. 12 or 13.

Coloration green, usually with dark spots on vertex, pronotum, thoracic pleura, large part of legs, and abdominal tergites. Bases of fore wings usually showing four dark spots, three on left fore wing and one on right, or sometimes (Malagasian and some South African material) more extensive dark coloured area in region of Cu_2.

♀. As male except for genitalia and fore wing-bases. Ovipositor as in Fig. 89. Subgenital plate with acute apex. Fore wings almost invariably unicolorous, rarely with dark spot in region where Cu_{1b} meets Cu_2.

Discussion

This is the only species of *Phaneroptera* Serville in the most southern parts of Europe ; in Africa it is the most common one. It is easily distinguished from *Ph. falcata* (Poda), whose range it overlaps in Europe, by the lateral pronotal lobes, which are deeper than long in the Palaearctic part of its range, by the less attenuate hind femora, and by the genitalia and stridulatory organ of the male.

In the past the taxonomic unit here called *Ph. nana* Fieber has been treated as two distinct species, " *Ph. quadripunctata* " and " *Ph. nana* ", the former being regarded as predominantly European in distribution and the latter as predominantly African. A wide zone of overlap was believed to exist, including both the north and south sides of the Mediterranean region. There were, however, extremely few published records of " *Ph. nana* " from north of the Sahara, and its supposed intrusion into the Palaearctic region was doubtless only recognized because of the type locality, Portugal. I have attempted to show in this study that these two forms, hitherto called " *Ph. quadripunctata* " and " *Ph. nana* ", are best regarded as conspecific, at least for the present ; that they are allopatric ; that their ranges meet along a line from the Sahara, across the Syrian Desert, possibly to southern Armenia ; and that they show a cline in fore wing-length/hind femur-length ratio from north to south across their combined ranges. An adjustment in nomenclature follows, of course, from these propositions, no new names fortunately being necessary, and some interesting zoogeographical conclusions are possible.

So that the new nomenclature for these forms may be applied in this discussion, this matter will be dealt with first. The conspecificity of the two forms necessitates the earlier name being retained for the resulting species ; *Ph. quadripunctata* Brunner, 1878 is thus preoccupied by *Ph. nana* Fieber, 1853, and becomes a synonym of the latter (**syn. n.**). Now the outcome of this

discussion is that the two forms of *Ph. nana* Fieber are best regarded as subspecies pending a better knowledge of their geographical dividing line, and the names of the two subspecies must now be considered. The type locality of *Ph. nana* Fieber is Portugal, within the range of the northern subspecies ; the latter is therefore the nominate subspecies, *Ph. nana nana* Fieber. The southern subspecies is thus left without a name, as it is shown in this study that the name " *nana* " has been misapplied in its old sense ever since Brunner's monograph of 1878, where this author shifted the name " *nana* " from the northern to the southern form and renamed the northern one " *quadripunctata* ". The first available synonym for the southern form is *sparsa* Stål, 1857, and its name therefore becomes *Ph. nana sparsa* Stål.

It is not always easy and occasionally impossible to separate the two subspecies. The three principal characters used in the past were the relative lengths of the fore wings and hind femora, the shape of the pronotum, and the shape of the male cerci. The examination of a fairly large number of specimens soon made it clear that these characters are very variable and often unreliable.

The use of the relative lengths of the fore wings and hind femora in separating the two forms suggested the possibility of a cline in this character from the European part of the range to the tropics. The fore wing and hind femur measurements of 322 males from throughout the range soon showed that this was in fact the case. The females were not included as they lack the important diagnostic character provided by the male cerci, and in any case would require separate treatment as their fore wing-length/hind femur-length ratio (from now on referred to as the *fw/hf* ratio) is about 5 per cent higher than that of the males ; measurements of female samples from representative parts of the range, however, showed that an exactly similar trend occurs.

The scatter diagram obtained by plotting fore wing-length against hind femur-length is shown in Fig. 98. It will be seen that, although the mean ratios of the two forms are well separated, there is an appreciable overlap. The coefficient of difference (C.D.) was calculated as follows (Mayr, Linsley & Usinger, 1953, p. 146) :—

$$\text{C.D.} = \frac{\bar{x} - \bar{y}}{\sigma x + \sigma y} = \frac{1{\cdot}173 - 1{\cdot}011}{0{\cdot}0538 + 0{\cdot}0885} = 1{\cdot}144,$$

where x is the *fw/hf* ratio for *Ph. n. nana* Fieber, y is that for *Ph. n. sparsa* Stål, and σ is the standard deviation. This coefficient corresponds to a joint nonoverlap (assuming, among other things, normal distributions) of about 87 per cent, and if the *fw/hf* ratio were the only diagnostic character it would probably be inadvisable to give the two forms separate subspecific status. It will also be noted from the scatter diagram that it is the relative length of the fore wing which shows geographical variation, the hind femur merely being used as a measure of size.

The mean *fw/hf* ratios and the mean latitudes of the specimens measured for each political area in the combined range of the two forms are shown below (p. 226) ; the sample sizes and the standard deviations are also given.

If these mean ratios are entered on a map on their appropriate mean latitudes, it is possible to draw approximate isophenes ; the result is shown in Fig. 99. The general distribution shown is interesting. The ratio reaches a minimum along a diagonal line stretching from the southern part of French West Africa across equatorial Africa to Mozambique and Madagascar ; south of this region the ratio becomes larger again, corresponding to the value for north-east Africa and the Canary Is. In general the lines run parallel to the

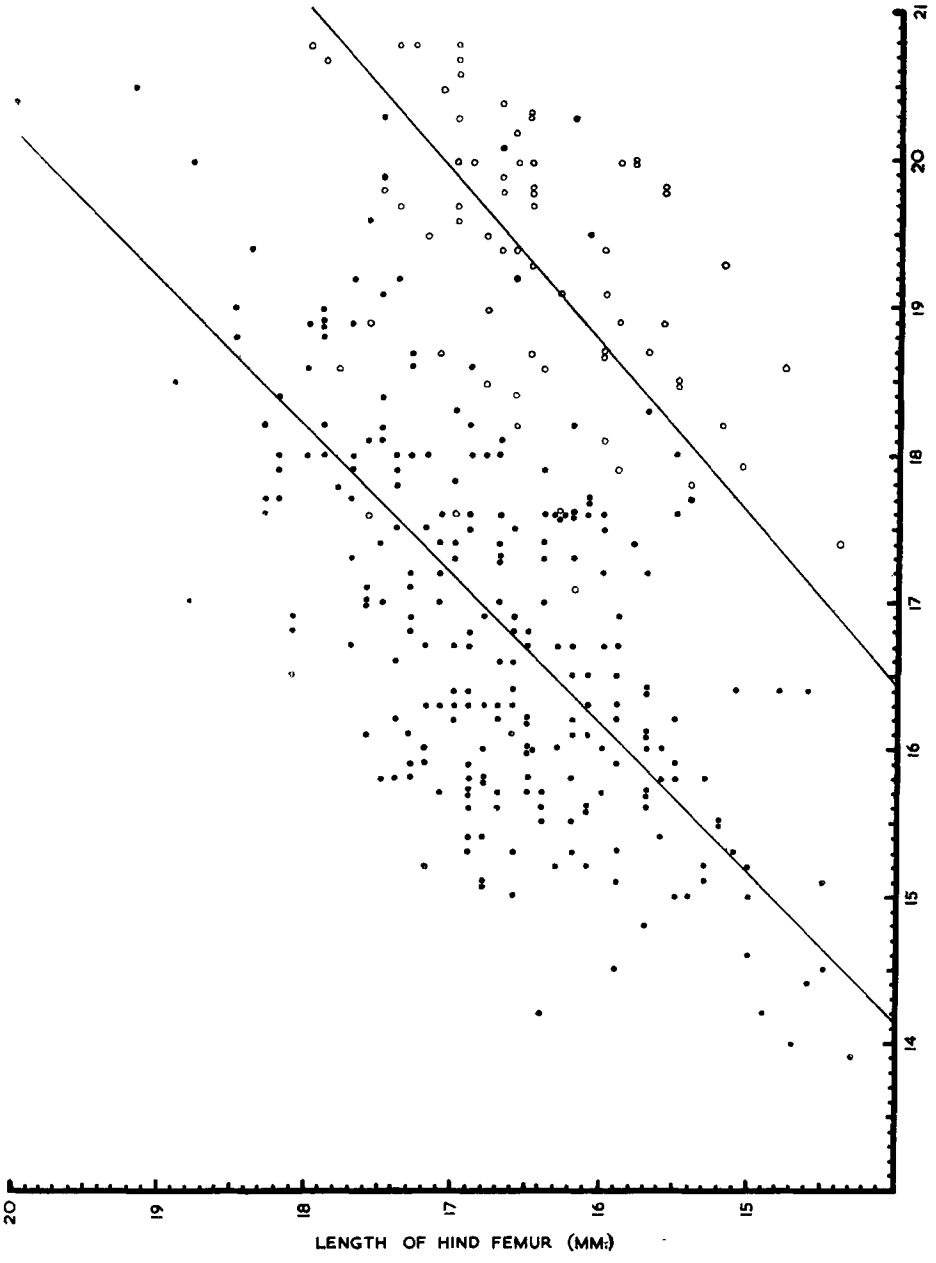

Fig. 98.—Scatter diagram showing the relationship between the length of the hind femur and the length of the fore wing in *Phaneroptera nana nana* Fieber (circles) and *Ph. n. sparsa* Stål (dots). The mean ratio is drawn in for each subspecies.

Ph. n. nana Fieber

Country	Mean Latitude	Sample Size	Mean *fw/hf* Ratio	Standard Deviation
Albania	41·3 N.	2	1·18	0·021
Algeria	36·1 N.	3	1·19	0·029
Azores	38·7 N.	2	1·19	0·028
Corsica	42·1 N.	3	1·27	0·000
Cyprus	34·8 N.	7	1·13	0·046
France	43·8 N.	4	1·21	0·059
Italy	45·3 N.	14	1·18	0·046
Lebanon	34·0 N.	2	1·20	0·071
Madeira	32·7 N.	7	1·11	0·093
Morocco	32·0 N.	1	1·16	—
Palestine	32·1 N.	3	1·22	0·055
Portugal	39·4 N.	1	1·22	—
Spain	39·6 N.	4	1·20	0·050
Switzerland	46·2 N.	2	1·18	0·021
Tunisia	34·5 N.	4	1·10	0·043
Turkey	38·2 N.	2	1·18	0·021
Yugoslavia	44·5 N.	7	1·17	0·038

Ph. n. sparsa Stål

Country	Mean Latitude	Sample Size	Mean *fw/hf* Ratio	Standard Deviation
Aden	13·4 N.	4	1·10	0·067
A–E Sudan	13·4 N.	2	1·06	0·050
Aldabra	9·3 S.	2	1·01	0·042
Angola	11·7 S.	9	1·08	0·070
Arabia	20·1 N.	5	1·08	0·071
Belgian Congo	0·9 S.	32	1·00	0·185
British Somaliland	10·1 N.	5	1·02	0·045
Cameroons	3·5 N.	2	0·98	0·007
Canary Is.	28·2 N.	9	1·03	0·104
Eritrea	15·3 N.	4	1·07	0·001
Ethiopia	9·0 N.	6	1·04	0·085
F E Africa	3·6 N.	13	0·99	0·056
F W Africa	11·6 N.	16	0·98	0·051
Gold Coast	7·0 N.	1	0·98	—
Kenya	2·0 S.	6	1·02	0·049
Madagascar	16·6 S.	10	1·00	0·051
Mozambique	17·5 S.	6	0·95	0·023
Nigeria	7·2 N.	17	0·96	0·058
N. Rhodesia	10·3 S.	3	1·00	0·092
Nyasaland	14·5 S.	6	0·96	0·052
Palestine	32·0 N.	4	1·07	0·036
Sierra Leone	8·0 N.	4	0·98	0·002
Socotra	12·4 N.	1	1·08	—
S Africa	31·2 S.	19	1·06	0·074
S W Africa	19·3 S.	2	0·98	0·061
S Rhodesia	18·5 S.	14	1·06	0·031
Tanganyika	5·9 S.	17	1·00	0·076
Uganda	0·4 N.	30	1·01	0·044
Yemen	13·6 N.	4	1·03	0·057
Zanzibar	6·4 S.	1	0·93	—

lines along which one type of vegetation is replaced by another. Thus the western part of the area enclosed by the 100 line is roughly the area of tropical forest, woodland, and savannah, giving way both northwards and southwards to steppe grassland and then semi-desert ; it is also the area of tropical agriculture, giving way to the wheat belt in the north, to nomadic stock-rearing in the south-west, and to wheat-growing again in the south-east.

The belt enclosed by the 110 line to the north and the 100 line to the south is of particular interest. A large part of this area is, of course, desert and pure semi-desert where *Phaneroptera nana* Fieber does not occur. This provides an effective barrier between *Ph. n. nana* Fieber and *Ph. n. sparsa* Stål in the more western part of their ranges. However, *Ph. n. sparsa* Stål extends up the semi-desert and steppe of western Arabia, across the Syrian Desert, and possibly to the Anatolian steppe of southern Armenia. This latter possibility is suggested by the original description of *Ph. bivittata* Bei-Bienko, 1954 (type locality : Dhuga, nr. Dzhulfa, on the river Arax, S. Armenia), which agrees well with *Ph. n. sparsa* Stål (for discussion see under *Ph. bivittata* Bei-Bienko). Bei-Bienko's measurements give an *fw/hf* ratio of about 1·06, which would extend the range of *Ph. n. sparsa* Stål up to latitude 40° N and suggests the possibility of this subspecies being found in eastern Turkey. *Ph. bivittata* Bei-Bienko is also recorded from Kopet Dagh.

It may be noticed that the mean ratio values given for a few of the political areas do not fall between the correct isophenes in Fig. 99 ; these exceptional values are mostly based on very small sample sizes. It would of course be possible to modify the isophenes so that there are no exceptional values, but these lines have been drawn so that there are no irregularities in them which would be difficult to account for on the grounds of vegetation, climate, topography, etc. As they stand at present it is very probable that the mean ratio given by a sample of ten or more specimens taken from several different populations in the same region of Africa would fall between the correct isophenes on the map. The high individual variability of this ratio, however, perhaps enhanced by the effect of local ecological factors, tends to obscure the cline, and the author felt it desirable to show mathematically that the change in *fw/hf* ratio across the range is a real one and not the effect of high variability and small samples.

It was not considered worth while to show statistically a correlation between *fw/hf* ratio and vegetation or climate or any other environmental factor. The author's intention has been merely to show that a cline exists, and that the isophenes in Fig. 99 are approximately in the correct positions ; any correlation with vegetation, etc., can then be seen from the trend of the isophenes. After careful consideration of various methods of approach, it was decided to group the mean ratios according to the isophenes between which they fell and to compare the grand means of adjacent groups. While the arbitrary nature of the isophenes is fully recognized, a comparison of adjacent means nevertheless gives a measure of the probability that there is a real difference between adjacent areas ; the likelihood of a cline existing then depends on the smoothness and general intelligibility of the isophenes. The result of applying this method is set out below

Area	Mean	Significance
90–100	98·5	
100–110	103·9	$p<5$ per cent
100–120	116·1	$p<0{\cdot}1$ per cent
120–130	121·6	$p>10$ per cent

This, in the author's opinion, is an indication that the 100 and 110 lines are statistically justified and that the 120 line is not. This is of course what would be expected from an inspection of Fig. 99; insufficient material was available from the Mediterranean region to show whether a cline exists within this area, but the 120 line is drawn in to show that a slight trend is suggested. The vegetation is much more uniform in the range of *Ph. n. nana* Fieber than it is in the range of *Ph. n. sparsa* Stål, and it is quite probable that further material will show that geographical variation is very slight or quite absent within the Mediterranean region.

Material from Palestine and Lebanon shows an increased variability in several characters. This is the region where the two forms meet, and from which it will be necessary to have much more material before their subspecific status can be finally accepted or rejected. The male cerci of the specimens referable to *Ph. n. sparsa* Stål are particularly variable, extreme forms in both the attenuate and broad directions appearing. *Ph. tenuicerca* Ramme was in fact described from a form with extremely attenuate male cerci, and yet which has an *fw/hf* ratio of about 1·13. It is possible that the two forms are interbreeding in this zone and that the unusual phenotypes have resulted from the genetic interaction associated with this. Some of the Arabian males examined also had unusually attenuate cerci. Specimens from Palestine and Lebanon which are referable to *Ph. n. nana* Fieber have an unusually high *fw/hf* ratio for this part of the range of this subspecies.

The range of variation in the male cerci is shown in Fig. 100. Cerci (*d*)–(*f*) are drawn from specimens of *Ph. n. sparsa* Stål, (*e*) being typical and (*f*) being an exceptionally attenuate one from Arabia. Cerci (*b*) and (*c*) are of *Ph. n. nana* Fieber, (*c*) being the more typical one of the two. Cercus (*a*) is of particular interest: it is from a South African specimen from Fish Hoek, Cape Province. Three of the South African males had cerci of this type, the other two being from Ceres and Table Mountain. These three males were also characterized by the longitudinal veins of the fore wings, which were more sharply defined than usual. On the basis of this latter character a female specimen from Stellenbosch was grouped with them. In all other characters these specimens agreed with *Ph. n. sparsa* Stål; the *fw/hf* ratios were normal for South Africa. Now all four specimens came from the central part of the relatively small area of Hard Leaf, Mediterranean-type vegetation which forms a south-westerly coastal fringe to Cape Province. An obvious interpretation is that a third subspecies has split off in this Mediterranean-type region, having cerci resembling *Ph. n. nana* Fieber and an *fw/hf* ratio agreeing with *Ph. n. sparsa* Stål. However, some typical specimens of *Ph. n. sparsa* Stål also come from this region, one, for example, coming from Hout Bay. This pachycercal form is therefore probably either an extreme variant or polymorph, or a distinct sibling species. Further material is necessary before this question can be finally settled; there is a

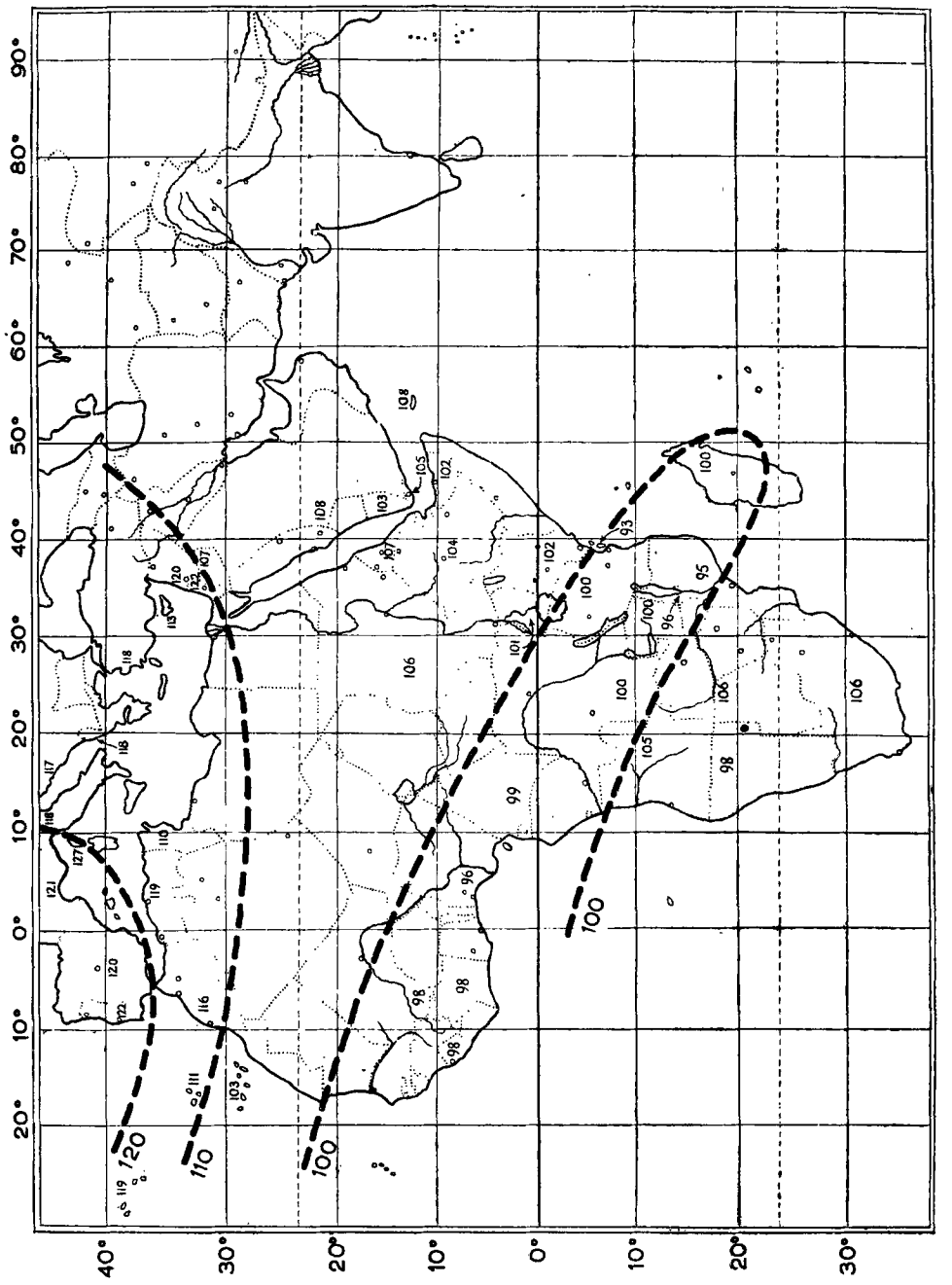

Fig. 99.—Map showing the mean values for the length of the fore wing, expressed as a percentage of the length of the hind femur, for each political area of Africa and southern Europe. Each value is entered on the mean latitude of the specimens from which it was obtained. Approximate isophenes are drawn at intervals of 10.

suggestion, however, that the shape of the male cercus is affected by environmental factors in a similar way to the relative length of the fore wings, though with much less continuity. The discontinuity in the shape of the male cercus which occurs at the zone of contact between *Ph. n. nana* Fieber and *Ph. n. sparsa* Stål may be seen in Fig. 100. There is a distinct difference in the degree and quality of curvature between cerci (*b*) and (*c*), and cerci (*d*)-(*f*); this character may always be used to separate the two subspecies.

So far, amongst all the material available from the contact zone, batches of two or more specimens bearing the same data have been wholly referable either to the one form or to the other, or have been to some extent intermediate. There is thus no evidence of the ranges actually overlapping. On the other hand the available material from this region has been completely inadequate for finally establishing non-overlap. It seems very likely, however, that the two forms have been conspecific in recent geological times at least, for when viewed as a whole they show a fairly continuous cline in *fw/hf* ratio from the northern to the southern parts of their combined ranges. The material from Madeira was all referable to *Ph. n. nana* Fieber except for two male specimens which were undoubtedly of *Ph. n. sparsa* Stål ; the latter subspecies has doubtless been introduced to the island comparatively recently, and it is of course possible that this also applies to *Ph. n. nana* Fieber.

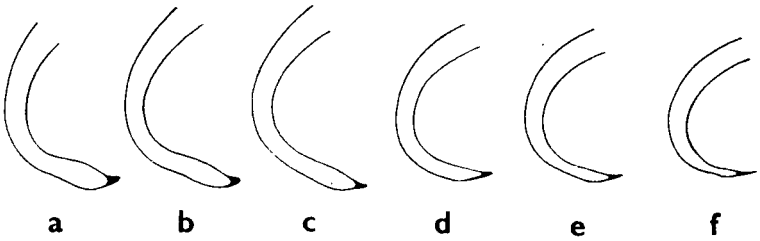

Fig. 100.—Dorsal views of the left male cerci of specimens of *Phaneroptera nana* Fieber from (*a*) Fish Hoek, Cape Province, (*b*) & (*c*) the Mediterranean region, (*d*) & (*e*) tropical Africa, and (*f*) Arabia.

The available evidence is insufficient for any final decision as to the status of *Ph. n. nana* Fieber and *Ph. n. sparsa* Stål. It may be stated confidently, however, that *Ph. nana* Fieber considered as a whole is near the borderline between a polytypic species and a superspecies. Further material may well prove the latter to be the case. The two forms are regarded as subspecies here for four reasons :—

1. Morphologically they are almost identical, some females not being definitely assignable to either one form or the other.

2. There is at present no direct evidence that their ranges overlap.

3. When considered as a whole they show a continuous cline in *fw/hf* ratio from the northern to the southern parts of their combined ranges.

4. If they were regarded as distinct species considerable confusion in nomenclature would result. The arguments presented here would necessitate giving the name *nana* Fieber, originally used for the southern form, to the northern form and renaming the southern form *sparsa* Stål. Should conspecificity be eventually disproved, the interpretation presented here would form a useful intermediate step towards this rather violent change in nomenclature for such common insects.

Distribution (Fig. 101)

Ph. nana Fieber covers the Mediterranean region, western Arabia, Africa, and Madagascar. In parts of Europe it reaches north to about 50° N.

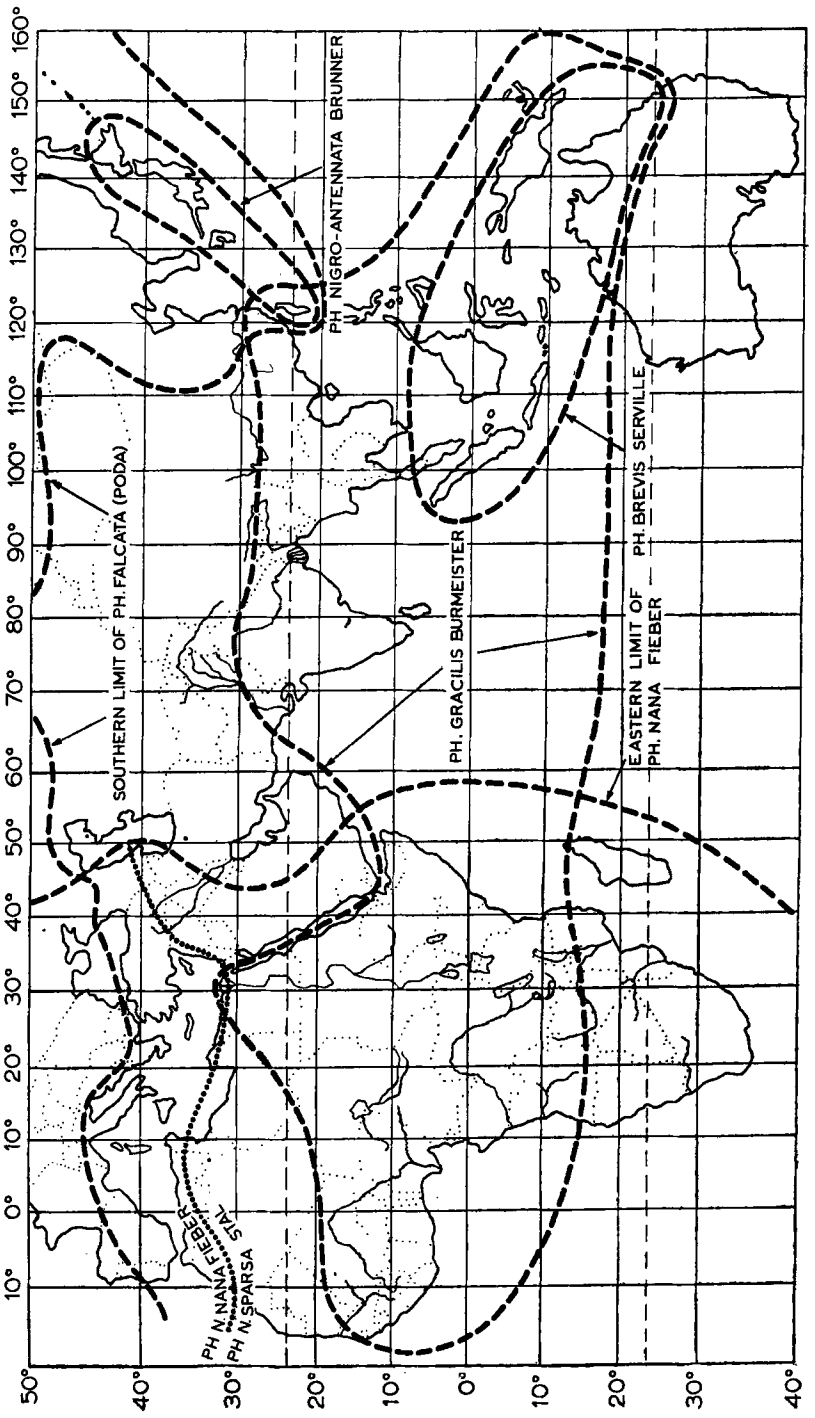

Fig. 101.—Map showing the approximate distribution of *Phaneroptera nana* Fieber, *Ph. gracilis* Burmeister, *Ph. falcata* (Poda), *Ph. nigro-antennata* Brunner, and *Ph. brevis* Serville.

Key to the subspecies

1. Fore wing-length/hind femur-length ratio more than 1·1, the fore wings usually extending beyond the hind knees. Lateral pronotal lobes deeper than long, as in Fig. 53. Male cerci as in Fig. 12 ..... *Ph. n. nana* Fieber (p. 232)

-. Fore wing-length/hind femur-length ratio less than 1·1, the fore wings usually not reaching the hind knees. Lateral pronotal lobes about as long as deep, as in Figs. 54 & 55. Male cerci as in Fig. 13 ..... *Ph. n. sparsa* Stål (p. 235)

1. *PHANEROPTERA NANA NANA* Fieber, 1853, **stat. n.**

Phaneroptera nana Fieber, 1853, *Lotos* **3**, 173.

Phaneroptera quadripunctata Brunner, 1878, Monographie der Phaneropteriden, p. 212. Lectotype ♂, ITALY: Trieste (C. Brunner von Wattenwyl Collection, No. 4460). Three ♂ cotypes, FRANCE: Montpellier, SARDINIA, SPAIN: Malaga (C. Brunner von Wattenwyl Collection, Nos. 1591, 2629, & 2594, respectively). Three ♀ cotypes, ITALY: Venice, SICILY, TURKEY: Ismir (C. Brunner von Wattenwyl Collection, Nos. 5130, 7409, & 9891, respectively). All in the Naturhistorisches Museum, Vienna. **Syn. n.**

Phaneroptera quadripunctata Brunner, Burr, 1910, A synopsis of the Orthoptera of Western Europe, p. 88.

Phaneroptera quadripunctata Brunner, Chopard, 1943, *Faune de l'empire français* **1**, 101.

Phaneroptera quadripunctata Brunner, Chopard, 1951, *Faune de France* **56**, 86.

Phaneroptera quadripunctata Brunner, Bei-Bienko, 1954, Fauna of the U.S.S.R., *Fauna Rossii* (New Series) Orthoptera **2** (2), 71.

Diagnosis

♂♀. Fore wing-length/hind femur-length ratio more than 1·1, fore wings usually extending beyond hind knees. Lateral pronotal lobes as in Fig. 53, deeper than long. Male cerci as in Fig. 100 (*b*) and (*c*), slightly swollen near apex, showing no constriction throughout length.

Measurements

Males	Females
Total length (20): 28·7–33·3, mean 31·18.	Total length (20): 30·7–35·8, mean 33·18.
Median length of pronotum (20): 3·0–3·7, mean 3·34.	Median length of pronotum (20): 3·2–4·1, mean 3·55.
Length of hind femur (68): 14·4–18·0, mean 16·52.	Length of hind femur (20): 16·4–20·5, mean 18·02.
Maximum vertical width of hind femur (20): 1·6–2·1, mean 1·85.	Maximum vertical width of hind femur (20): 1·6–2·3, mean 2·02.
Length of fore wing (68): 17·1–20·8, mean 19·36.	Length of fore wing (20): 20·2–22·7, mean 21·32.
Length of exposed part of hind wing (20): 7·3–9·9, mean 8·67.	Length of exposed part of hind wing (20): 7·7–10·3, mean 8·79.
	Length of ovipositor (20): 4·4–5·5, mean 4·92.

Discussion

This subspecies may be distinguished from *Ph. n. sparsa* Stål by the relative length of the fore wings and by the shape of the male cerci (Fig. 100).

The taxonomic status of *Ph. n. nana* Fieber has been fully discussed above. The eight specimens (2♂♂, 4♀♀, 2 nymphs) examined from the type

locality, Portugal, belonged indisputably to the northern subspecies, which must therefore bear the name *nana* Fieber. The cline in *fw/hf* ratio, which is shown over the whole range of *Ph. nana* Fieber, is least well-marked in the Mediterranean region. There is a suggestion that the ratio tends to be rather higher in S.W. Europe than in S.E. Europe and N. Africa, but this cannot be definitely established until many more specimens are available.

I have selected and marked a male lectotype from among the cotypes of *Ph. quadripunctata* Brunner; this specimen is No. 4460 of Brunner's collection.

Material examined

♂ lectotype, 3 ♂ cotypes, and 3 ♀ cotypes, of *Ph. quadripunctata* Brunner.

AUSTRIA: Anninger, 13.ix.1951 (Ebner) (1 ♀) (coll. Ebner); SWITZERLAND: Lugano, Ticino, 10.ix.1928 (Zeuner) (1 ♂, 1 ♀); FRANCE: Alpes Maritimes, Le Rouret, 300 m., 1.xi.1946 (Korsakoff) (1 ♂); Mentone, 13.ix.1937 (Zeuner) (1 ♂); Alpes Maritimes, Cagnes, viii-ix.1924 (Morton) (1 ♂, 2 ♀♀); Var, Bagnoles, x.1946 (Korsakoff) (1 ♀); Montpellier (Daube) (1 ♂, 1 ♀) (Nat. Mus. Vienna); Montpellier, 1870 (Türk) (1 ♀) (Nat. Mus. Vienna); Bézu-St.-Eloi, Eure, 1888 (Brongniart) (1 ♀) (Mus. Hist. Nat. Paris); Provence, Mirabeau, 2.ix.1949 (Willemse) (1 ♀) (coll. Willemse); Bagnols, 1.ix.1887 (Finot) (1 ♂) (Inst. Sci. Nat. Brux.); ITALY: Vicenza, Schio, 1928 (Gray) (4 ♂♂, 1 ♀); Castellamare, 22.ix,1917 (Hargreaves) (1 ♂); Rome (Vito Zanon) (1 ♂, 2 ♀♀); Col. Mogliano, x.1918 (1 ♂); Strupinigi, 22.ix.1919 (Ashby) (1 ♀); Arquata, ix-xi.1918 (Ashby) (1 ♂, 3 ♀♀); Madonna Delpilone, 30. viii.1919 (Ashby) (1 ♂); Calabria, Cosenza, x.1922 (Salfi) (1 ♀); Apuan Alps, Camaiore Lombrici, 100 m., 17.ix.1937 (Zeuner) (1 ♀); Venice (1 ♂) (Nat. Mus. Vienna); Ceraino-Roveredo (1 ♂) (Nat. Mus. Vienna); Görz (Brunner) (1 ♂) (Nat. Mus. Vienna); Monfalcone (2 ♂♂, 2 ♀♀) (Nat. Mus. Vienna); Lesina (Bucchich) (1 ♂, 1 ♀) (Nat. Mus. Vienna); Trieste, Mori, 200 m., 8.viii.1937 (Ebner) (2 ♂♂) (coll. Ebner); Voltaggio, ix.1876 (Bormans) (1 ♂, 1 ♀); Trentino, Storo, 400–500 m., 9–13.viii.1937 (Ebner) (1 ♀) (coll. Ebner); HUNGARY: ——— (1 ♀) (coll. Willemse); RUMANIA: Bucharest (Moutandon) (1 ♀) (Inst. Sci. Nat. Brux.); YUGOSLAVIA: ——— (1 ♂); Rijeka, iii.1877 (Krauss) (4 ♂♂, 7 ♀♀) (Nat. Mus. Vienna); Curzola, 1870 (Türk) (2 ♂♂) (Nat. Mus. Vienna); Mostar (Brunner) (1 ♂) (Nat. Mus. Vienna); ——— (Staudinger) (3 ♂♂, 3 ♀♀) (Nat. Mus. Vienna); Lesina (Finot) (1 ♀) (Inst. Sci. Nat. Brux.); ALBANIA: Durazzo, ix.1917 (Karny) (2 ♀♀) (coll. Ebner); PORTUGAL: Alcamiser (?), 8.viii.1923 (1 ♂ nymph); Mata de Leiria, 11.viii.1925 (1 ♂); Pedras Salgadas, 18.viii.1926 (1 ♀); Matasiphos (Wattison) (1 ♀); ——— (1 ♂, 1 ♀); Porto (1 ♀); Monchique, 500 m., 30.viii.1938 (Ebner) (1 ♀ nymph) (coll. Ebner); SPAIN: Moratalla, 15–18.ix.1935 (Burr) (1 ♂); L. Navás, 19.ix.1907 (1 ♀); ——— 1864 (1 ♀) (Nat. Mus. Vienna); Uclés (3 ♂♂, 2 ♀♀) (Nat. Mus. Vienna); Malaga (Staudinger) (1 ♀) (Nat. Mus. Vienna); TURKEY: Istanbul, Bebek, 19.xi.1952 (Burr) (1 ♀); Istanbul, Bebek, ix–xi.1953 (Burr) (2 ♂♂); Bosphorus, Bebek, 13.ix.1951 (Burr) (1 ♀); Burnova, nr. Smyrna, 26.vii.1931 (Uvarov) (1 ♂); U.S.S.R.: Caucasus, Kasikoporan (Ebner) (1 ♀) (coll. Ebner); Poln.

Ischifslück, 15.viii.1909 (Fahringer) (1 ♂) (coll. Ebner); AZORES: Fayal, ix.1952 (Carthy) (2 ♂♂); Terceira, Monte Brasil, 1930 (Chopard) (1 ♀) (Mus. Hist. Nat. Paris); San Miguel, Ponta Deloada, 1930 (Chopard) (1 ♀) (Mus. Hist. Nat. Paris); MADEIRA: ———, 1954 (Vieira) (3 ♂♂, 2 ♀♀); ——— (Wollaston) (1 ♀); Ribeira do Bento, 8.viii.1929 (Balfour-Browne) (1 ♀); nr. Funchal, viii–ix.1936 (Chopard) (2 ♂♂, 2 ♀♀) (Mus. Hist. Nat. Paris); CORSICA: Aleria, 1.viii.1931 (Mosely) (4 ♂♂); MALTA: ———, 1924 (Harford) (2 ♀♀); CYPRUS: Kilani, Krios R., ix–x.1937 (Mavromoustakis) (2 ♂♂, 12 ♀♀); Ayies Nikoloos, Papho, 20.vii.1937 (Mavromoustakis) (1 ♂); Limassol, 13.viii. 1920 (Mavromoustakis) (1 ♂); Limassol, 17.viii.1927 (Mavromoustakis) (1 ♂); Platres, Limassol distr., ix.1901 (Bates) (1 ♂); Platres, 4,500–5,000 ft., 5.ix.1926 (Mavromoustakis) (1 ♀); Platania Forest station, 11–12.ix.1951 (Mavromoustakis) (1 ♂, 1 ♀); Ortu Keny, 11.xii.1945 (Mavromoustakis) (1 ♀); Platres, 15.ix.1945 (Mavromoustakis) (1 ♀); MOROCCO: High Atlas, Goundafa, 1,200 m., 21–29.vi.1933 (Zerny) (1 ♂) (Nat. Mus. Vienna); Taroudant, 820 ft., vi.1936 (Chapman & Bisset) (1 ♀); Rabat (Thery) (1 ♀) (Mus. Hist. Nat. Paris); ALGERIA: Sidi Terruch (Thery) (1 ♀) (Mus. Hist. Nat. Paris); Mustapha, nr. Algiers, 1903 (Joly) (1 ♀) (Mus. Hist. Nat. Paris); Philippeville (Thery) (1 ♂) (Mus. Hist. Nat. Paris); St. Croix de l'Edough, 700–1,000 m., 1917 (Chevreux) (1 ♂) (Mus. Hist. Nat. Paris); Boufarik (Thery) (2 ♀♀) (Mus. Hist. Nat. Paris); Mascara, 1922 (Cros) (1 ♂); Sidi-bel, Abbes (Ebner) (1 ♀) (coll. Ebner); TUNISIA: Bou Hedma, 1929 (Dumont) (1 ♀) (Mus. Hist. Nat. Paris); Maknassy, 1929 (Dumont) (3 ♂♂, 1 ♀) (Mus. Hist. Nat. Paris); Gafsa, 1904 (Weiss) (1 ♂, 2 ♀♀) (Mus. Hist. Nat. Paris); EGYPT: ——— (1 ♂) (Rijksmus. Nat. Hist. Leiden); LEBANON: Wadi el Harir, 22.vii.1945 (G.H.Q. M.E.F.) (1 ♂); Dover Schweir, ix.1923 (Christiansen) (1 ♂); nr. Beirut, Kahlaé, 17.xii.1951 (Waterston) (1 ♀); SYRIA: Damascus, vi.1945 (G.H.Q. M.E.F.) (1 ♀); Damascus, 1.xi.1944 (G.H.Q. M.E.F.) (1 ♀); PALESTINE: Mellaha, 7.x.1935 (Washbourn) (1 ♂); Mt. Carmel, 800 ft., 30.vi.1931 (Buxton) (1 ♂); Beit Jibrin, Judaean Highlands, 23.ix.1922 (Buxton) (1 ♂).

All in the British Museum (Natural History) unless otherwise stated.

Distribution (Fig. 101)

Ph. n. nana Fieber is distributed throughout the Mediterranean region. Its northern limit in Europe is probably about 50° N., though it is not often found north of 48° N. It occurs on the Azores, Madeira, and throughout the Mediterranean islands. The range of this subspecies is almost exactly the area of Mediterranean-type vegetation and Mediterranean crops. This is particularly true of the southern and eastern limits: it is found in Morocco, the northern subcoastal fringe of Algeria, Tunisia, Egypt (probably only in the region of the Nile delta), Israel, Lebanon, western Syria, and western Turkey. This close correlation with vegetation suggests that *Ph. n. nana* Fieber also occurs in Greece, southern Turkey, and in the extreme north-west and north-east of Libya. In the region of the Syrian Desert, and probably also in the region of the Anatolian Steppe, this subspecies is immediately replaced beyond its range by *Ph. n. sparsa* Stål; in N. Africa the two forms are of course widely separated by the Sahara Desert.

2. *PHANEROPTERA NANA SPARSA* Stål, 1857, **stat. n.**

Phaneroptera sparsa Stål, 1857, *K. svenska Vetensk. Akad. Handl.* **13,** 170. Holotype ♀, SOUTH AFRICA: Caffraria. In the Naturhistoriska Riksmuseum, Stockholm.

Phaneroptera lurida Walker, 1869, Catalogue of Dermaptera Saltatoria, p. 339. Holotype ♂, W. AFRICA. In the British Museum (Natural History).

Phaneroptera tetrasticta Gerstaecker, 1869, *Arch. naturgesch.*, **35,** 215. Holotype ♂, TANGANYIKA: Uru (Decken). In the Zoologisches Museum of the Humboldt-Universität, Berlin.

Phaneroptera conspersa Stål, 1874, Recensio Orthopterorum **2,** 29. *Nom. nov.* for *Ph. sparsa* Stål, 1857.

Phaneroptera punctulata Burr, 1900, *Proc. zool. Soc. Lond.* **1900,** 41. Holotype ♂, BRITISH SOMALILAND: Whardi Datal, 26.vii.1895 (Peel). In the University Museum, Oxford. **Syn. n.**

Phaneroptera tenuicerca Ramme, 1951, *Mitt. zool. Mus. Berl.* **27,** 348. Holotype ♂, LEBANON: Djezin. In the Zoologisches Museum of the Humboldt-Universität, Berlin. **Syn. n.**

Diagnosis

♂♀. Fore wing-length/hind femur-length ratio less than 1·1, fore wings usually not reaching hind knees. Lateral pronotal lobes as in Figs. 54 & 55, about as deep as long, often tumescent in posterior part in tropical specimens. Male cerci as in Fig. 100 (*d*)–(*f*), more sharply incurved and with more attenuate apex than in *Ph. n. nana* Fieber, not swollen near apex, but often constricted in this region, thus giving apex swollen appearance.

Measurements

Males	Females
Total length (20): 27·6–33·1, mean 29·84.	Total length (20): 28·1–36·5, mean 31·64.
Median length of pronotum (20): 2·9–4·0, mean 3·35.	Median length of pronotum (20): 3·1–3·8, mean 3·28.
Length of hind femur (254): 13·9–20·5, mean 16·71.	Length of hind femur (20): 16·5–20·0, mean 18·42.
Maximum vertical width of hind femur (20): 1·6–2·1, mean 1·72.	Maximum vertical width of hind femur (20): 1·7–2·3, mean 1·91.
Length of fore wing (254): 14·3–20·0, mean 16·89.	Length of fore wing (20): 17·5–21·9, mean 19·76.
Length of exposed part of hind wing (20): 8·3–10·5, mean 9·68.	Length of exposed part of hind wing (20): 7·1–10·5, mean 9·42.
	Length of ovipositor (20): 4·0–4·7, mean 4·41.

Discussion

This subspecies may be distinguished from *Ph. n. nana* Fieber by the relative length of the fore wings, and the more sharply incurved and more attenuate male cerci. Its chief feature of interest is the cline in *fw/hf* ratio which occurs across its range and the relationship which this bears to vegetation; an adequate discussion of this has been given above.

Ph. n. sparsa Stål shows distinct geographical variation in other characters, the most important of which is the coloration of the male stridulatory organ. All the males available from Aldabra and the Seychelles had the black spot situated at the distal end of Cu_2 in the left fore wing much enlarged; in some specimens the spot near the base of Cu_2 was also enlarged, often making the spots more or less confluent. In many of the Madagascan males this process

was accentuated ; in some specimens there was a broad black band across the base of the left fore wing. This was also true of almost all the South African material. The lateral pronotal lobes of most of the South African specimens were intermediate in shape between those typical of *Ph. n. nana* Fieber and of tropical *Ph. n. sparsa* Stål (see Figs. 53–55). This character showed a similar tendency in the Madagascan material, but the specimens from Aldabra and the Seychelles had lateral pronotal lobes similar to those of tropical *Ph. n. sparsa* Stål. Thus this character and the coloration of the stridulatory organ are both varying geographically but in different ways. The change in shape of the pronotum is gradual, but the difference in coloration of the male stridulatory organ is abrupt and was carefully considered as grounds for further subspecific differentiation. This course has been rejected for the time being, as no good supporting characters are shown, and the material available at present is inadequate for a satisfactory assessment of the reliability of the coloration of the stridulatory organ as a racial characteristic. It should be noted, however, that if further material shows that a subdivision of *Ph. n. sparsa* Stål would be useful the South African–Malagasian subspecies would retain this name (type locality : Caffraria) and the tropical African subspecies would take the name of the next available synonym, i.e. *Ph. lurida* Walker, 1869 (type locality : W. Africa).

Examination of the type specimens of *Ph. punctulata* Burr and *Ph. tenuicerca* Ramme has made it quite clear that these names are synonyms of *Ph. nana* Fieber. In the former case the holotype is a normal specimen of *Ph. n. sparsa* Stål, but *Ph. tenuicerca* Ramme is intermediate between the two subspecies (see p. 25).

Material examined

♀ holotype. ♂ holotype of *Ph. lurida* Walker. ♂ holotype of *Ph. tetrasticta* Gerstaecker. ♂ holotype of *Ph. punctulata* Burr. ♂ holotype and ♀ paratype (same data and depository as holotype) of *Ph. tenuicerca* Ramme.

As over 1,000 specimens of *Ph. n. sparsa* Stål were examined it would be impracticable to list the data of every one. Full data is therefore given only for the countries near the zone where *Ph. n. nana* Fieber and *Ph. n. sparsa* Stål meet ; the remaining countries and islands are listed without further details.

PALESTINE : Tabghah, 6.x.1942 (Lumsden) (1 ♂) ; Haifa, 29.vi.1919 (Barraud) (1 ♀) ; Jerusalem, 21,ix.1922 (Buxton) (1 ♂) ; Ain Farah, nr. Jerusalem, 4.vii.1928 (Ebner) (1 ♂) (coll. Ebner) ; Ferum, 25.vii.1928 (Ebner) (1 ♂) (coll. Ebner) ; SAUDI ARABIA : Bir Sharah, 1.i.1937 (Philby) (1 ♂) ; Arif, 28.xii.1935 (Philby) (2 ♂♂) ; Dhofar, Salalah, aerodrome, 22.ix.1943 (Fitzgerald) (1 ♂) ; Taif, 4,000–5,000 ft., vii.1934 (Philby) (1 ♂, 1 ♀) ; Taif, 22.ix.1930 (Philby) (1 ♂) ; Salya, 17° 10′ N., 42° 40′ E., iii.1945 (Waterston) (1 ♀) ; YEMEN ; ADEN ; CANARY IS. ; SOCOTRA ; FRENCH WEST AFRICA ; GAMBIA ; SIERRA LEONE ; GOLD COAST ; NIGERIA ; FERNANDO POO ; FRENCH EQUATORIAL AFRICA ; ANGLO-EGYPTIAN SUDAN ; ERITREA ; ETHIOPIA ; BRITISH SOMALILAND ; BELGIAN CONGO ; UGANDA : KENYA ; TANGANYIKA ; ZANZIBAR ; ANGOLA ;

NORTHERN RHODESIA ; SOUTHERN RHODESIA ; NYASALAND ; MOZAMBIQUE ; SOUTH-WEST AFRICA ; BECHUANALAND ; SOUTH AFRICA ; MADAGASCAR ; ALDABRA ; SEYCHELLES.

All in the British Museum (Natural History) unless otherwise stated.

Distribution (Fig. 101)

This subspecies covers Africa south of the Sahara Desert, western and southern Saudi Arabia, and extends northwards through the Levant, probably to eastern and central Turkey, and possibly to southern Armenia. It occurs on the Canary Is., Socotra, Madagascar, and some of the other islands of the western Indian Ocean. The northern boundary of the range is at present very poorly known ; possible evidence on this subject is given by the next species, *Ph. bivittata* Bei-Bienko.

2. *PHANEROPTERA BIVITTATA* Bei-Bienko, 1954

Phaneroptera bivittata Bei-Bienko, 1954, Fauna of the U.S.S.R., *Fauna Rossii* (New Series), Orthoptera **2** (2), 74. Holotype ♂, ARMENIA : Dhuga, nr. Dzhulfa, on R. Araks, 4.vii.1931 (Riabov). In the Zoological Museum of the U.S.S.R. Academy of Sciences, Leningrad.

Original description (translated from Russian)

♂. Body not large, delicate, pale green. Apex of vertex slightly broadened at the base, with a long, narrow, longitudinal sulcus, which reaches to the anterior end. Antennae pale. Pronotum relatively small, usually with a pale longitudinal stripe on the sides ; disc moderately convex in anterior two-thirds, flat in posterior part ; lateral lobes not forming an angle with the disc, as long as high, their posterior margin obliquely bow-like, lower margin also distinctly oblique. Elytra quite or almost reaching the apex of the hind femur, rather narrow, slightly broadened at the base ; costal area with moderately thick irregular veinlets, except the apical part, which, as well as the neighbouring part of the subcostal area, has rather sparse, partly regular, transverse veinlets ; stridulatory organ of male not projecting over margin of elytron, brownish-yellow, without black spots ; area along anal margin is basally the same width as the apex of the stridulatory organ, semi-pellucid, with irregular venation, becoming gradually narrower, pellucid, not darkening, with fairly regular transverse veinlets beyond the middle of the elytron. Wings pellucid, with brown main longitudinal veins. Anterior tibia 1·9–2 times as long as pronotum. Supra-anal plate of male small, almost square, with slightly rounded posterior margin and parallel sides, its postero-lateral angles slightly rounded and very slightly downcurved, giving the impression of slight thickening. Male cercus slender, strongly arcuate, moderately conical in basal half, then cylindrical, slightly flattened in apical part, very gradually tapering towards acute apex, which has the appearance of an attenuated, flat, straight, spine ; the spine itself is not black, but at least the tip is brownish. Subgenital plate of male with straight parallel sides in apical part, its posterior margin with a distinct obtusangulate or rectangulate incision and acutangulate lobes. Length of body of male 11·5–13·5, pronotum 2·8–3·1, elytron 16·5–18·5, hind femur 16–17 mm.

♀ unknown.

Discussion

The type material of this species was not available for study, but from the description it closely resembles *Ph. nana* Fieber, differing by the absence of black spots on the stridulatory organ, the parallel-sided subgenital plate, and the more gradually tapering cerci. In view of these slight differences, and bearing in mind the variation, both individual and geographical, shown by *Ph. nana* Fieber, it is quite possible that *Ph. bivittata* Bei-Bienko is no more than a further subspecies of *Ph. nana* Fieber, or perhaps an infrasubspecific variant of it. It should be noted that the range of *Ph. n. sparsa* Stål, with which *Ph. bivittata* Bei-Bienko agrees well in the shape of the pronotum and cerci, extends northwards through Arabia and across the Syrian Desert ; its northern limit cannot yet be definitely fixed, and it is quite possible that it reaches into the Anatolian Steppe country of southern Armenia in the form of *Ph. bivittata* Bei-Bienko. This question can only be settled by more extensive collecting in the critical area of the Middle-East.

Distribution

Ph. bivittata Bei-Bienko is so far only known from southern Armenia and southern Turkmenistan.

3. *PHANEROPTERA NIGROPUNCTATA* Chopard, 1955

Phaneroptera nigropunctata Chopard, 1955, South African Animal Life, **2**, 269. Holotype ♂, SOUTH AFRICA: Cape Province, Drakensbergen, 8 miles E.N.E. of Rhodes, 10.iii.1951 (Brinck & Rudebeck). In the Universitetets Zoologiska Institution, Lund.

Diagnosis

♂. Very similar to *Ph. n. sparsa* Stål, but hind tibiae with less than 35 external dorsal spines, which are larger than in *Ph. n. sparsa* Stål (see Fig. 48). Frons with few dark spots. Antennae with dark bands. Lateral pronotal lobes as in Fig. 56. Supra-anal and subgenital plates as in *Ph. n. sparsa* Stål.

♀. As male, except for genitalia.

Measurements

Males	Females
Total length (2) : 25·0–25·5, mean 25·25.	Total length (2) : 28·1–29·6, mean 28·85.
Median length of pronotum (2) : 3·0–3·1, mean 3·05.	Median length of pronotum (1) : 3·3.
Length of hind femur (2) : 15·1–15·3, mean 15·20.	Length of hind femur (2) : 16·2–16·4, mean 16·30.
Maximum vertical width of hind femur (2) : 1·7–1·7, mean 1·70.	Maximum vertical width of hind femur (2) : 1·8–1·9, mean 1·85.
Length of fore wing (2) : 15·6–15·6, mean 15·60.	Length of fore wing (2) : 18·1–19·2, mean 18·65.
Length of exposed part of hind wing (2) : 6·3–6·3, mean 6·30.	Length of exposed part of hind wing : (2) 6·6–8·3, mean 7·45.
	Length of ovipositor (2) : 5·6–5·7, mean 5·65.

Discussion

This species is extremely similar to *Ph. n. sparsa* Stål. The most important distinction lies in the smaller number of dorsal spines on the hind tibiae. The shape of the lateral pronotal lobes differs from that usually found in *Ph. n. sparsa* Stål, but is approached to some extent by South African specimens of this subspecies (cf. Figs. 55 & 56).

Material examined

♂ holotype ; 1 ♀ paratype, same data as holotype, also in the Universitetets Zoologiska Institution, Lund.

SOUTH AFRICA : Maluti Mountains, Nyakoesuba, 8,000–9,000 ft., 18–19. ii.1929 (Scott) (1 ♂, 1 ♀). In the British Museum (Natural History).

Distribution

Known only from the Drakensberg mountain ranges in South Africa.

4. *PHANEROPTERA ACACIAE* Chopard, 1954

Phaneroptera acaciae Chopard, 1954, *Trans. R. ent. Soc. Lond.* **105**, 323. Holotype ♂, KENYA : Mandera distr., Rahmu, 3° 55′ N, 41° 14′ E, desert grass and thorn-bush, 19.vi.1944 (Kevan). In the British Museum (Natural History).

Diagnosis

♂. Subgenital plate deeply bifid (Fig. 32). Stridulatory organ (wing-area Cu) forming about quarter of total area of fore wings. More distal part of areas C and Sc and sometimes anterior part of area R_1 translucent in fore wings. Cells of archedictyon of posterior part of fore wings dark brown ; veinlets paler. Supra-anal plate subquadrate (Fig. 74). Cerci as in Fig. 15. Lateral pronotal lobes as in Fig. 57. Spine of fore coxae very small or absent.

♀. As male except for stridulatory organ and genitalia. Ovipositor very large and gently curved, as in Fig. 90 ; dorsal margin smooth or minutely denticulate distally.

Measurements

Male	Females
Total length : 21·1.	Total length (3) : 25·9–27·3, mean 26·70.
Length of hind femur : 13·2	Median length of pronotum (3) : 2·8–3·0, mean 2·91.
Maximum vertical width of hind femur : 1·6.	Length of hind femur (2) : 14·4–15·7, mean 15·05.
Length of fore wing : 12·3.	Maximum vertical width of hind femur (2) : 1·8–1·9, mean 1·85.
	Length of fore wing (3) : 16·8–17·9, mean 17·30.
	Length of exposed part of hind wing (3) : 6·6–7·4, mean 6·87.
	Length of ovipositor (3): 5·7–5·8, mean 5·77.

Discussion

This species may be easily diagnosed by the large stridulatory organ and deeply bifid subgenital plate of the male, and by the disproportionately large and unusually shaped ovipositor of the female. In this latter character, in the appreciably swollen basal part of the mid tibiae (Fig. 3), and in the obsolescence of the anterior coxal spine, this species approaches *Nephoptera* Uvarov. The shape of the pronotum also shows an affinity in this direction, and the species may be looked upon as an intermediate between *Phaneroptera* Serville and *Nephoptera* Uvarov. The fastigium of the vertex, the basal structure of the ovipositor, and the six apical spurs of the hind tibiae, however, necessitate its inclusion in the former genus.