PROPOSALS ON THE CLASSIFICATION AND NOMENCLATURE OF RANGES*

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Entomologists, systematists and faunal experts have accumulated and are continuing to accumulate a vast amount of material on the distribution of individual species and different systematic groups of insects. This material remains unsystematized to a considerable extent or is systematized on the basis of outmoded outlines and principals.

Not the least among the reasons for such a situation is the current opinion that there are independent zoogeographic divisions for different groups of insects and other land animals; the applicability of zoogeographic outlines devised for other groups is regarded as slight and dubious (cf. eg. Skorikov, 1935: 281; Bey-Bienko, 1950: 74). Consequently it follows that divisions especially worked out for each group may appear only in the concluding stages of a study of the distribution of any group. With such an approach stress is laid on the distinctiveness and on special characteristics of the distribution of individual groups, while general features remain unconsidered.

What is common to the pattern of the distribution of plants and animals is determined by the effect on them of the same abiotic factors of the environment, primarily climate, the differentiation of which is profoundly regular, and the effect of which on different groups is fundamentally similar. The theory of physiographic belts, zones and sectors deals with the pattern of the differentiation of living creatures and plants as a function of climate.

The second most important cause of shared features in the geographic differentiation of plants and animals is to be found in the biogeocoenotic interconnection of their distribution, in the formation of their reactions to the environment as a whole, including the abiotic environment, not independently but interconnectedly through the biotic environment both in its historical and in its contemporary aspects. Vegetation has a particularly important and many-sided influence on the formation of the environment.

In other words, features of fundamental similarity and coordination primarily reflecting changes in (the differentiation of) common abiotic conditions transformed and integrated through the biogeocoenosis predominate in the distribution of organisms. This determines both the possibility of (and the need for) the creation of a general biogeographic outline of zonation as a basic outline, and the possibility of using detailed outlines of zonation devised for individual groups, for example, for flowering plants, to analyze the distribution of other groups, for example insects. However, outlines of zonation constructed on the basis of limited material, for individual small groups of animals, can only be of a temporary subsidiary nature and must be regarded as material for the creation and refinement of general biogeographic outlines of zonation.

It should also be noted that the choice of groups of organisms for zoogeographic research on a taxonomic basis is not quite correct and is due mainly to the fact that zoogeography is largely the province of systematists. The analysis of distribution should be carried out by groups combining species with similar ecological and biological attributes irrespective of the direct degree of their taxonomic affinity, by groups of life forms, etc., while outlines of zonation should be worked out on the basis of a representative spectrum of such groups embracing the whole range of conditions in the area of zonal division. This is the situation of botanical geographers, who usually base themselves on the whole of the flora of flowering plants and the vegetation. Zonation carried out solely on the basis of certain groups of life forms or on the basis of systematic groups confined only to certain habitats leads to distortion of the general picture. It is impossible, for example, to carry out zonation solely on the basis of groups in which ubiquists dominate, or to carry out zonation of areas that are arid on the whole on the basis of primarily mesophilous groups, and it is also impossible to arrive at a correct understanding of the importance of zonal boundaries by analyzing the distribution, for example, only of plants and animals found around water, which are in general poorly differentiated zonally in connection with the salient features of habitat conditions.

Obviously, it will subsequently be possible to detect (ecological and biological) groups that differ in their relationship to biogeographic divisions, boundaries etc., but special independent "zoogeographies" should not be created for them. Such particular zoogeographies represent the mean between completely satisfactory outlines based on adequate material and analysis of the distribution of individual species and groups of species. It is clear that the species most suitable for deteiled zonation and the establishment of precise boundaries are relatively immobile, sessile, stenotopic, small species, while more mobile, eurytopic, large species are far less suitable.

One of the main factors that has led zoogeography into lengthy stagnation and has even led to attempts to reject zoogeographic zonation in the usual sense (Shtegman, 1938) and to the almost lack of points of contact with botanical geography has been that zoogeography has dealt (because of the better state of investigation) primarily with vertebrates and among them particularly with birds (i.e. the most mobile animals, animals that are eurytropic, and because they are warm-blooded, are least dependent on the environment, and that have, moreover, comparatively few species).

*The article is printed as a basis for discussion. Editorial Board.

Only the boundaries between the highest ranks and the largest divisions are clearly traceable from data on the distribution of vertebrates. It is not by chance that many outlines of zoogeographic zonation based on vertebrates are given without maps or with maps on which only the boundaries of the largest divisions are depicted (Kuznetsov, 1950; Portenko, 1965). The almost total lack of recognition of the steppe region by vertebrate zoogeographers (Geptner, 1936; Puzanov, 1938; Kuznetsov, 1950 and others) is a striking example of the inadequacy of zoogeography based solely on vertebrates. It is only most recently that articles and maps have appeared in which the steppe zone (region) is treated as in some sense independent (Bobrinskiy, 1951; Kucheruk, 1959).

Only the wide and integrated use of theoretical and practical achievements of landscape studies and of the different branches of biogeography affords great possibilities for the understanding and systematization of data on the distribution of groups when these data are inadequate for the creation of valid independent divisions owing to their paucity or their biological onesidedness, and for groups that have been inadequately investigated, without waiting for the time when we shall possibly be able to produce outlines of zonations based on material relating to these groups themselves.

BASIC CHARACTERISTICS OF THE BIOGEOGRAPHIC DIFFERENTIATION OF THE BIOTA

The general features of territorial physiographic differentiation, physiographic division into belts or zones, sectors and provinces, is reflected in the distribution of living organisms, as also in other natural phenomena (Isachenko, 1965, 1971; Ignat'yev, 1966), and division into sectors or provinces is usually contrasted with division into belts or zones or with lack of zonal division (Isachenko, 1965).

The real pattern of the geographic distribution of living creatures is governed by the combined effect of all these features. Differentiation by belts or zones, determined by the uneven supply of heat to the Earth's surface in connection with its rotation around its axis and with inclination of the axis of rotation relative to the plane of the ecliptic is the most strongly manifested. Large physiographic belts or zones of latitudinal extent, from equatorial to arctic, are distinguished by gradations of heat supply. The belts are divided into narrower latitudinal strips, corresponding in longitudinal extent to zones. Therefore, a belt combines several zones with similar heat supply occurring in succession from north to south and from west to east.

The second feature, division into sectors, is of a mixed zonal-azonal nature. Division into sectors can be clearly manifested only when there is latitudinal alternation of vasts continents and oceans, the contours and disposition of which are of an azonal nature. However, the spread of the influence of the ocean to the continents is governed by the rotation of the earth, a factor which also determines differentiation by belts (zones). The influence of the oceans extends primarily from west to east and from east to west. Division into sectors is manifested in the greater midlness of the climate around the western and eastern shores of a continent and in its increasing continentality towards the deep submeridional zone. Therefore, the sectors are in general arranged across physiographic belts. Division into sectors is weaker than division into belts and does no more than modify the manifestation of the features of the latter in different sectors. The combined effect of the features of belts and sectors is responsible for the isolation of zones and their extent. It is primarily the law of geographic division into belts that is expressed in zones, while the law of division into sectors is manifested either in the fact that the secondary characteristics of the zones alter from sector to sector, or that certain zones are confined to certain sectors (oceanic or continental), and are replaced in other sectors of the same belt by zones that are analogs (Isachenko, 1971). Thus, for example, the broad-leaved forest zone is confined to oceanic and transitional sectors, while the steppe zone is confined to transitional and continental sectors in the same belt.

Although the sectoral aspect of geographic differentiation is very important for the understanding of ranges and their classification, it has been far less worked out than the zonal and belt aspect, and should therefore be dealt with in greater detail (Fig. 1).

A. G. Isachenko (1971) has given a consistent and detailed division of the northern half of the Eastern Hemisphere into sectors (plotted on a geographic map); a similar, but less detailed division has been proposed by V. I. Kovaleva and V. I. Prokayev (1971). Earlier A. P. Kuzyakin (1962) had divided the territory of the USSR into sectors on the basis of zoological material, while E. Jäger (1968) had constructed isolines of continentality for the whole of the land mass of the world on the basis of floristic data, which is an approach that is not far removed from the question of sectors.

The main sectoral boundary is the interface between the influences of the Pacific and Atlantic oceans, which runs approximately along the Yenisey, and continues across the Tien Shan and west of the Indus. This boundary, the individual parts of which have long been indicated by biogeographers, is of subregional rank almost through its extent. According to the views of V. M. Sinitsyn (1966), this boundary already occupied approximately the same position in the Mesozoic. The areas to the east of it have a climate of the monsoon type with maximum precipitation in the summer or a climate resembling it, while the areas to the west of it have a climate of the Mediterranean type with maximum precipitation during the cold half of the year or a boreal climate with a summer maximum, but with a damper and warmer spring than in the east.

The western part of the Palearctic is divided into four sectors—Atlantic, sub-Atlantic, subcontinental and continental, but the second and third sectors may be combined into a single transitional sector with the rank of subsectors.

As a sector bordering on the ocean, the Atlantic sector is typified by the disappearance of some zones, primarily arid ones, as well as by more or less appreciable petering out of the tundra and the tayga, which are replaced by oceanic barren meadows and shrub thickets, and also by the expansion of the humid zones and a weakening of zonal contrast expressed in the deeper interpenetration of the Mediterranean, nemoral, tayga and other similar elements. It is only in the southern subtropical belt that the sector is occupied by deserts with a permanently high (sic!) air humidity.

The transitional sub-Atlantic sector is also typified by the practically total absence of strictly arid zones, and semi-arid zones are represented by the Mediterranean zone and the forest-steppe in the eastern part of the sector. Zones of nemoral and subtropical

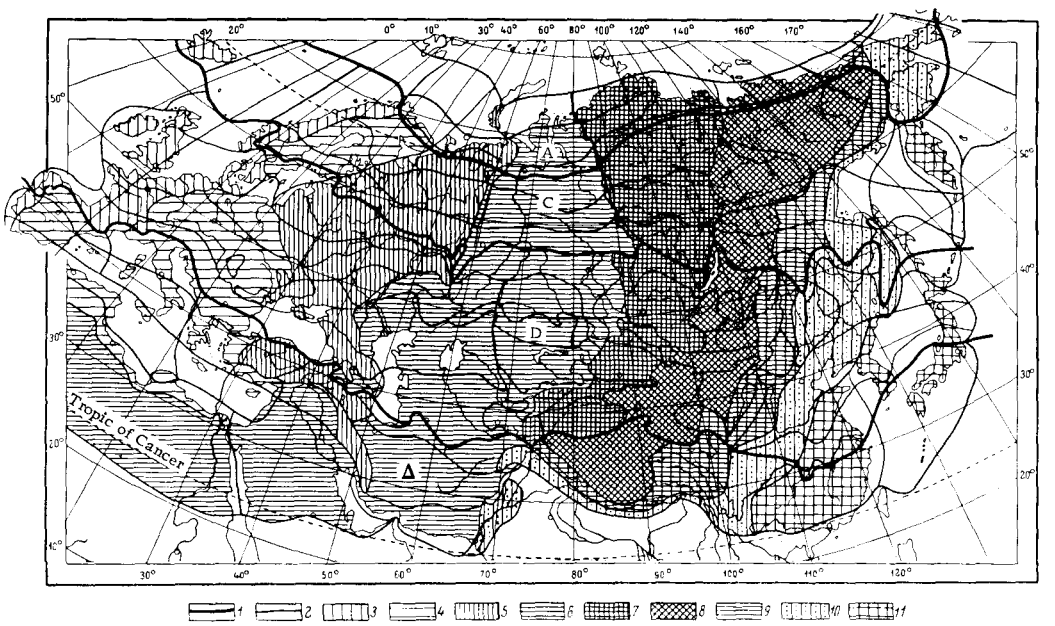

Fig. 1. Division of the Palearctic into belts and sectors.

Key: 1—Boundaries of belts; 2—boundaries of other divisions (sectors, provinces, subprovinces and subzones) not coinciding with belt boundaries. Sectors and subsectors: 3—Atlantic; 4—sub-Atlantic; 5—Western subcontinental; 6—Western eucontinental; 7—Western sharply continental; 8—eastern sharply continental; 9—eastern eucontinental; 10—eastern transitional; 11—Pacific. Belts: A—Arctic, C—euboreal, D—subboreal, Δ—subtropical.

hemixerophilous forests dominate in this sector; the tayga and tundra zones are impoverished in composition.

The transitional western subcontinental sector is typified by the presence of normally developed tundras and tayga, by the contraction and impoverishment of the zone of nemoral forests, by the appearance of a steppe and nemorose forest-steppe zone and in the south by wasteland transitional in type from subtropical to temperate. Contrary to A. G. Isachenko, the mountainous districts of the Levant, which correspond in terms of sectors to the Black Sea steppe, should be accorded to this sector; here there is a steppe belt of the Black Sea type (Lavrenko, 1965) and open oak woodlands, which are an indication of similarity with the Mediterranean, and the typical continental climate is absent from the mountains (Popov, 1950). It is not by chance that many biogeographers treat the mountains of the Levant as belonging to the Mediterranean.

The continental sectors are typified by disappearance of the zone of nemoral forest and by expansion of the tayga zone and the arid zones, especially the deserts, which here penetrate northward beyond the subtropical belt. The zones of the western continental sector are typified by strips of small-leaved woodlands to the south of the tayga, replacing the nemoral forests, the small-leaved woodlands of the forest-steppe and the desert of Mediterranean type and temperate type transitional to Central Asia. The southern part of the sector is occupied by subtropical and tropical desert of the trade wind belt (the tropical deserts are outside the Palearctic). This is essentially another subsector differing in origin and extent from the northern subsector, with which it merges. It extends latitudinally, squeezing out the transitional sector in the west and here coming directly into contact with the oceanic sector.

The following sectors already belong to the sphere of influence of the oceans of the eastern and southeastern seaboard, the Pacific and the Indian Ocean. The effect of the Pacific declines fairly rapidly owing to the mountain barriers almost invariably situated near the shores, and the system of transitional and oceanic sectors is here greatly compressed and to some extent reduced, but on the other hand a unique sharply continental sector, which has no direct analogs in the other continents, is of vast extent.

No eastern continental sector is distinguished in the outline of A. G. Isachenko; it is combined with the sharply continental sector (this is clear, although it is not stated directly), and the eastern transitional sector is shown as interrupted; its eastern (oceanic) boundary is constructed in steps which have no clear connection with orography, etc. It seems that this part of the outline proposed by Isachenko is not entirely successful. Taking the principles that are clearly embodied in the western sectors as a starting point, it is possible slightly to modify the outline of the differentiation of the eastern sectors, making the interpretation mainly on the basis of the distribution of the vegetation.

Since the tundra zone is not interrupted by a meadow-shrub zone in the region of the Bering Strait, where the continents practically come together, it must be considered that the transitional sectors of Asia and America are directly adjacent here, and that the oceanic sectors have petered out southward, being here limited by the North Pacific meadow-shrub subregion. Thereafter the tayga of the Okhotsk coast, which is replaced by tundra in the north (in the northeast in accordance with the isolines of continentality and with the degree of expression of monsoon circulation, i.e. in accordance with the sectoral extent) should not be classified as belonging to the oceanic sector, but to the transitional sector, as has been done for the tayga of northern Sakhalin. The Soviet Maritime Territory also evidently belongs to the transitional sector, since meadow-steppe coenoses here penetrate right to the shore of the Sea of Japan. A similar opinion has been expressed by V. B. Sochava (Sochava et al., 1966).

East Asia remains very poorly investigated both within the USSR and especially to the south of it, and this is also manifested in the uncertain construction of the sector boundaries.

The inner part of subtropical China, classified by Ye. M. Lavrenko as belonging to the Himalayan-Yunnan hemixerophytic evergreen forest subregion (distinguished as a counterpart of the mesophytic Japanese-Nanling subregion), evidently already belongs to the transitional sector.

With the corrections introduced the Pacific sector acquires a spectrum of zones similar to that of the Atlantic sector, ranging from Arctic meadow-shrub through the dark coniferous (spruce and fir) tayga to nemoral and thereafter to subtropical mesophilous forests; the eastern transitional sector acquires the spectrum of zones: tundra, dark coniferous tayga, nemoral forests and steppes, hemixerophytic subtropical forests.

An eastern continental sector or, to be more accurate, the eastern part of the sharply continental sector with weakened features may be distinguished somewhat provisionally with the rank of subsector. Here we may include the open northern tayga woodlands north of the shores of the Sea of Okhotsk, the light coniferous tayga with elements of dark coniferous tayga between Aldan and Dzhugdzhur, along the Zeya and along the north of the Bol'shoy Khingan range, the western steppes before the Khingan range, the Ordos steppes and the mountain formations of Eastern Tibet. This part (subsector) of the sharply continental sector lies at the limit of the extinction of monsoon circulation between the boundaries of the Pacific climatic sector as defined by N. N. Ivanov and B. P. Alisov (Alisov, 1950, 1956; Ivanov, 1956) and by A. A. Borisov (1967).

The main part of the vast, sharply continental sector is further divided into two subsectors—Western and Central. The sector as a whole is typified by replacement of the dark confierous tayga by light coniferous, by disappearance of leafy trees from the forest-steppe, by the maximum distance of the northward penetration of the steppes and deserts, and by a distinctive wasteland subzone that does not have direct analogs in other sectors.

The western subsector, which is the less contrasting, has features of transition to the western continental sector. Here Dahurian larch is replaced in the mountain tayga, in the south, by Siberian larch; the steppe associations contain a large admixture of the western element, which is also apparent in the deserts. The Central subsector is the harshest; it is typified by the penetration of steppe coenoses through the tayga right to the tundra.

The Nearctic may also be divided into sectors by analogy with the Palearctic and on the basis of the same principles (Fig. 2). The division of the Nearctic into belts and sectors is essentially contained in the vegetation map of North America produced by A. M. Semenova-Tyan-Shanskaya (Physiographic World Atlas, 1964). Such a map, on which the belts, regions and provinces of the Nearctic have been correlated with definite sectors, may be of use for the type classification of Holarctic ranges and in the search for analogies in the fauna and flora of the different parts of the Holarctic. Evaluation of the sectors of the Nearctic by the same criteria as are used in the Palearctic shows that the most continental sectors of the Nearctic must be classified as subcontinental, since here there is not, for example, sectoral interruption of the broad-leaved zone and the forest-steppe is enriched with broad-leaved elements, while open oak woodlands, which are absent from the mountains of the true continental sector of the Palearctic, are widely represented in the desert mountains.

Among the factors governing sectoral differentiation we may distinguish two principal factors, temperature (continentality in the narrow sense) and circulation, which vary in a similar direction, but are relatively independent and not always coordinated. The axis of maximum continentality of the climate in the Palearctic is shifted to the east relative to the boundary of the large western and eastern sectors. The entire western sector is under the clear influence of Atlantic air masses, whereas the inner part of the eastern sector lies in the region weakly affected by the Pacific, the clear influence of which ceases within the eastern subsector of the sharply continental sector. The eastern sectors are more differentiated in circulation than the western ones from west to east and are more continental in temperature ranges. These circumstances make it impossible to construct complete analogies between the corresponding western and eastern sectors.

Sectoral divisions are undoubtedly less integral than zonal and belt divisions. Zonal divisions are typified by a fairly appreciable number of species and groups covering the entire zone or belt as a whole and immediately indicating with some degree of approximation the whole of their zonal-belt boundary. Such species and groups are uncharacteristic of sectoral divisions or are even totally absent; sectoral boundaries are formed from the boundaries of the chains of superimposed ranges of different species.

The third feature of territorial physiographic differentiation, namely lack of zoning as such, or provinciality, is responsible for the actual expression and modification of the first two in relation to local conditions unrelated to the physiographc division into belts. The azonal characteristics of territories, especially topography, are sharply expressed in the differentiation of provinces. When the topography is uniform a province may be characterized as the territory of a zone in a particular sector, while when the topography is mixed there may be several provinces in such a sectoral-zonal unit. Several types of provinces, lowland, mountain, high mountain and mixed mountain-basin, may be distinguished by the nature of topography. The first are typified by simpler differentiation, the direct manifestation of zonal successions, etc., while the second

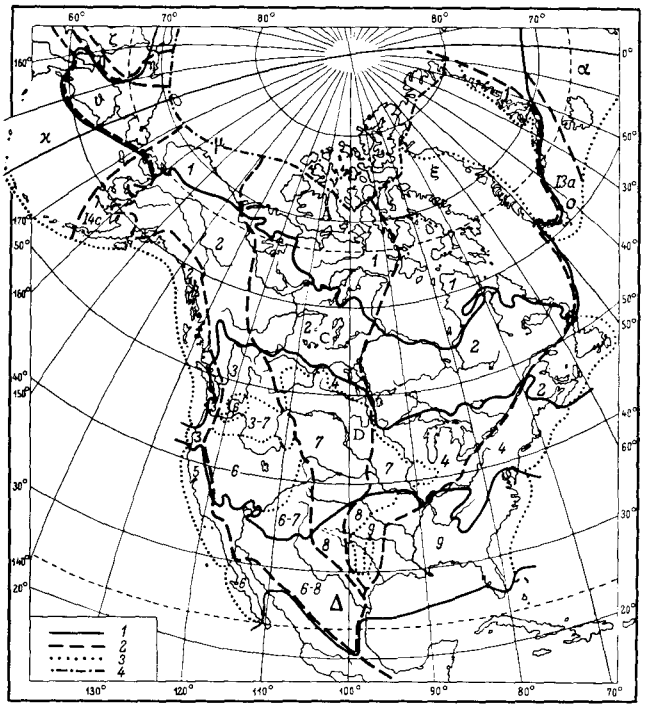

Fig. 2. Division of the Nearctic into belts, sectors and regions.

Key: 1—Boundaries of belts; 2—sector boundaries; 3—boundaries of regions not coinciding with boundaries of belts and sectors; 4—boundary of Arctic tundras and Arctic deserts, to the north of which the sectors are not traced. The Greek capital letters denote the belts (see Fig. 1 and Table 1). The lower case Greek letters denote sectors; λ —(Neo) Pacific; μ—western transitional; ν—eastern subcontinental; ϵ—sub-Atlantic; o—(Neo) Atlantic; See Table 2 for other sectoral symbols. The numerals on the map denote regions: 1—Eskimo tundra; 2—Canadian tayga; 4—Alleghenian nemoral; 5—California evergreen; 6—Coloradan (Coloradan-Mexican) desert; 7—Missourian steppe (prairie region); 8—Texan savanna; 9—Louisianan evergreen. Mixed divisions are designated by two figures.*

*Translator's Note. Entry 3 omitted from Russian text.

are typified by manifestation of the features of mountain altitude belts in which the lower belt is an analog of the zonal strip of the corresponding adjacent plain, while the higher belts are in part analogs of more northerly zonal formations, and in part highly distinctive, without any obvious lowland analogs, such as, for example, the semi-savanna belt in the mountains of Soviet Central Asia. High mountain provinces are distinguished by the absence of the lower belts in connection with absence of the appropriate altitude.

The zonal and sectoral position of mountain provinces are manifested in the type of division into belts specific to them, in the development of some belts and reduction of others. Thus, for example, the forest belts which predominate in the mountains in oceanic sectors are reduced in continental sectors in the north and often disappear altogether in the south (see Stanyukovich, 1955; Isachenko, 1965; Stanyukovich and Stanyukovich, 1972).

Direct comparison of the faunas of lowland and mountain provinces is impossible, since the general nature of the mountain fauna cannot be determined only from the predominant belt in the mountain profile. In such instances the comparison must be on a broader basis between sectoral-belt units (superprovinces), including the mountain province and the lowland provinces on either side.

The most complicated type of province arises when mountainous terrain in the narrow sense alternates with wide valley-basin sectors, which are already areas of lowland topography, but are at the same time influenced by the surrounding mountains. A mountain fauna is clearly expressed as well as a lowland fauna in such provinces, and the latter is of the nature of a separate entity specific to the given province. Such provinces, on the one hand, occupy a kind of intermediate position between mountain and lowland provinces, and, on the other hand, are a more intricate type.

The differentiation of conditions is most complicated in mountain-based topography in subarid regions. Whereas increased humidity and a succession of increasingly humid belts are to be observed on ascending in

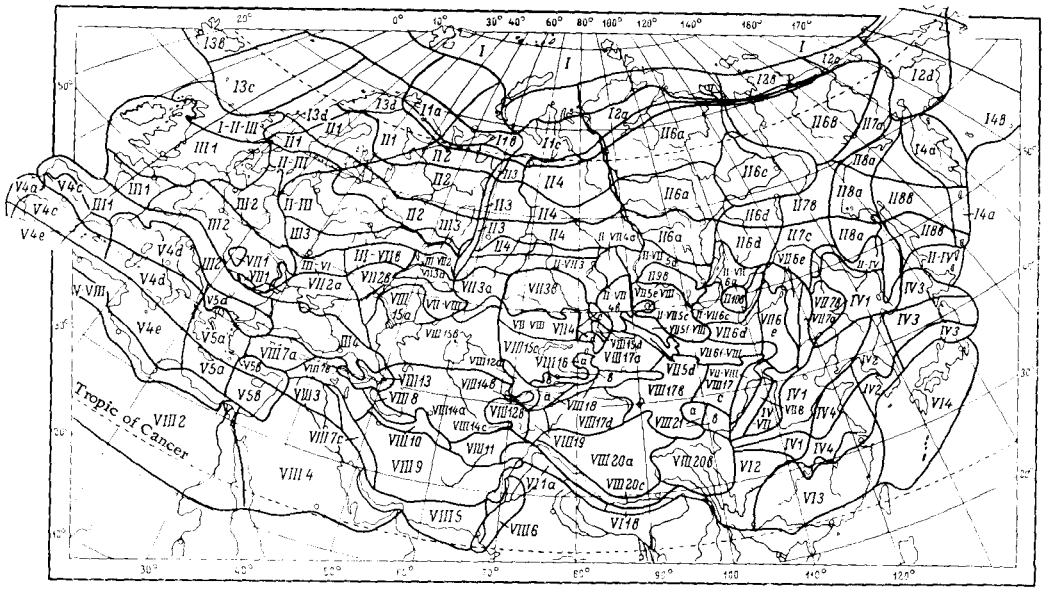

Fig. 3. Division of the Palearctic into provinces and subprovinces.

Key: The boundaries of provinces and subprovinces and the boundaries of subzones not coinciding with the first two are shown on the map. Each division is designated by the figure under which it appears in the list of biogeographic divisions (see pages 18-20). Regions are designated by Roman numerals, provinces by Arabic numerals, subprovinces by lower case Roman numerals. Transitional divisions are designated by a double figure.

ordinary mountain topography, an additional increase in the aridity of the lowest belt is to be observed in basins (i.e. the floor of the basin). Here there is manifested what would seem to be an additional belt below, and one that frequently has no direct analogs in lowland zonal formation (see Preobrazhenskiy, 1958). This is evident from the advance of steppes and deserts farther to the north along basins than along the adjacent plains outside the mountains, and in the upward displacement of the arid belts in the interior of mountainous regions. The zonal types of different regions, which are separated by wide expanses in which they do not occur on the plains, exist side by side in such territories. In the Sayans-West Mongolian region the southern boundary of the forest lies to the south of the southern boundary of the desert; similar relations are produced in the interior of the Cordilleras in the Nearctic. In such instances the attempt to construct unambiguous boundaries between regions and other major divisions by analogy with the plains comes up against insurmountable obstacles. In botanical-geographic divisions (Lavrenko, 1950, 1970b) the south Siberian island steppes—mountain forest-steppes—disappear completely from the steppe region, while in zoological divisions an island steppe province is distinguished, incorporating only the steppes of the largest, essentially forest-steppe islands; the small islands are incorporated in the tayga (Physiographic Atlas of the World, 1964). Neither can be said to be successful.

Were all the areas of dry land to be lowland, the task of large-scale biogeographic division would be simple, and it would also be comparatively simple were all the areas of dry land to be mountain or mountain-basin areas, except that the evaluation would then be based on slightly different principles, although the task is contained in the need to relate the divisions of mountain and lowland areas in a single system. It seems to the author that a way out may be found by using the category of combined transitional divisions of double subordination, which will give the division some flexibility better corresponding to reality than rigid inflexible outlines.

CLASSIFICATORY PRINCIPLES AND THE NAMES OF THE RANGES

The classification of ranges is naturally based on the biogeographic regional divisions. A regional division corresponding to the present-day level of science must provide an interrelated reflection of all three aspects of general chorological differentiation—division into belts, sectors and provinces, as referred to above. The results of such a correlation may be an outline of biogeographic regional division, the basic unit of which is the province incorporated in a definite belt, zone and sector.

The proposed outline is also a practical attempt at such a correlation. It has been made for the purposes of the classification of ranges, but these purposes do not require any changes to a general outline. In many respects the proposed outline is similar to that of H.

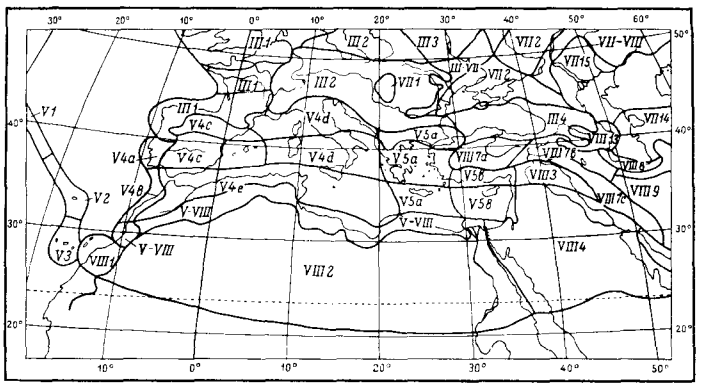

Fig. 4. Division of the southwestern part of the Palearctic into provinces and subprovinces. Key: see Fig. 3.

Meusel et al. (Meusel, 1943; Meusel, et al., 1965) and it develops some of his proposals on a more detailed basis, having regard to more recent works.

1. An outline of the biogeographic division of the Palearctic (Figs. 1, 3, 4). The outline is of the nature of a review compilation. Division is based on the botanical-geographic and zoogeographic divisions of authors, especially the botanical-geographic division of the Palearctic proposed by Ye. M. Lavrenko (1950) and subsequently filled out by him for the steppe and desert zones (Lavrenko, 1965, 1970a, 1970b), the division of H. Meusel et al referred to above, the vegetation maps in the Physiographic Atlas of the World (1964, the maps concerned edited by Sochava and Ye. M. Lavrenko), the Geobotanical map of the USSR (1954), taking into consideration the elaboration for separate areas found in B. A. Yurtsev (1966) for the hypo-Arctic belt, in L. V. Shumilova (1962) and V. N. Vasil'yev (1956) for Siberia, in V. I. Grubov (1959) for Central Asia, in V. I. Grubov and A. A. Yunatov (1952) for Mongolia, etc.; and the elaborations of zoologists: A. P. Semenov-Tyan-Shanskiy (1936), N. A. Bobrinskiy (1951, 1969), B. A. Kuznetsov (1950) and others. On the whole botanists and zoologists construct the main boundaries similarly, but those of the zoologists are more schematic and approximate; the botanical boundaries were taken as being the more detailed in all such instances.

As has already been stated, a category of transitional divisions possessing double subordination has been introduced in order to eliminate the excessive rigidity of ordinary divisions, which is particularly noticeable when combined transitional divisions are accorded to some given region or province. They are provisionally ascribed to a given region in the list of divisions, but their transitional nature is noted and they are invariably specially designated on the maps.

The largest provincial (azonal) divisions of the Palearctic are its arid and humid parts, the Tethyan* (Ancient Mediterranean) and the Hyadean** (Fig. 5). They correspond in rank to subkingdoms, but do not entirely coincide with the division of the Palearctic kingdom into regions—the Mediterranean and Chinese subtropical regions are cut in half, on which basis these divisions must be regarded as facultative along with another similar pair of belt divisions—the subtropical and extra-subtropical belts, which divide the desert region into two parts. This situation reflects the duality of the basic differentiation of the biota—by heat supply and by moisture.

Use of the category of transitional division provides a compromise solution; in relation to Tethys these divisions will be the humid parts of the Mediterranean and the subarid western parts of the Manchurian and Chinese regions.

Unfortunately, the system of names in use for the major biogeographic divisions is very inconvenient for the naming of ranges owing to its cumbersome nature, the mixing of different principles for the formation of names, and the existence of homonyms or ambiguity. The main divisions are very often named by two or three words—if a range covers three such divisions the name may consist of nine words. It also frequently happens that the main divisions acquire names with qualifying epithets, for example, Western Tien Shan province, and in such a case ranges embracing only the southern or only the western part of the division will receive the inappropriate names southern-western Tien-Shan and western-western Tien-Shan. Composite names and qualifying epithets should be avoided for the names of the main divisions. Furthermore, the regions frequently do not have their own names, but only landscape-typological names, which are essentially descriptive, for example, Tundra, Steppe; as a result a meadow-steppe species may appear alongside a European meadow species and so on. The names of all biogeographic divisions must be proper names. A division and one of its subdivisions often have the same name, for example the Mediterranean region is divided into the Makaronesian and Mediterranean subregions. One of the homonyms must be replaced.

The shortest possible names among the existing ones have been selected in the outline here presented, or new names have been proposed in the absence of satisfactory old ones. The new names for the regions are Hesperian (regio hesperica from hespa = evening), Orthrian (regio orthrica from orthros = morning),

*From Tethys, genitive Tethyos, on which basis the Russian transcription should be Tetiya or Tefiya, and the Russian adjective should be "tetiyskiy", rather than "teticheskiy" or "tetisovyy".

**From the Hyades, the rain nymphs of the Ancient Greeks.

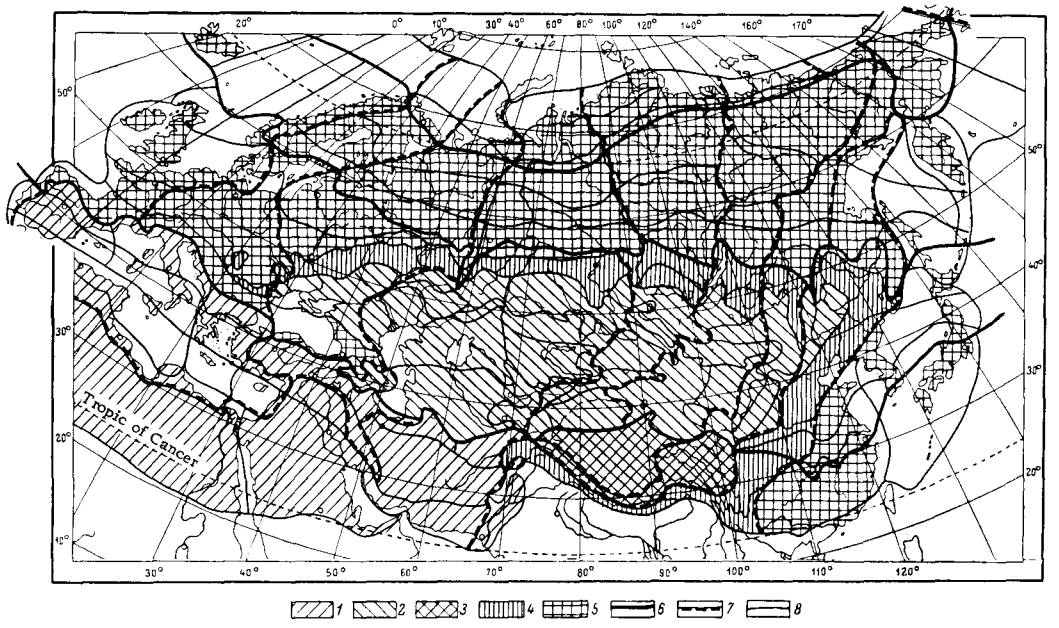

Fig. 5. Divsion of the Palearctic into subkingdoms.

Key: 1-3—Tethyan subkingdom, 1—South Tethyan division, 2—North Tethyan division, 3—high mountain provinces; 4—transitional territories between the Tethyan and Hyadean subkingdoms; 5—Hyadean subkingdom. Boundaries: 6—of belts; 7—of sectors; 8—of provinces, subprovinces and subzones.

Stenopaean (regio stenopaea by analogy with regio europaea), Scythian (regio scythica, from the Scythians who inhabited the steppes between Mongolia and the Black Sea) and Sethian (regio sethica, from Seth, the God of deserts among the ancient Egyptians).

In the list below Roman numerals are used to prefix the names of provinces, upper case Latin letters subprovinces, Arabic numerals provinces within regions and lower case Latin letters subprovinces within provinces. The words province and subprovince have been omitted from the list. Each division enumerated has its own symbol and transitional divisions have a double symbol (the second part, which indicates the second subordination, is given in brackets after the name). Forest subprovinces of transitional combined steppe provinces are given in brackets in the list of the steppe region. Furthermore, the names of divisions are followed by additional typological characteristics—the belt and sector to which they belong are indicated by Greek letters for regions (see Tables 1 and 2 for the key), while the sectors to which they belong, the topographic type and certain other facts are indicated for provinces and subprovinces.

The Palearctic is treated as a kingdom (regnum) or as a subkingdom (regio) subdivided into regions.

I. Circumpolar region (Fig. 6).
IA. Hyperboreal subregion (tundra).
1. Western Hyperboreal (lowland).
1a. Lapland (β).
1b. Nenets (γ).
1c. Lower Ob (δ).
2. Eastern Hyperboreal (mixed).
2a. Dolgany (ϵ).
2b. Indigirka (ζ).
2c. Chaun (η)
2d. Anadyr (ϑ).
IB. North Atlantic subregion (meadow-wasteland).
3. North Atlantic (mixed).
3a. South Greenland (Nearctic).
3b. Iceland (α).
3c. Faeroes-Shetland (α).
3d. Norwegian (II, 1, α).
IC. North Pacific subregion (meadow-wasteland).
4. North Pacific (mixed).
4a. Kuril-Kamchatka (II 8, χ).
4b. Commander-Aleutian (χ).
4c. Alaskan (Nearctic).
II. Euro-Siberian region (tayga) (Fig. 7).
IIA. West Euro-Siberian subregion.
1. Bothnian (mixed) (β).
2. Zyryansk (lowland) (γ).
3. Uralian (mountain) (δ).
4. Ob (lowland) (δ).
(5) VII 4. Altai (complex). Northern Altai group of subprovinces.
5a. Kuznetsk (VII 3, δ).
5b. Russian Altai (VII, δ).
IIB. East Euro-Siberian subregions.
6. Angara (mixed).
6a. Tungusska (ϵ).
6b. Kolyma (ζ).
6c. Yakut (ζ).
6d. Vitim (ζ).
7. Cis-Okhotsk (mountain).
7a. Northern Cis-Okhotsk (η).
7b. Maya (η).
7c. Zeya (η).

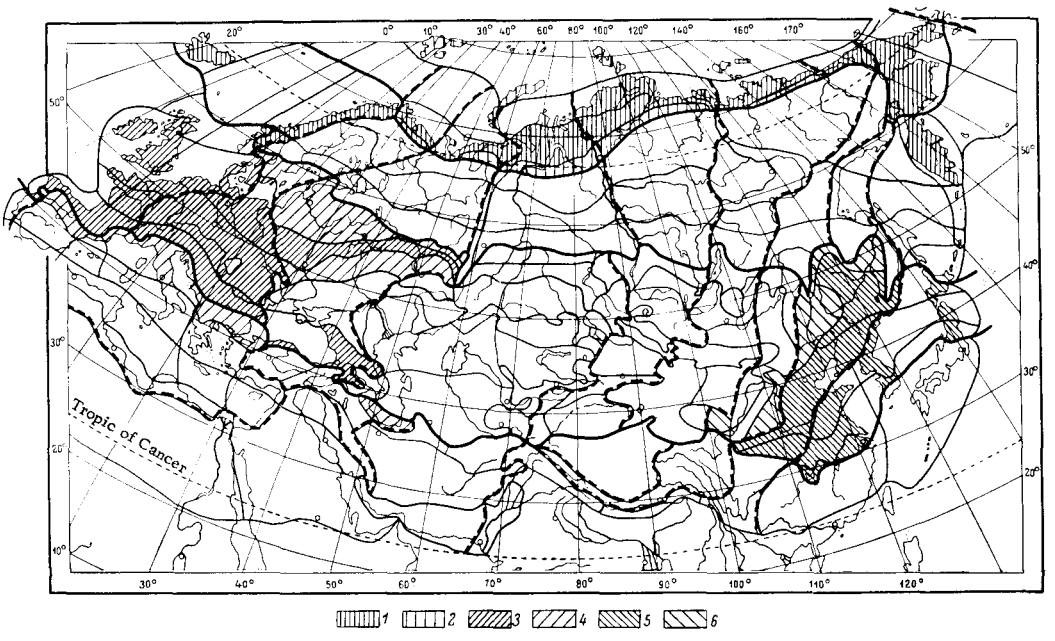

Fig. 6. Tundra and nemoral regions of the Palearctic.

Key: 1-2—Circumpolar tundra region, 1—main territories, 2—transitional to adjacent regions; 3-4—European nemoral region, 3—main territories, 4—transitional to neighboring regions; 5-6—Stenopaean-nemoral region, 5—main territories, 6—transitional to neighboring regions. Key to boundaries as in Fig. 5.

8. Okhotsk (mountain).
   8a. West Okhotsk (ϑ).
   8b. East Okhotsk (ϑ).
(9). VII. 5. West Mongolian. Sayans group of subprovinces.
   9a. Cis-Sayan (VII 5a, (ϵ).
   9b. Sayan (ϵ).
   9c. Trans-Sayan (VII 5c, ϵ).
(10). VII. 6. East Mongolian. Transbaikalian group of subprovinces.
   10a. Northern Transbaikalian (VII 6a, ξ).
   10b. Khentey (ξ).
   10c. Cis-Khentey (VII 6c, ξ).

III. European region (Fig. 6).
1. West European (mixed) (α).
2. Central European (mixed) (β).
3. East European (lowland) (γ).
4. Euxinian (mountain) (γ).

IV. Stenopaean (Manchurian-North Chinese-North Japanese) region (nemorose) (Fig. 6).
1. West Stenopaean (mixed) (ϑ).
2. Korean (mountain) (χ).
3. North Japanese (mountain) (χ).
4. Yellow Sea (lowland) (χ).

V. Hesperian (Mediterranean-Makaronesian) region (evergreen) (Figs. 7, 8).
VA. Makaronesian subregion.
1. Azores (mountain) (α).
2. Madeira (mountain) (α).
3. Canaries (mountain) (α).
VB. Mediterranean subregion.
4. Western Mediterranean (mixed).
   4a. Lusitanian (α).
   4b. Maroccan (α).
   4c. Iberian (β).
   4d. Latin (β).
   4e. Atlas-Bethian (β).
5. Eastern Mediterranean (mountain).
   5a. Aegean (β).
   5b. Levantine (β).

VI. Orthrian (Himalayan-South Chinese-South Japanese region) (evergreen) (Fig. 7).
VIA. West Orthrian subregion.
1. Himalayan (mountain).
   1a. West Himalyan (ϑ).
   1b. East Himalayan (ϑ).
2. Yunnan (mixed) (ϑ).
VIB. East Orthrian subregion.
3. South Chinese (mixed) (χ).
4. South Japanese (mountain) (χ).

VII. Scythian region (steppe) (Fig. 9).
VIIA. West Scythian subregion.
1. Pannonian (lowland) (III 2, β).
2. Black Sea (lowland).
   2a. Western Black Sea (γ).
   2b. Eastern Black Sea (γ).
3. Kazakhstan (lowland).
   3a. West Kazakhstan (ο).
   3b. East Kazakhstan (ο).
4. Altai (complex) (IIA).
   4a. Kuznets (VII 3, δ).
   4b. Russian Altai (II 5, (δ).
   4c. Kalbinskiy (δ).
   4d. Tarbagatay (δ).
VIIB. Scythian subregion.
5. West Mongolian (complex) (II. B).

5a. Cis-Sayan (II 9, ϵ).
(5b. Sayan) (ϵ).
5c. Trans-Sayan (II 9, ϵ).
5d. Mongolian-Altai (ϵ).
5e. Ubsinskiy (VIII 17, ϵ).
5f. Khara Usu (VIII 17, ϵ).
6. East Mongolian (complex) (II. B).
6a. North Transbaikalian (II 10, ζ).
(6b. Khentey) (ζ).
6c. Cis-Khentey (II 10, ζ).
6d. Khalkha (ζ).
6e. Barga (η).
6f. North Gobi (VIII 17 ζ).
7. Bunbey (mixed) (IV 1).
7a. West Dunbey ( ).
7b. East Dunbey ( ).
8. Ordos (lowland) (η).

VIII. Sethian (Saharan-Gobi) region (desert) (Figs. 9, 10).

VIIIA. Saharabian subregion.
1. Tekni (lowland) (α).
2. Sahara (lowland) (δ).
3. Syrian (lowland) (δ).
4. Sumerian (lowland) (δ).
5. Mekran (mixed) (δ).
6. Sind (lowland) ( ).

VIIIB. Iranian-Turanian subregion.
7. Levantine (mixed) (VB).
7a. Ankaran (γ).
7b. Armenian (γ).
7c. Zagros (γ).
8. Girkan (mountain) (VB. γ).
9. Iranian (mixed) (o).
10. Khurasan (mountain) (δ).
11. Afghan (mountain) (o).
12. Turkestan (mountain).
12a. North Turkestan (o).
12b. South Turkestan (o).
13. Kara-Aras (mixed) (δ).
14. South Turanian (lowland).
14a. Kumistan (δ).
14b. Fergana (o).
14c. Tadzhik (o).
15. North Turanian (lowland).
15a. Ciscaspian (δ).
15b. Cisaralian (δ).
15c. Cis-Balkhash (o).
15d. Zaisan (δ).
16. Alatau (mountain).
16a. Cis-Ili (δ).
16b. Trans-Ili (δ).

VIIIC. Central Asian subregion.
17. Gobi (lowland).
17a. Dzhungar (ϵ).
17b. Central Gobi (ζ).
17c. Alashan (ζ).
17d. Kashgar (ζ).
18. Inner Tien-Shan (mountain).
18a. Central Tien-Shan (ϵ).
18b. Eastern Tien-Shan (ϵ).
19. Pamirs (high mountain) (ϵ).
20. Tibetan (high mountain).
20a. Chanta (ζ).
20b. Sikan (η).
20c. Transhimalayan (η).
21. Nan Shan (mountain).
21a. Western Nan Shan (ζ).
21b. Eastern Nan Shan (η).

2. The terminology of belts (Table 1, Fig. 1). Only the most general division into belts is proposed, since the secondary belt boundaries duplicate zonal boundaries to a considerable extent and because there is still not the essential consensus of views on the position of belt boundaries, especially with regard to subdivisions. The correlation of belts with zones given is that of A. G. Isachenko (1971) with slight modifications, for example in Soviet Central Asia, where physical geographers (Murzayev, 1956; Isachenko, 1971) put the boundary of the belts between the northern and southern strips of the Southern Turanian of biogeographers. In the other instances the belt boundaries in the diagram of A. G. Isachenko coincide with zonal boundaries of higher rank. The correlation proposed by A. G. Isachenko between the finer belt divisions and zonal boundaries is evidently still in need of correction and in some instances possibly of reexamination. Thus, it seems not entirely correct to accord all steppes between the Black Sea steppes and the Mongolian steppes to the sub-Boreal belt. In the sharply continental sector steppe conditions are closer to the description of purely Boreal conditions.

3. The terminology of sectors (Table 2, Fig. 1). The sector boundaries given are those of A. G. Isachenko with the modifications referred to in the introductory part of the article (pp. [500-502]).

4. The terminology of provinces. This is based on biogeographic division. In order to simplify the names of ranges separate short names should be given to groups of provinces (superprovinces) within a sector or adjacent sectors distinguished by common features reflected in the ranges, for example the Altai-Sayans-Dahurian superprovince or the Afghan-Turkestanian-Inner Tien-Shan-Alatau superprovince, but it is very difficult to find acceptable names for them.

5. The basic principle of the compilation of names. A combined belt-sectoral and provincial principle is used for the naming and type classification of ranges. Only the most general characteristics of the extent of any range, those associated with the general zonal and belt differerntiation, are reflected in a purely belt-sectoral classification, while narrow ranges receive what is in general a very vague and inadequate description. Conversely, in a purely provincial classification it is the special characteristics of the provinces that are primarily reflected while the general features are overlooked if the range is large. In addition, when the provincial attribute is employed the names of extensive ranges become very cumbersome and difficult to master.

The combination of these two principles in a single system makes it possible to combine their merits and offset their defects. There is no organic defect in such a mixed approach, since one or more provinces correspond to the unit sector-belt division.

Belt-sectoral terminology is used for the widest ranges and for ranges of clear belt or sectoral extent that do not fit into a single region (i. e. that are not highly entire in a provincial respect). Provincial terminology is used for other instances, i. e. for ranges that do not extend beyond a single region, or that extend only slightly beyond its limits, including ranges lying in adjacent parts of different regions. A double terminology is permissible to give more accurate description of the extent of moderately wide ranges, as well as to clarify the general description of narrower ranges. If the names of two partly superimposed divisions are used to describe a range (not adjacent divisions that are superimposed only in the transitional strip), then it corresponds to their common part and not to the total; for example, the Atlantic-European range occupies the Atlantic sector only in the European region.

6. Additional typological characteristics of ranges. Since existence in the various mountain altitude belts is clearly reflected in the range, we should distinguish

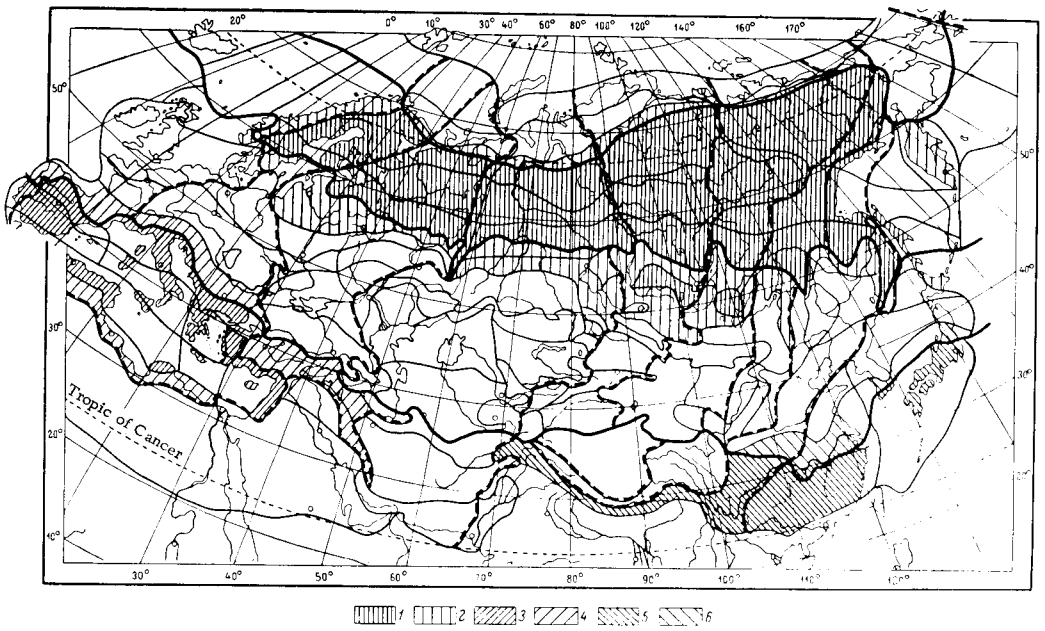

Fig. 7. Tayga and evergreen regions of the Palearctic.

Key: 1-2—Euro-Siberian tayga region. 1—main territories, 2—transitional to neighboring regions; 3-4—Hesperian evergreen region (incomplete, see also Fig. 8), 3—main territories. 4—transitional to neighboring regions; 5-6—Orthrian evergreen region. 5—main territories. 6—transitional to neighboring regions. Key to boundaries as in Fig. 5.

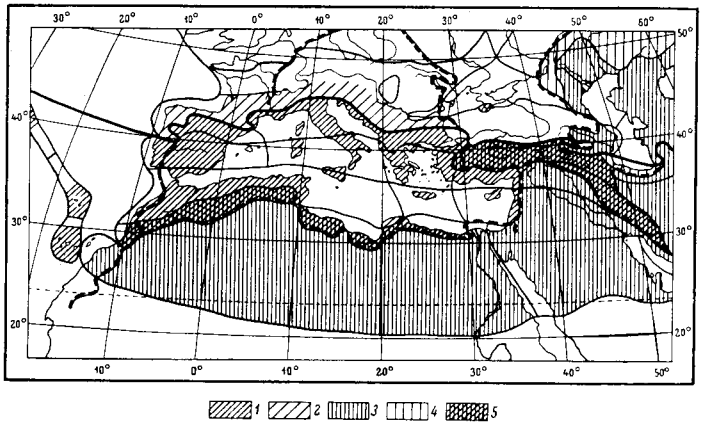

Fig. 8. Hesperian region and western part of Tethyan region.

Key: 1, 2 and 5—Hesperian evergreen region. 1—main territories, 2 and 5—transitional to other regions; 3, 4 and 5—Tethyan desert regions, 3—main territories, 4 and 5, transitional to other regions. Key to boundaries as in Fig. 5.

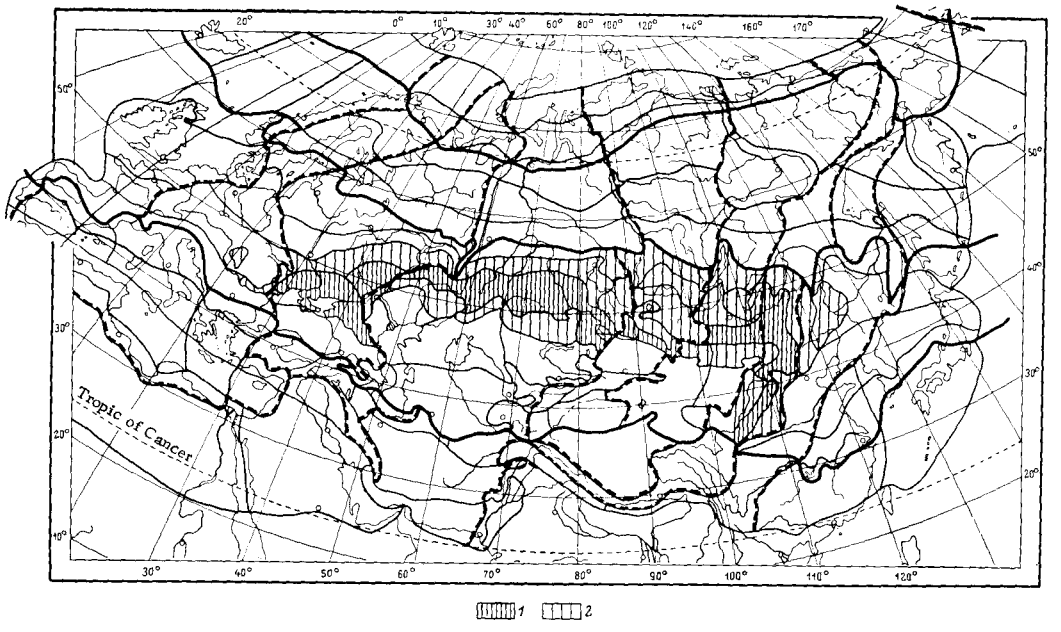

Fig. 9. Scythian steppe region.

Key: 1—Main territories; 2—transitional to neighboring regions. Key to boundaries as in Fig. 5.

lowland, mountain and mountain-lowland ranges. The ranges of species inhabiting the middle altitude belts of mountains and high mountains also differ considerably —the latter are confined to large and high mountain masses and they should be named after them, the more so because zonal and sectoral differences are evened out in high mountains.

In many instances lowland and mountain-lowland species of the same geographic belt or sector penetrate into another only along the mountains. We know that many Arctic species extend along high mountains to the subtropics and even further (Arctalpine species). Species of other northern belts and humid regions also extend into southern and more arid regions only along the mountains. Such species have territories of more or less continuous extent and a mosaic-island mountain territory. The epithet "mountain" should be applied to them and appended to those parts of the name of the type of range where they are found only in the mountains, for example: Arctic-mountain Boreal, or Mediterranean-mountain Iranian, etc.

We should possibly note Maritime coastal ranges, for example coastal European-Mediterranean and some other types.

Disjunctive ranges. The separate parts of disjunctive ranges are described in accordance with the general rules and accompanied by the epithet disjunctive or multi-disjunctive, etc. Mountain ranges are given similar prefixes only when the gaps are large.

7. Rules for the rounding off of ranges. The province is the unit of the extent of ranges, which are described schematically precise to major parts of a province or subprovince, down to 1/3-1/4 of a province in belt extent, one zonal strip in sectoral extent and exceptionally two 1st-order zonal strips (subzones).

Ranges bounded by a given region and by the transitional strips bordering it are named after the region with the addition of the prefix "broadly"; for example, the range of a broadly European species may extend into the forest-steppe, the subtayga and the north of the Mediterranean in sectors occupied by the European region.

If the range of a species occupies the greater part of some division (approximately one half) which does not have a name of its own or is not regarded as a subdivision, the epithet southern, western etc., characterizing the part occupied, is added to the name of such a division in the name of the range. The names of provinces and other divisions in which a species is found only in a peripheral transitional belt adjacent to its main range are ommitted from the name of the range.

Cruder generalization is carried out in the formal description of poorly investigated ranges by comparison with other better investigated ones and gaps within the range or along its edges are filled by interpolation if there are no general theoretical arguments against this or if there are arguments for it.

The degree of detail in the analysis of ranges must correspond to the task as formulated, as well as to the extent of the areas. Detailed description of a range is not always necessary and must not be an end in itself.

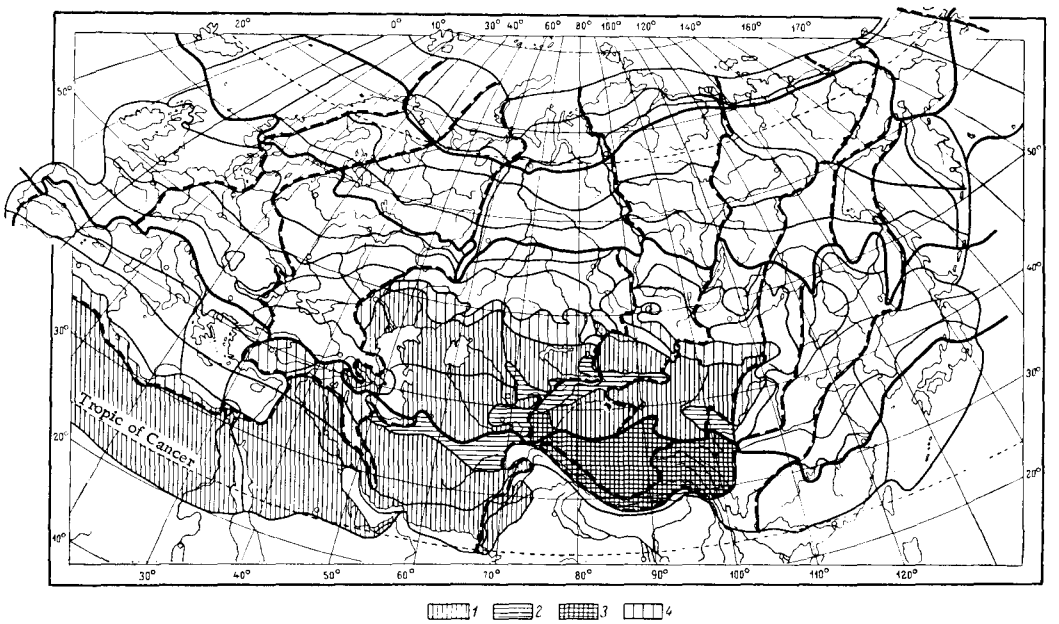

Fig. 10. Sethian desert region (excluding the westernmost part —see also Fig. 8).

Key: 1-3—Main territories, 1—lowland, 2—mountain, 3—high mountain; 4—territories transitional to neighboring regions. Key to boundaries as in Fig. 5.

LIST OF THE MAIN TYPES OF RANGES

1. Wide ranges. These ranges, which cover zoogeographically dissimilar territories belonging to at least two sectors within a single region, are coextensive with the region or larger than it. The expressions "wide" and "narrow" range should be used in a biogeographic context, i. e. in relation to the biogeographic subdivisions occupied by the range rather than to area in square kilometers; these two characteristics do not completely coincide.

We give below a list of the types of ranges from the widest to the narrowest by zonal and belt divisions, subdividing the belts into sectors, i. e. in conformity with the general significance of belt and sectoral differentiation, but the classification is not itself homogenus and permits of different means of codifying the enumeration of ranges by types.

In a definite limited sense the proposed system of naming ranges is more universal than its object—many types of ranges, the names of which may be made up from the outline do not exist in nature.

The large provincial ranges— Tethyan and Hyadean —are provisionally equated to zonal-belt ranges, since zonal-belt features predominate over sectoral features in them.

I. Wide ranges.

Ia. The widest.

1. Palearctic: general (pan- Palearctic), western Palearctic, eastern Palearctic; all sectoral ranges extending from the Arctic to the subtropics if such exist in nature.

2. Hyadean (generally humid): general, western, eastern and large sectoral combinations necessarily including the whole of some oceanic sector plus several others: Eury- Atlantic- Hyadean, pan- Atlantic- Hyadean, super- Atlantic- Hyadean, eury- Pacific- Hyadean, pan- Pacific- Hyadean, super- Pacific- Hyadean.

3. North Palearctic: general, western, eastern; sectoral division and their combinations within the belt.

4. South Palearctic: general, western, eastern; sectoral divisions and their combinations within the belt.

5. Tethyan (generally arid): general, western, eastern. Lesser sectoral divisions are based on the provincial nomenclature (see below in the sub- Boreal and subtropical group of types of ranges for other Tethyan divisions).

1b. Belt ranges.

6. Arctic: Arcto- Palearctic. Lesser subdivisions are based on provincial nomenclature.

7. Arctoboreal: general, western, eastern; combinations of sectoral divisions within the belt. Narrowly sectoral divisions are based on provincial nomenclature.

Table 1

Belt terminology

	Belts			
	Arctic A	Euboreal B	Sub-Boreal Γ	Subtropical Δ
Combinations of belts	Extratropical			
		Boreal-subtropical		
	Arctoboreal		Southern	
	Northern			
		Boreal		

Table 2

Sectoral terminology

	Sectors and subsectors									
	Eastern Atlantic	Western transitional		western continental	sharply continental			eastern transitional		Western Pacific
		eastern sub-Atlantic	western subcontinental	western Eucontinental	western sharply continental	eastern sharply continental	eastern eucontinental	(eastern subcontinental)	(western sub-Pacific)	
	α	β	γ	δ	ε	ζ	η	θ (θ + ι)		κ
Sectoral combinations		Pancontinental								
		Western pancontinental			Eastern pancontinental					
	Eury-Atlantic	Eurycontinental								Eury-Pacific
		Western eurycontinental			Eastern eurycontinental					
	Pan-Atlantic	Continental								Pan-Pacific
		western continental			Eastern continental					
	(Western)	Sharply continental								(Eucontinental Pacific)
	Super-Atlantic									Super-Pacific
	Western	Eastern								

8. Boreal: general, western, eastern, boreal-western Hyadean, boreal-eastern Hyadean; sectoral divisions and their combinations within the belt.

9. Boreal-subtropical: general, western, eastern; sectoral divisions and their combinations.

10. Subboreal: general, western, eastern, subboreal-Hyadean, north Tethyan. Lesser subdivisions are based on provincial nomenclature.

11. Subtropical: general, western, eastern, south Tethyan. Lesser subdivisions are based on provincial nomenclature.

Ic and II. Moderately wide and narrow ranges.

Moderately wide ranges do not extend beyond two adjacent regions (very occasionally three, when they have a common junction). Names are based on provincial nomenclature.

The names of moderately wide and narrow ranges are made up from the names of the largest combinations of divisions which they occupy wholely or almost wholely, such as provinces, regions, superprovinces, subprovinces etc. The sequence of enumeration of the names of combinations in compound names of ranges is based on contiguity, from west to east and from north to south.

The classification or ranges provides only general guidance concerning the distribution of organisms, their relationship to natural conditions and through this to some extent the history of their formation.

No more can be demanded from the classification of ranges than it is capable of providing. Thus, there is an opinion that there should be as many classifications of ranges as there are particular problems concerned with the analysis of ranges, and that no general classification can be created, since there are no two completely identical ranges, and one is not needed, since it is incapable of solving a number of problems arising in the analysis of ranges (Tolmachev, 1962). Such an approach attempts to use the particular differences of distribution, on which all the attention is centered, to obscure and deny the common and regularly repeated features found in the distribution of different species and groups, which are clearly reflected in biogeographic divisions, the elements of which are known to be characterized by a definite uniformity of population, while the boundaries of the divisions are characterized by the greatest changes in this uniformity, i. e. are places where the boundaries of ranges are densest.

Classifications of ranges do not replace and cannot substitute for detailed analysis of ranges for any purposes, but are the basis for it.

SUMMARY

We propose a system of the classification of ranges based on combined biogeographic regional division compiled from many sources. An attempt is made to bring together the belt-sectoral and provincial approaches—each unit in the sectoral-belt network corresponds to one or more provinces or subprovinces. A category of transitional provinces and subprovinces with dual subordination is distinguished at the boundaries of different regions; this makes possible a more flexible reflection of the nature of natural changes in the classification. Transitional divisions at the boundary of a range are not taken into consideration in the schematic representation of ranges. A system for the naming of divisions and their combination for the naming of ranges is proposed. A number of short names are proposed for major divisions—subkingdoms, regions and provinces. The Palearctic is treated as a kingdom or subkingdom in which 8 regions are distinguished, corresponding to the areas of the main zones.

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