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The formation of subspecies in Acridoidea (Orthoptera) in the mountains of Middle Asia

With 1 text figure

The mountain fauna of Middle Asian Orthoptera is known to be characterized by a high endemism in its genera and species (UVAROV 1927; PRAVDIN 1964).

As previously shown by the author, the causes of the development of the endemic mountain fauna in Middle Asia may be divided into two groups: 1) historical (geological) and 2) ecological ones. The first group comprises large geological and related climatic changes which occurred on the whole territory of Middle Asia since the Neogene. The second group includes ecological factors of which the most important are: the vertical stratification of the climate typical of the mountains; weathering and denudation processes; vertical stratification of soils, and the specificity of the development of plant formations on different mountain ridges in different vertical belts (PRAVDIN 1964).

The effect of the factors belonging to the first group is considerably decreased at present, although orogenic processes continue to play a certain part. For example, the ridges surrounding the Fergana depression in the South and the East are still exposed to elevation (SHCHUKIN 1960). The factors of the second group are ecological and play the leading role in the recent formative process in Orthoptera in the mountainous regions of Middle Asia. This process is evident in the formation of geographical races (subspecies) in different mountain ridges or even in their separate and more or less ecologically isolated parts, being most obvious in Acridids, among which about fifty species have endemic subspecies.

All these species may be divided into two large groups. The first includes species with wide ranges most of which are located within the lowlands of Eurasia, being associated with the landscapes of deserts, semideserts, steppes or meadows. The following species belong to this group:

1. *Calliptamus italicus* (LINNAEUS)
2. *Calliptamus barbarus* (COSTA)
3. *Metromerus coelesyriensis* (GIGLIO-TOS)
4. *Paracyptera microptera* (FISCHER-WALDHEIM)
5. *Dociostaurus kraussi* (INGENITZKY)
6. *Notostaurus albicornis* (EVERSMANN)
7. *Gomphocerus sibiricus* (LINNAEUS)
8. *Chorthippus apricarius* (LINNAEUS)
9. *Chorthippus biguttulus* (LINNAEUS)
10. *Chorthippus longicornis* (LATREILLE)
11. *Oedipoda maniata* (PALLAS)
12. *Sphingonotus maculatus* UVAROV
13. *Sphingonotus rubescens* (WALKER)
14. *Sphingonotus nebulosus* (FISCHER-WALDHEIM)

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Some Middle Asian species dwelling in both lowlands and mountains (*Asiotmethis heptapotamicus* (ZUBOVSKY), *Pezotmethis tartarus* (SAUSSURE), *Sphingonotus obscuratus* (WALKER) may also be assigned to this group.

All the representatives of the first group have formed peculiar subspecies in the mountains of Middle Asia in the course of evolution. *Calliptamus italicus* (LINNAEUS) is represented in the Karateghin and in the Hissar valley by a peculiar subspecies, *reductus* RAMME, *Calliptamus barbarus nanus* MISTSHENKO, described from the Zeravshan ridge where it is dwelling at the heights of 900 bis 2800 m (RAMME 1930; MISTSHENKO 1949). *Metromerus coelesyriensis* (G.-T.) is represented in Middle Asia by two mountain subspecies one of which occurs on the Hissar ridge, *hissaricus* MISTSHENKO, while the other, *intricatus* MISTSHENKO, is distributed in the Kopet-Dagh and Iran. *Paracyptera microptera* (FISCHER-WALDHEIM) is widely represented in the mountains of South Kazakhstan and Central Asia by a specific geographical race, *turanica* (UVAROV). A peculiar endemic subspecies *Notostaurus albicornis rubripes* MISTSHENKO inhabits the Hissar ridge. *Dociostaurus kraussi* (INGENITZKY) forms a subspecies, *ornatus* MISTSHENKO, whose range lies in the mountains of Kukhistan (the Turkestan and Hissar ridges). *Gomphocerus sibiricus* (LINNAEUS) and several grassland steppe species of the genus *Chorthippus* FIEBER that penetrated into Middle Asian mountains during glaciation periods there developed typical geographical races (*Gomphocerus sibiricus turkestanicus* MISTSHENKO, *Chorthippus apricarius asiaticus* MISTSHENKO, *Ch. biguttulus pamiricus* (RAMME), *Ch. longicornis geminus* MISTSHENKO). Some desert and semidesert geophyls which ascend foot-hills and mountains are represented there by geographical races of their own (*Oedipoda miniata atripes* BEY-BIENKO, *Sphingonotus rubescens subfasciatus* BEY-BIENKO etc.).

The three above-mentioned Middle Asian species, *Asiotmethis heptapotamicus* (ZUBOVSKY), *Pezotmethis tartarus* (SAUSSURE) and *Sphingonotus obscuratus* (WALKER), are also characterized by the presence of lowland and mountain subspecies.

It is easily understood that in all the cases described here, when a species distributed in the lowlands forms special geographic races in the mountains, the formation of these latter follows the principle of the change of habitats (BEY-BIENKO 1959). The causes of this phenomenon are rather obvious. Populations of a given species when penetrating to great heights are subjected first of all to the effect of different climatic factors such as temperature, humidity, isolation as well as new conditions of nutrition, since the composition of species of the vegetation in the new biotopes is also different.

This thesis is illustrated when a species forms several subspecies under mountain conditions which occur on the same ridge but in different biotopes. Such subspecies, although dwelling in the same geographical area, are ecologically separated, since, being related to different plant formations, they may occur at different heights.

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Chorthippus biguttulus (LINNAEUS), a species widely distributed over almost all the European part of the USSR, in the Caucasus and in Siberia may serve as a good example; in Middle Asia this species has two subspecies, *meridionalis* MISTSHENKO and *pamiricus* (RAMME). The former subspecies is often found on different mountain ridges of Usbekistan, Kirghizia and Tajikistan as well as in north Afghanistan (BEY-BIENKO & MISTSHENKO 1951). The latter subspecies was described from the Karateghin ridge, where it was found at the height of 2500 m (RAMME, 1930). I collected both subspecies on the Turkestan ridge, yet their distribution here obeys a certain regularity (PRAVDIN 1962). *Chorthippus biguttulus meridionalis* MISTSHENKO is a mass form typical of the semidesert belt and of that of *Festuca*-steppe and *Juniperus turkestanica* formations, i.e. of the heights from 700 to 2,800 or 2,900 m. In the grouping of *Stipa-Artemisia-Festuca* semidesert this subspecies and *Dociostaurus kraussi ornatus* MISTSHENKO and *Chorthippus apricarius asiaticus* MISTSHENKO are predominant forms. In *Stipa-Festuca* formation *Ch. biguttulus meridionalis* MISTSHENKO dominates alone; its abundance, however, sharply decreases at greater heights, and in the upper part of the belt of *Festuca*-steppe and *Juniperus turkestanica* formations this subspecies is completely replaced by another one, *Chorthippus biguttulus pamiricus* (RAMME). This latter becomes prevailing in plant associations of the subalpian belt (mixed grasses-*Poa-Festuca*-steppe so-called, „sas" or salt meadows) reaching in the Keravshin River basin the spurs of the SHCHUROVSKY glacier.

A similar pattern is found in *Sphingonotus nebulosus* (FISCHER-WALDHEIM), a typical geophilous form related to stony areas and rocks. In the foot-hills and mountains of Middle Asia this species is represented by two subspecies both of which occur on the territory of the Turkestan ridge. One of them, *Sph. nebulosus violascens* UVAROV, is often found in the sagebrush-salwort formation of the desert belt. Only single specimens penetrate into the mountains higher than 700—800 m along stony-cobbly slopes (PRAVDIN 1962). A different picture is presented by another subspecies, *Sph. nebulosus discolor* UVAROV, which according to the data of A. G. DAVLETSHINA (1949) is connected with the southwardly exposed slopes at the heights from 2,000 to 2,800 m and more. This species inhabits the sedimentation cones of Tertiary deposits from hardened red clays, cobbly mounds and the formations of mountain xerophytes on pebbly soils bearing thorny xerophytic cushion plants, such as *Onobrychis echidna*, *Acantholimon alatavicum*, *Astragalus* spp. etc.

Of considerable theoretical interest is the nature of the variability of morphological characters during the formation of mountain subspecies in the Acrids of the analysed group. This variability proceeds along three lines:

1) relative sizes of organs undergo changes (wings, antennae);

2) modifications are observed in the structure of the pronotum and the wings;

3) the character of the colouration of the teguments, wings, internal side of hind femurae and tibiae changes.

These regularities may be illustrated by the following examples.

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The elytra and wings of *Calliptamus italicus reductus* RAMME, *C. barbarus nanus* MISTSHENKO, *Paracyptera microptera turanica* (UVAROV), *Chorthippus biguttulus pamiricus* (RAMME) are shortened in comparison to the lowland subspecies of the same species; the Middle Asian mountain subspecies of *Gomphocerus sibiricus* (*turkestanicus* MISTSHENKO) differs from the main European-Siberian form in thicker and shorter antennae in both sexes.

In the subspecies of *Asiotmethis heptapotamicus* (ZUBOVSKY) such pronotum structures as the shape and height of the median keel, the length and width of the metazone etc. vary. Subspecies show changes in the venation in some species of the genus *Chorthippus* FIEBER (*Ch. apricarius* (LINNAEUS) and *Ch. biguttulus* (LINNAEUS)).

Variations of subspecies in colouration can be clearly observed in geophilous forms being connected either with the development of the cryptic colouration or of demonstrative characters in the process of natural selection. A change in the cryptic colouration may be demonstrated at the subspecies of *Sphingonotus maculatus* UVAROV. The desert form, *maculatus* UVAROV, is distinguished by yellowish body colouration; the subspecies associated with firm sands, *extimus* BEY-BIENKO, is coloured yellowish grey, while the mountain form developing on stony slopes, *petraeus* BEY-BIENKO, is coloured dark grey, resembling the stones. Typical subspecies colouration patterns of wings and hind tibiae are observed in the representatives of several geophilous species (*Oedipoda miniata*, *Sphingonotus maculatus*, *Sphingonotus obscuratus* and others).

Such are the composition of species, peculiarities of the geographic distribution and the variability of morphological characters in the representatives of the first group of the Acridids developing endemic subspecies in Middle Asian mountains.

The second group of species divided into subspecies with narrow ranges on separate mountain ridges includes orophilous endemics species only. At least 26 species belonging to 10 genera can be assigned to this group:

1. *Gomphomastax clavata* (OSTROUMOFF)
2. *Bienkoa fedtshenkoi* (ZUBOVSKY)
3. *Conophyma almasyi* (KUTHY)
4. *Conophyma boldyrevi* BEY-BIENKO
5. *Conophyma semenovi* ZUBOVSKY
6. *Conophyma pylnovi* UVAROV
7. *Conophyma plotnikovi* UVAROV
8. *Conophyma maracandicum* MISTSHENKO
9. *Conophyma uvarovi* SEMENOV
10. *Conophyma sokolovi* ZUBOVSKY
11. *Conophyma jacobsoni* UVAROV
12. *Conophyma dirshi* BEY-BIENKO
13. *Conophyma miramae* UVAROV
14. *Conophyma mirabile* MISTSHENKO
15. *Conophyma umnovi* BEY-BIENKO
16. *Melanotmethis fuscipennis* (REDTENBACHER)
17. *Pezotmethis karatavicus* (UVAROV)
18. *Pezotmethis nigrescens* (PYLNOV)
19. *Saxetania cultricollis* (SAUSSURE)
20. *Chorthippus cavilosus* MISTSHENKO
21. *Chorthippus vicinus* MISTSHENKO
22. *Chorthippus plotnikovi* UMNOV
23. *Brunnerella mirabilis* SAUSSURE
24. *Oedipoda fedtshenkoi* SAUSSURE
25. *Sphingonotus pamiricus* RAMME
26. *Sphingonotus zebra* MISTSHENKO

The development of subspecies in this group of species is sometimes related to the disintegration of the range into certain orographic units, the ranges of

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subspecies are located on different ridges of the same or related mountain systems (fig. 1). Thus, for example, the range of the sole species of the genus *Bienkoa* MISTSHENKO, *B. fedtshenkoi* (ZUBOVSKY), covers the ridges: Zeravshan, Hissar, Babatag, the Ridge of PETER the I and Darwas. The species is divided into three subspecies. One of them, *fedtshenkoi* (ZUBOVSKY), lives on the Zeravshan ridge; another one, *ornata* RAMME, is found on the Hissar and Babatag ridges and on the western Darwas ridge; the third subspecies, *accola* MISTSHENKO, is distributed on the eastern Darwas ridge and on the ridge of PETER

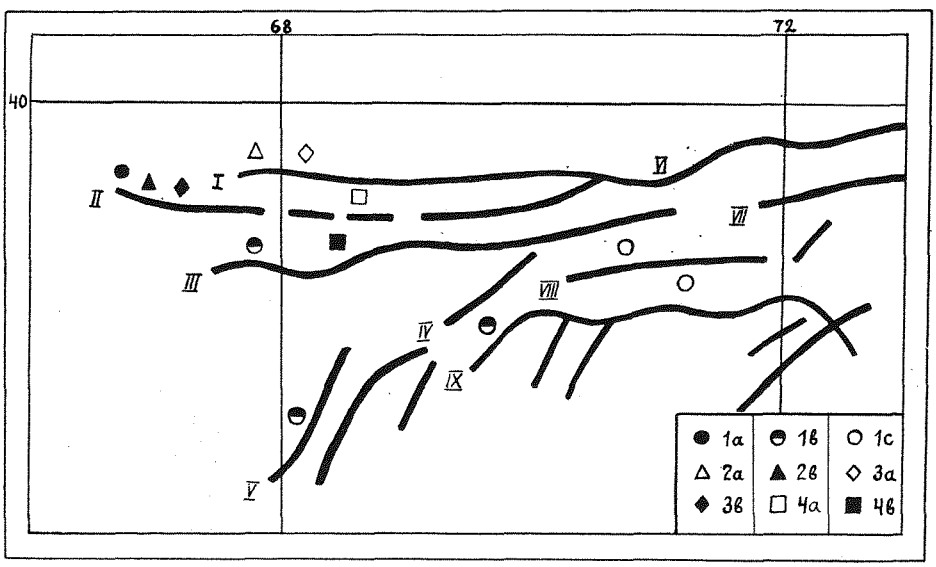

Fig. 1. Distribution of some species and subspecies of Acridids on the Pamiro-Alai ridges

Species *1*: *Bienkoa fedtshenkoi* (ZUBOVSKY) with subspecies: *a* — *fedtschenkoi* (ZUBOVSKY); *b* — *ornata* (RAMME); *c* — *accola* MISTSHENKO. — Species *2*: *Conophyma maracandicum* MISTSHENKO with subspecies: *a* — *sordidum* MISTSHENKO; *b* — *maracandicum* MISTSHENKO. — Species *3*: *C. mirabile* MISTSHENKO, with subspecies: *a* — *mirabile* MISTSHENKO; *b* — *coruscum* MISTSHENKO. — Species *4*: *Sphingonotus zebra* MISTSHENKO with subspecies: *a* — *flavipes* BEY-BIENKO; *b* — *zebra* MISTSHENKO.

Ridges: *I* — Turkestan; *II* — Zeravshan; *III* — Hissar, *IV* — Karateghin; *V* — Babatag; *VI* — Alai; *VII* — Transalai; *VIII* — Mountain Ridge of PETER the I; *IX* — Darwas

the I (MISTSHENKO 1952). Similar examples are typical of several species belonging to other Acridid genera. For example, in *Conophyma maracandicum* two subspecies have separated, one of which *maracandicum* MISTSHENKO, dwells on the Zeravshan ridge, while the other, *sordidum* MISTSHENKO, is confined to the Turkestan ridge. A similar picture is observed in another species of this genus, *C. mirabile* MISTSHENKO. The endemic mountain species *Sphingonotus*

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zebra MISTSHENKO is divided into two subspecies, one of which is recorded from the northern slopes of the Zaravshan ridge, while the other is found on the northern slopes of the Hissar ridge (fig. 1).

In some instances the process of the formation of subspecies in relation to the change of habitats can be followed, as in the case of *Gomphomastax clavata* (OSTROUMOFF). This species forms three subspecies. One of them, *clavata* (OSTROUMOFF) is distributed in the foot-hills of the Transili Alatau; another subspecies, *plotnikovi* C. BOLIVAR, occurs in the Tashkent Alatau and on southern slopes of the Chatkalsk and Fergana ridges. As to the third subspecies, *alticola* BEY-BIENKO, it was found in the Trans-Ili Alatau, Kungei Alatau and Chatkalsk ridge but at great heights only, from 2,000 to 3,300 m (BEY-BIENKO & MISTSHENKO 1951). Thus both *Gomphomastax clavata clavata* and *G. clavata alticola* occur in the Trans-Ili Alatau; however, the former dwells in the foot-hills on mixed-grass meadows and in eglantine brushwood, while the second subspecies does not occur below 2,000 m and dwells on high mountain mixed-grass meadows.

The instances in which a species is divided into subspecies on one mountain ridge are of peculiar interest when elucidating regularities of the formative process in Acridids. The distribution of two species of the genus *Pezotmethis* UVAROV, *P. karatavicus* (UVAROV) and *P. nigrescens* (PYLNOV), over the Karatau ridge may serve as an example (PRAVDIN 1960).

As it was shown by M. KULTIASSOV (1938), different vegetation types appear in different portions of Karatau on fine-grained soils. The lowlands adjoining the ridge from the north represent a subshrub desert where *Artemisia karatavica* is predominant. The north-eastern foot-hill from the Biilucol depression to the Kyzylkul lake is characterized by the landscape of scrub-desert. Low bushes, *Atrafaxis spinosa, Prunus prostrata, Caragana grandiflora* etc., are typical of this landscape. A different picture can be observed on the southern slope of the central portion of the ridge (in the vicinity of the town of Turkestan) which is distinctly marked by ephemeral desert with its typical vegetation.

The whole north-western portion of the Karatau, up to the Badzhi pass, lies in the desert zone, being characterized by the distribution of the scrub desert of low mountain regions. In the central portion of the ridge from the Badzhi pass to the Turlan pass a gradual vertical change of the vegetation types can be observed, from the ephemeral desert in the foot-hills through *Artemisia-Festuca* semidesert to the typical scrub steppe with the prevalence of *Festuca* and *Stipa* in the herbaceous stratum. On the plateaus in the south-eastern portion of the ridge, Eurasian steppes occur, differing from the scrub steppes in its central portion in their considerably smaller number of brush plants. The vegetation of Borolday-tau where *Agropyrum* mixed-grass dry steppe prevails (KULTIASSOV 1938) is specific.

Such a typical distribution of vegetation types is connected with the peculiarities of climatic factors in different portions of the ridge, as it is illustrated by table 1.[2]

[2] Numerical values presented in the table are taken from KULTIASSOV 1938.

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The areas of distribution of desert vegetation types are distinguished by low precipitation in autumn, spring and winter and by very high temperatures during the rainless summer season. The steppe areas are characterized by ample precipitation and a considerable fall of temperature in July. A certain difference is observed in the climatic conditions, however, in different regions of the distribution of steppe vegetation types. Although the town of Blagoveshchenskoje lies almost 100 m higher than the town of Burnoe, it has a somewhat higher average temperature. Apart from this, a different distribution of precipitation is found in Burnoe: more rain falls in summer than in winter.

Peculiarities of climatic conditions affect not only the zonal vegetation types but also the life of the organisms inhabiting intrazonal biotopes.

Table 1
Climatic peculiarities of Karatau

	Suzak	Turkestan	Burnoe	Blagovesh-chenskoje
Height above sea level	253	237	958	1105
Average t° in July		29.0	21.8	22.1
Average annual t°		12.3	7.4	8.1
Average precipitation (in mm)	156	176	344	378
Average number of days with precipitation in a year	52	55	56	81
Vegetation type	Sub-scrub-desert	Ephemeral (clay) desert	Eurasian *Festuca*-steppe	*Agropyrum*-mixed grass steppe

This includes the biotope of the formation of mountain xerophites widely represented in all vertical zones of the Karatau on stony and stony-cobbly slopes. The shrubs *Spiraea hypericifolia, Lepidolopha karatavica, Prunus prostrata* and cushion-like Compositae (tau-saghyz and *Artemisia karatavica*) as well as tall herbaceous umbelliferous plants (*Ferula ceratophylla, Schrenkia pungens* etc.) determine the peculiar character of this formation.

Two above-mentioned species of *Pezotmethis* UVAROV, *P. karatavicus* (UVAROV) and *P. nigrescens* (PYLNOV), are associated with this biotope. Both of them are typical petrobionts dwelling in the conditions of the formation of mountain xerophites. The range of *P. karatavicus* lies completely within the Karatau, where it occupies central and north-western portions of the ridge. The species is divided into two subspecies, one of which, *karatavicus* (UVAROV), is distributed to the north-west of the Badzhi pass, i.e. in the lowest portion of the ridge where few summits reach 1000 m while the other subspecies, *pylnovi* (BEY-BIENKO), dwells eastward from this pass, occurring at heights from 700 to 1,500 m. As a result of this, while inhabiting the same biotope, these subspecies dwell in different vertical zones and in areas with different vegetation types. The former is characteristic of the regions of scrub desert of low mountains, the latter of the scrub steppe. Thus, although both subspecies retain the usual confinement to a certain biotope typical of a given species, their formation pro-

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ceeds under somewhat different climatic conditions affected by the latitude of the vertical zone and by predominating plant associations.

The same holds true for *Pezotmethis nigrescens* subspecies inhabiting the Karatau territory. Although the borders of the range of this species are not confined to Karatau, yet the major portion of its range lies on this ridge. The species is divided into five subspecies, each of which has a rather clearly delimited range. The typical form by which the species was described is *nigrescens* (PYLNOV), which occupies the south-eastern portion of the range; it is known from the south-western slopes of the Kirghiz and Ichkele-tau ridges. Thus its range is isolated from the Karatau by a valley separating it from other ridges of the Tien-Shan. Another subspecies, *desertus* BEY-BIENKO, is known by two specimens only from the vicinities of Kzyl-Orda and, therefore, its range also lies beyond the Karatau ridge. The other three subspecies are typical endemic subspecies of Karatau related to the formation of mountain xerophytes. The distribution of their ranges across the ridge is very typical. *Pezotmethis nigrescens crassus* (UVAROV) dwells on the northern slopes of the south-eastern Karatau, i.e. in the distribution region of Eurasian *Stipa-Festuca* steppes. The range of *P. nigrescens hemipterus* BEY-BIENKO lies on Boroldai-tau ridge, whre *Agropyron* mixed-grass dry steppe is to be found with its typical plants such as *Inula grandis, Hordeum bulbosum* etc. The fifth and last subspecies of the species, *subalatus* BEY-BIENKO, is known mainly from the central portion of the ridge located between the Turlan and Badzhi passes; it occurs here at heights of 700 to 800 m in the vertical zone transitional from the desert to the scrub steppe. It seems to be able to inhabit the northwestern portion of the ridge (behind the Badzhi pass) where appropriate areas can be found.

The nature of the variability of morphological characters in the subspecies of two *Pezotmethis* species analysed can be seen in table 2. It is the length of elytra in males which is the first to undergo variation: females are distinguished by shortened elytra in all cases. In both species the forms dwelling in desert or semidesert conditions have more developed elytra than the forms of mountain steppe subspecies. The effect of the colouration of the inner side of hind femora and tibiae are typical subspecies characters. Apart from this, the Karatau subspecies of *Pezotmethis nigrescens* considerably differ from each other by the keel size in the prozone of the pronotum. This corresponds to the genereal regularity of the variability of subspecies characters in mountain Acridids discussed above.

It should be noted here that in the Karatau the formation of peculiar subspecies in *Pezotmethis* species mentioned above seems to reflect the general regularity of the formative process occurring not only in insects but in plants as well. Such an example of the formation of mountain xerophytes as the groups of related forms of the genus *Scorzonera* united under the general name „tau-saghyz" may serve as evidence.

As it was shown by M. V. KULTIASSOV (1938), tau-saghyz in the Karatau is represented by several hereditary stable units of different taxonomic ranks (species, races) with their own ranges related in their distribution to certain

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Table 2

Subspecies characters in *Pezotmethis karatavicus* and *Pezotmethis nigrescens*

Species	Subspecies	Elytra	Median keel in the prozone of the pronotum	Colouration of the inner side of the hind femora	Colouration of hind tibiae
Pezotmethis karatavicus	*karatavicus*	Reach the apices of hind femora or somewhat beyond them	Moderately elevated	Red	Red, violet or blue withe red basis
	pylnovi	Reach only the basis of hind knees	—„—	Red or pink with a blue spot	Blue with the white basis
Pezotmethis nigrescens	*subalatus*	Reach beyond the middle of hind femora	Not very low	Red, sometimes with a blue spot	Red
	hemipterus	Short, not loner than the pronotum	Rather high	—„—	—„—
	crassus	—„—	Very low	Blood-red	—„—

conditions of habitat. Four of such forms deserve our attention; in the opinion of M. V. KULTIASSOV, they rank as species, although they have not yet lost the ability to give a fertile progeny when crossed. The distribution of these forms over the territory of the Karatau is illustrated in table 3.

Table 3

Distribution of the subspecies of *Pezotmethis karatavicus* and *Pezotmethis nigrescens* and tau-saghyz species in the Karatau

Vegetation types	Subspecies of *Pezotmethis karatavicus*	Subspecies of *Pezotmethis nigrescens*	Species of tau-saghyz
Scrub desert of low mountains	*karatavicus*		*Scorzonera vavilovii* a. *Scorzonera mariae*
Artemisia-Festuca semidesert		*subalatus*	*Scorzonera* tau-saghyz
Scrub steppe	*pylnovi*		*Scorzonera* tau-saghyz
Eurasian *Festuca* steppe		*crassus*	*Scorzonera kirghyzorum*
Agropyrum-mixed grass steppe		*hemipterus*	*Scorzonera karataviensis*

It follows the same regularity as the distribution of subspecies in *Pezotmethis karatavicus* and *Pezotmethis nigrescens*: a special form of tau-saghyz corresponds to each vegetation type. All the forms are characterized by specific morphological features, which is a result of the formative process leading to the differentiation of tau-saghyz on the territory of the Karatau. The trend of this process can be observed in two species of *Scorzonera vavilovii* and *Scorzonera mariae*; they inhabit the north-western ridge under the conditions of scrub desert of low mountains and are characterized by great xerophitization. This latter is manifest in a typical change of the leaf apparatus. Unlike grass-like blades typi-

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cal of tau-saghyz forms dwelling under the conditions of different variants of the mountain steppe, the leaves of these two forms are distinguished by a considerable reduction of the lamina. This reduction is less manifest in *Sc. mariae* with narrow-linear elongated leaves, being more distinct in *Sc. vavilovi* which occupies the outmost portion of the ridge and is distinguished by almost rounded leaves showing hollows in cross sections.

The facts presented suggest that in the case of the Karatau species of *Pezotmethis* as well as in the case of tau-saghyz the formative process is determined by ecological factors affecting the animal and vegetative world. It follows that the formative process in the Acridids may run parallel to a similar process in plants dwelling under the same ecological conditions.

Summary

1. The Acridid fauna in Middle Asian mountains is characterized by the fact that the formative process started in the Neogene in relation to orogenesis is being continued nowadays on a large scale. This can be exemplified by the isolation of intraspecies forms in a large number of mountain-dwelling species. — 2. Acridid species in which the process of the formation of geographical races is going on in the mountains can be divided into two large groups. The first includes the species with wide ranges, most of which lie within the lowlands of Eurasia. These are, first of all, the species related to desert, semidesert and steppe landscapes. The second group contains species endemic in Middle Asian mountains. — 3. When the species distributed in the lowlands form special geographical races in the mountains, the formation of these latter follows the principle of the change of habitats (BEY BIENKO). — 4. In some cases the formation of subspecies in endemic species is related to the division of the range into certain geographical units, and the ranges of subspecies lie on different ridges of the same mountain system. In other instances subspecies may occur on the same ridge, being always ecologically separated since they occur in different vegetative formations. — 5. The morphogenetic process in the Acridids may run parallel to a similar process in plants dwelling in the same ecological conditions.

Zusammenfassung

1. Die Acrididen-Fauna der mittelasiatischen Gebirge ist dadurch gekennzeichnet, daß sich der im Neogen in Verbindung mit der Orogenese begonnene Formenbildungsprozeß heute noch in großem Maßstab fortsetzt. Das läßt sich an der Isolierung von Intra-Spezies-Formen bei einer großen Zahl von gebirgsbewohnenden Arten nachweisen. — 2. Die Acrididen-Arten, bei denen der Prozeß der Bildung geographischer Rassen im Gebirge andauert, lassen sich in zwei große Gruppen einteilen. Zur ersten gehören die Arten mit weiten Bereichen, die meist innerhalb der Flachländer Eurasiens liegen. Das sind hauptsächlich die Arten, die mit den Landschaftsformen der Wüste, Halbwüste und Steppe verbunden sind. Die zweite Gruppe enthält die Arten, die in den mittelasiatischen Gebirgen einheimisch sind. — 3. Wenn die in den Flachländern verbreiteten Arten besondere geographische Rassen im Gebirge bilden, folgt diese Bildung dem Prinzip des Standortwechsels (BEY-BIENKO). — 4. In einigen Fällen ist die Bildung von Unterarten bei einheimischen Arten mit einer Aufteilung des Bereichs in gewisse geographische Einheiten verbunden, und die Bereiche der Unterarten liegen auf verschiedenen Gebirgszügen des gleichen Gebirgssystems. In anderen Fällen können Unterarten auf dem gleichen Gebirgszug auftreten, doch sind sie immer ökologisch getrennt, da sie in verschiedenen Vegetationsformen auftreten. — 5. Der morphogenetische Prozeß bei den Acrididen kann parallel verlaufen zu einem ähnlichen Prozeß bei Pflanzen, die unter gleichen ökologischen Bedingungen leben.

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Резюме

1. Характерной особенностью фауны саранчовых гор Средней Азии является то, что формообразовательный процесс, начавшийся в связи с орогенезом в неогене, продолжается и в настоящее время и притом в широких масштабах. Это видно на примере обособления внутривидовых форм у большого числа обитающих на горах видов. — 2. Виды саранчовых, у которых в горах идет процесс формирования географических рас, могут быть разбиты на две большие группы. К первой из них относятся виды с широкими ареалами, большая часть которых лежит в пределах равнинных частей Евразии. Это, прежде всего, виды, связанные с ландшафтами пустынь, полупустынь и степей. Вторая группа включает в себя эндемичные для гор Средней Азии виды. — 3. В тех случаях, когда распространенные в равнинах виды образуют в горах особые географические расы, формирование последних идет по принципу смены стаций (Бей-Биенко). — 4. В ряде случаев образование подвидов и эндемичиых видов связано с распадением ареала на определенные географическне отдельности, причем ареалы подвидов оказываются лежащими в пределах разных хребтов одной системы. В других случаях подвидовые формы могут встречаться на одном и том же хребте, но всегда оказываются экологически разобщенными, так как встречаются в разных растительных формациях. — 5. Формообразовательный процесс у саранчовых может протекать параллельно аналогичному процессу у растений, обитающих в тех же экологических условиях.

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