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NOTES ON A DESERT GRASSHOPPER WITH DIGGING HABITS,
EREMOGRYLLUS HAMMADAE KRAUSS 1902 (ORTHOPTERA,
 ACRIDIDAE)

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Eremogryllus hammadae Kr. is a small grasshopper hitherto known from only a few localities of northern Sahara, and its habits, ecology and distribution have remained very little known. The present paper is based on observations made by M. A. and M. T. Volkonsky on a Mission from the Institut Pasteur of Algiers in April 1938. This Mission explored the Ougarta region south of Beni-Abbes, and then crossed the western part of the Great Western Erg from Beni-Abbes to Beni-Ounif.

The main part of the paper, consisting of field observations on *Eremogryllus*, is by M. A. Volkonsky, while the notes on synonymy, distribution and morphological adaptations are by B. P. Uvarov.

The species has been found in southern Algeria and in Tunis by Krauss, and he gave its description (1902, *Verh. zool.-bot. Ges. Wien.* 52 : 238-240, figs. 4-6); since then it has been recorded only twice, by Vosseler from Tunis (1902, *Zool. Jahrb. (Syst.)* 16 : 355) and by Uvarov from southern Algeria (1923, *Novit. Zool.* 30 : 64). In 1932, however, Werner described from Tendrara and Azrou in Morocco a *Leptopternis quadriocellata* (*Sitz.-Ber. Akad. Wiss. Wien, (Mat.-Nat.)*, 141 : 146, fig. 10) which Uvarov (1934, *Ann. Mag. nat. Hist.* (10) 14 : 473) referred to the genus *Eremogryllus* without recognising its identity with Krauss's species. The good series of specimens collected by Volkonsky now makes it possible to establish the following synonymy: *Eremogryllus hammadae* Krauss 1902 = *Leptopternis quadriocellata* Werner 1932 (**syn. nov.**). The reason which induced Uvarov at first to regard the two insects as distinct was the presence in *quadriocellata* of fairly well-marked pronotal carinae, often marked with white spots, but this character is subject to individual variations, as may be seen in the series now available.

Eremogryllus hammadae is called by Arabs *bou ser-ser* ("father stridulator"), and it is probably the only Acridid whose stridulation may be heard in spring in the north-western Sahara. The localities where it is common and where the air is filled with its song, form a strong contrast with the rest of the desert, almost silent at that season.

Eremogryllus was observed by the Institut Pasteur Mission between the 6th and 18th April only on the route from Beni-Abbes to Beni-Ounif along the northern edge of the Grand Erg, between Hassi-Ouskir and Oued en-Namous (at el-Khebour, Guern Chaib, Tamzaia and M'Hardhi), on limestone soil, partly covered by sand. The landscape here is formed of the following main elements: *reg*, or a plain covered by small pebbles and gravel; *fedj*, or a *reg* where pebbles



are mixed with sand so that it becomes difficult to negotiate a car, and *arish*, or limestone hills, some of which form the bases of sand dunes. The country appears either as a plain cut up by a network of deep ravines (e.g. at M'Hardhi and Tamzaia), or as a system of low hills (at Guern Chaib and el-Khebour), depending on the degree of development of the old (geological) river beds. Everywhere are scattered small, 2-5 metres high, mobile dunes, of yellowish-white sand (see fig. 1). Similar landscape extends farther to the north-east, into the el-Hobeur area.

The vegetation is of transitional type and consists of sparse xerophilous shrubs belonging both to the flora of the *erg*, or sand-hills (e.g. *Retama raetam*, *Calligonum comosum*, *Cornulaca monacantha*), and to that of the stony *reg* (*Salsola vermiculata*, *Limoniastrum feei*). The following are, however, particularly characteristic for this area: *Helianthemum brachypodium*, *Haloxylon scoparium* and *Henophyton deserti* (*Oudneya africana*). In addition, the whole area, owing to good rains in October 1937, was abundantly covered by flowering seasonal ephemeres ("asheb" in Arabic), such as *Danthonia forskahlii*, *Aristida plumosa*, *Asphodelus tenuifolius*, *Erodium glaucophyllum*, *Monsonia nivea*, *Helianthemum Lippii*, *Savignya longistyla*, *Tourneuxia variifolia*, *Plantago albicans*, which in places formed almost a steppe-like, though sparse, cover.

The Acridid fauna of this area is also of a transitional character, since side by side with the typical inhabitants of the *erg* (such as *Hyalorhhipis canescens* Sauss.) there occur saxicolous species (*Sphingonotus rubescens* Wlk., *Tmethis cisti* F.).

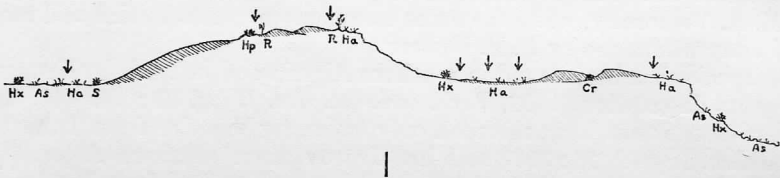
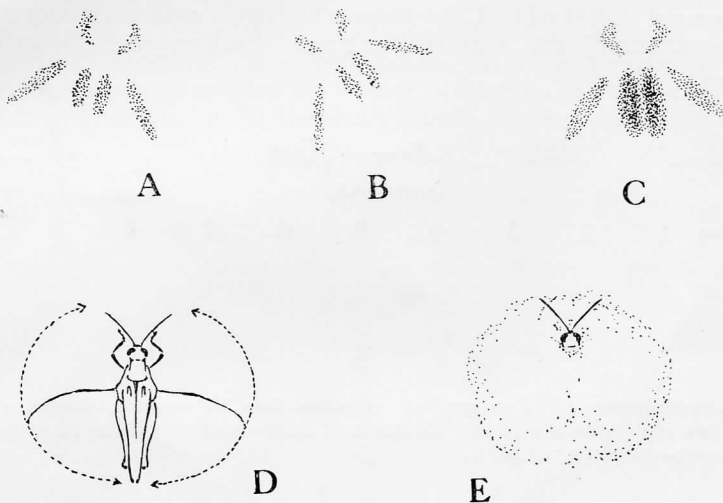


FIG. 1.—Diagram of habitats of *Eremogryllus hammadæ* Kr. Arrows indicate where the grasshoppers were found. Sandy areas shaded. Letters denote plants, as follows: As—*Asphodelus tenuifolius*, Cr—*Cornulaca monacantha*, Ha—*Helianthemum brachypodium*, Hp—*Henophyton deserti*, Hx—*Haloxylon scoparium*, R—*Retama raetam*, S—*Salsola vermiculata* (small seasonal herbs not shown).

During the visit of the Mission most of the *Eremogryllus* were adult, and one case of copulation was observed, but there still occurred some larvae of the later instars. *Eremogryllus* in the M'Hardhi plain was particularly numerous where the ephemeral vegetation was most varied. Here this species constituted the bulk of the Acridid population, and during the warm hours of the day one could continually hear the song of 2-3 males at the same time.

Eremogryllus definitely prefers places covered by sand (at least one centimetre deep) at the base of little sand-hillocks, or on the *fedj*, in the sand between pebbles. Here it may be seen moving by rapid zigzag flights for 4-5 metres, or by short frequent jumps. A stop is almost immediately followed by "digging-in." To do this, the grasshopper stands on its first two pairs of legs, while the posterior legs are jerked alternately backwards, throwing the sand from under the abdomen (see fig. 2, C). The insect also moves forward and backward, thus enlarging the depression made in the sand. Soon the depression becomes so deep that the dorsum of the grasshopper is lower than the level of the surrounding sand. In this position *Eremogryllus* is sheltered from wind,

and males, in the warm part of the day, usually commence to stridulate, crouching in the depression. Females, however, continue the process by covering themselves by sand. For this purpose, a female uses mainly the second pair of legs which, in this species, are exceptionally long. By moving these legs backwards and forwards the female sweeps sand on to her body (fig. 2, D), while the anterior legs help to cover the head. Finally, only the vertex, eyes and antennae remain visible above the sand (fig. 2, E). The whole process of "digging-in" takes less than a minute. It appears that males, when the weather is not favourable for stridulation, cover themselves as completely as



2

FIG. 2.—A & B. Footprints of *Eremogryllus* on sand—made when jumping; C, footprints after an attempt at digging; D, diagram of sweeping movements of middle legs; E, a female covered up by sand.

females. When covered by sand, *Eremogryllus* is not disturbed by a stick moved over its head as close as one centimetre, but if touched, it flies up from the sand at once.

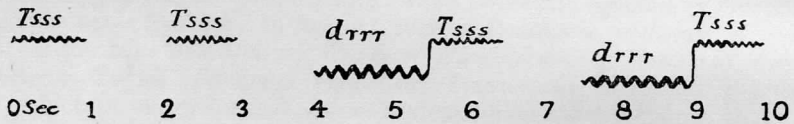
The selection of habitat by *Eremogryllus* must be dependent on the habits just described. In a pure stony desert (*hammada*) it would be unable to dig itself in, while the sand of the great dunes of the *erg* (50–200 metres high) consists of reddish very coarse grains and is probably unsuitable for the purpose. It must be due to the same reason that *Eremogryllus* is not found on the bare places in the middle of the *erg* where coarse sand is sharply delimited from the pebbly *reg*. All habitats of *Eremogryllus* observed were in the area with patches of fine whitish wind-blown sand.

These observations suggest that Krauss (*loc. cit.*) has probably also observed *Eremogryllus* not on the pure *hammada* but in places where some patches of blown sand occurred. Therefore, the specific name appears somewhat misleading.

The digging habits of *Eremogryllus* are of special interest, in the first instance

because so far it has been only briefly recorded that *Acrotylus insubricus* Scop. (Nikolsky, 1928, in Uvarov : *Locusts and Grasshoppers* : 63) and *A. crassus* St. and *A. deustus* Thnbg. (Key, 1930, *S. Afr. J. Sci.* 27 : 410) can bury themselves in sand, but details of the process remained undescribed.

Secondly, the observations on *Eremogryllus* throw some light on the ecological significance of the specialised posterior tibial spurs and of the extremely elongated middle legs in a number of arenicolous ACRIDIDAE. These characters are found in all members of the genera *Hyalorrhypis* and *Tenuitarsus*, as well as in some *Acrotylus*, and they suggest that the digging habit may be much more common in arenicolous ACRIDIDAE than is at present known. Since these genera are not closely related, *Tenuitarsus* belonging even to another subfamily (PYRIGOMORPHINAE), this is an excellent case of convergence due to identical habitat.



3

FIG. 3.—Stridulation of *Eremogryllus*. Abscissa—time in seconds, height above the abscissa represents the pitch; thickness of lines—relative volume of sound; length of waves—frequency of beats.

The stridulation of *Eremogryllus* (described briefly by Krauss, *tom. cit.* : 240) consists of two vibrating notes, one rather low and loud, *drrr* or *grrr*, followed immediately by a higher and less loud one, *tsss* (see fig. 3). When beginning to stridulate, or in danger, only the *tsss* sound is heard. The sound *drrr* is accompanied by strong and wide vibration of half-opened elytra and wings. Volkonsky was unable to observe the stridulation sufficiently closely to be able to say whether the sound is produced by the rubbing of elytra against each other, or by rubbing the femur against elytron (as stated by Krauss). When the sound *tsss* is produced, the elytra are less open and their vibrations less extensive. Stridulation usually commenced about 9.30 a.m. and ended shortly before sunset. No direct observations on the temperature conditions of stridulation were made, but from the records taken three times a day in the shade of a tent it would appear that the lower limit of stridulation is about 21–23° C. Strong wind, blowing sand about, and causing a haze, did not interfere with stridulation.

The known distribution of *Eremogryllus* may be summarised, as follows.

S.E. MOROCCO : Tendrara, north-west of Figuig (Werner, 1932, *tom. cit.*); Ouhelane (Uvarov, 1934, *tom. cit.*).

S. ALGERIA : between Ouargla and Ghardaja (Krauss, 1902, *tom. cit.*); between Oued Mzab and Oued Nsa (Krauss, 1902, *tom. cit.*); El Mreir (Finot, 1895, *Ann. Soc. ent. Fr.* 1895 : 463; under the name *Leptosirtus aviculus*, but the specimens were examined by Uvarov and found to belong to *E. hammadæ*; see also Vosseler, *tom. cit.*, who recorded specimens from the same locality sent him by Brunner, and belonging to the same series as those in the Finot collection); Ain Sefra (Uvarov, 1923, *tom. cit.*); el-Khebour, Guera Chaib, Tamzaia

and M'Hardhi on the northern edge of the Great Western Erg (Volkonsky, see above).

TUNIS : sand-dunes south of Gafsa (Vosseler, *tom. cit.*).

TRIPOLITANIA : Sofeddin (Voyage Menier et Mathuissieux), a female in the Finot collection in Paris under the name *Leptoscirtus aviculus*, examined by Uvarov.

It may be seen that all these records are compatible with the ecology of *E. hammadæ* as observed by Volkonsky and the species must be restricted to the *reg* and *hammadæ* areas of Sahara, where there is some wind-blown sand. It is, therefore, quite certain that Werner's record (*tom. cit.*) of his *Leptopternis quadriocellata* from Azrou in the Middle Atlas of Morocco at an altitude of 1200 metres in the zone of cedar forests should be regarded as erroneous, and probably due to mislabelling. It is unfortunate that the specimen with this particular label has been selected by Werner as the type, since he had another specimen from Tendrara, in the Moroccan Sahara, where, probably, both were collected.
