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H. K. Bhowmik

Zoological Survey of India

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INTRODUCTION

Grasshopper species abundance is correlated with the plant communities on which they depend and is linked to the climatic, physiographic, edaphic and biotic factors which control the plant distribution (Champion 1938 and Fig. 3). For this reason the grasshoppers of India can be divided among *six* biogeographical faunas, broadly corresponding to major floral zones. Historically, Hooker (1833 and 1907) recognised *nine* phytogeographical regions, of which six belong to present day India (Fig. 1). Clark (1898) basing his classification on the Cyperaceae created 8 regions including Nepal (central Himalayas) and Assam extra to Hooker's system, while he introduced terms such as "India Deserta" for the Indus plain and "Coromandalia" for the Decan region. Calder (1937) divided India into *six* regions including Sikkim and Upper Assam into his Eastern Himalayan region and refining the system with three altitudinal zones (trophical ; temperate ; alpine). "Coromandal" was introduced by him as a botanical sub-province referring to land between the Eastern Ghats and the sea coast. Chatterjee (1939) divided India into eight regions (Fig. 2) creating a new region for Nepal, recognising Assam (Clarke op. cit.) but omitting the Coromandel sub-province of Calder (op. cit.). Chatterjee (1960) upgraded his system to exclude Pakistan and Bangladesh, but maintained *eight* botanical regions.

In this study I recognise six biogeographical regions within the confines of modern India. These are—the Eastern Himalayas (E.H.) ; the Western Himalayas (W.H.) ; the Indus plain or Indian desert (I.D.) ; the Gangetic plain (G.P.) ; the Malabar (M.) and deccan Plateau (D.) (Fig. 4). The available collections from the Assam—Himalayan Hills (Khasi, Jayanti, Garo, etc.) do not justify full regional status for this area, though subregional status could be granted. For each biogeographical region, its boundary, brief characteristic ecological factors like vegetation, etc. are given in short (Figs. 1-4). Here I have tried to link grasshopper biogeography to the phytogeographical regions of India, across as broad a spectrum of grasshopper taxa as possible. Status of grasshopper fauna, its endemic and non-endemic taxa both at generic and species levels and their intraregional and extra-territorial relations, are discussed and analysed.

ACRIDIDAE OF DIFFERENT BIO-GEOGRAPHICAL REGIONS

The Eastern Himalayan Region (E.H.)

The eastern Himalayas include Darjeeling and Jalpaiguri districts of West Bengal, Sikkim, Bhutan and regions extending to Mishmi Hills in Upper Assam and the Assam-Himalayan Hills. This region is bounded on the north by Tibet and on the South by Bengal and Lower Assam.

Climatically this region is distinguished from the Western Himalayas by higher rainfall (400-600 mm), scanty snowfall chiefly restricted to alpine zone, higher humidity and temperature (35-40°C during April, and not below 5°C in winter in average). Sikkim is the most humid region. Four altitudinal zones are recognized, (i) tropical, (ii) sub-tropical, (iii) temperate and (iv) alpine. The tropical zone is mainly composed of *Shorea robusta* or "sal" forests with patches of riverine mixed deciduous forests, savannas and swamps. The temperate zones of Sikkim are divided into upper and lower zones ; the upper zone is rich in conifers and bamboos, while the Alpine zone is composed of *Rhododendron* and *Juniperus* species.

Different forest types are met with in this region. Rain green deciduous forest—this forest is found in tropical and sub-tropical zones covering the northern fringe of West Bengal and the foothills of Himalayas up-to 700—900 m. This type of forest is uniquely dominated by *Shorea robusta*, *Tectona grandis*, many shrubs and herbs, trees forming canopy, lianes, etc. Mixed broad leaved foresr-sub-tropical mixed broad leaved forests occurs to an altitude of 1500-1700 m. Evergreen oak forest—this is a temperate forest composed of evergreen oaks and lauraceous species, occurring in middle elevation between 2500-2800 m. *Rhododendron*—conifer forest (Alpine forest)—this forest is found above 2,500 m. and continues to the timber line, and is locally replaced by a coniferous forest in some places (at 4,000 m. altitude). As an individual tree *R. arboreum* occurs at an altitude of 1200 m. in a mixed broad-leaved forest.

The coniferous forest is composed of two species only—*Abies spectabilis* (in upper altitude—above 3100 m.) and *Tsuga domosa* (at a lower altitude) ; these two species occur in association with *Rhododendron* to from the secondary layer in the forest. Alpine scrub and meadow—the *Rhododendron* forest marks the timber line at an altitude of 4000 m. and then up to 5000 m. the forest is occupied by alpine meadow with prostrate *Juniperus squamata* and low bushes of *Rhododendron* spp.

Temperate deciduous forest is confined to small patches on northern or eastern slope in the evergreen oak and the *Rhododendron* forest zone. Grassland—a grassy community is found on the south faced steep rocky slope at Siling Tzokupa (3800 m. alt.).

This forest region differs from that in the western Himalayas by the occurrence of fewer broad leaved forests and conifers and an abundance of *Rhododendron* spp. (Ericaceae). Another important feature of the vegetation is that the tropical species ascend far into temperate and the temperate descends into tropical altitudinal zones.

The eastern Himalayas as a whole chifly shows affinity with Sino-Himalayan region (constituting eastern and northern portion of the great Tibetan Plateau), Burma and Japan.

Except plantation of Tea and some fruit orchards like Orange, there is hardly any agriculture of worth mentioning.

The Acridid fauna is characterized by a number of strictly endemic genera and species as well as by Japanese, Chinese and Indo-Chinese, Burmese and Malaysian region elements from the East, Western Himalayan, Pakistani, Afganisthani, Central Asia, African and a few Palaearctic elements from the West, with a few species of Indian desertic, Malabarian, Gangetic and Deccan plateau origin from the south or south-western side.

Of the total 42 genera of grasshoppers in this region, 10 are endemic, 24%, including 75 species, 29 are endemic, 39% (table 2). Eight endemic genera are monotypic and out of which seven are soley restricted to the region (table 3). The genus *Chondronotulus*, though a monotypic genus, is also now know from Malabar and Deccan regions ; showing that it is quite widely distributed in India. Both the genera *Hygracris* and *Eupreponotus* have two species in each, the former described from the Gangetic plain has now a second spp known from Malabar ; similarly one species of the latter genus is, so far restricted to this region and G.P., while the W.H. is represented by another distinct species.

The region is fairly rich in endemism of its species component, occupying 4th position in this respect. Out of 29 endemic species, 17 species are strictly indigenous to this region ; only 12 species show affinity with other biogeographical regions. Of these 12 endemic spp , six spp. share distribution with W H., eight spp. with G.P., two spp. with I.D., four spp with D. and three spp. with M. (Table-3).

The importance of cosmopolitan sp. is that they not only have interesting intra regional distribution pattern, but demonstrate relations with foreign elements. Leaving aside the 12 widely distributed spp. (Table-4) which are common in all 6 regions, the remainders are distributed as follows—10 in common with W.H, four species with I.D., 17 spp. with G.P., seven spp. with M. and 18 spp. with D. and following eight spp. are unique to the region :- *Gastrimargus marmoratus, Hieroglyphus concolor, Oxya diminuta, Assamacris striatus, Cingalia dubia, Coptacridia dorsalis, Xenocatantops brachycerus* and *Patanga (Patanga) japonica.*

Quite a large number of 'wides' species of this region show strong resemblance with that of Burma and China, specially southern China, on account of their geographic proximity ; 17 Burmese spp. and 16 Chinese spp. are represented here (Table 4). Of these, *Ceracris nigricornis nigricornis* which show affinity to Burmese fauna through central Himalayas is rarher common to W.H. and G.P. Similarly *Assamacris striata*, a unique monotypic genus, is described from and solely restricted to Assam and Burma. The monotypic genus *Coptacridia dorsalis* is known from material described from Sikkim and China ; likewise *Xenocatantops brachycercus* is only known from China and Taiwan, other than beyond the limit of this region. *Diabolocatontops pinguis* is restricted to this region and China. In addition to this, one spp. of Indo-Chinese origin and two spp. of Tibetian origin occur here. The Malaysian element, to the contrary, as normally one would think, is weakly represented here ; only nine widely distributed spp. are represented here. On the other hand, Japan has a comparatively good representation to the region (Six spp. of which *G. punctifrons* is common to G.P. is the only spp. restricted to Japan and to this region). The floral distributional pattern and affinity of eastern Himalayas correlates with that of the affinity of grasshoppers of this region. The Himalayan flora, specially of its temperate and alpine genera, bear a strong likeness to the floral elements of South China and North and north eastern slopes of Tibet (not real Tibetan plateau), and to Japanese, Burmese and Malayan regions.

Sri Lanka, though distant, both geographically and geologically from E.H , have a sizeable component of its fauna in common to this region, 16 spp. of which *A. exaltata, P. cinctifemur, O. obtusa, T pulvinata, H. pulcher* are important and a number of common spp. that are more or less common to other parts of india as well as other foreign countries ; only the genus *Cingalia*, a truly Sri Lankan genus, with one spp. *C. dubia*, has a distribution restricted to these regions.

The palaearctic region, including Afganistan, Pakistan, Central Asia, has a good representation in the region, second perhaps to W.H. Out of 23 spp., 10 Pakistani, five Afganistani, four Central Asian and four palaearctic spp. are known here. These spp. have migrated to the region through western and Central Himalayan ranges. The representatives of the genera *Acrida*, *Phlaeoba (panteli)*, *Aiolopus*, *Chloebora*, *Sphingonotus (longipennis)*, *Eyprepocnemis (alacris alacris)*, *Shirakiacris*, *Patanga (Patanga) (japonica)* share in common with Palaearctic elements in addition to some common and widely distributed spp., but as we will see later, while discussing western Himalayan fauna, that many of the prominent and interesting palaearctic elements present in W.H. are totally lacking here.

Four widely distributed spp such as *Aiolopus simulatris simulatris*, *Gastrimargus africanus africunus*, *Sphingonotus longepennis*, mostly a palaearctic and Central Asian desert fauna found also in W.H. and G.P. regions, and *Oxya hyla hyla* are in common with African fauna.

The study and analysis of endemic spp. specially those belonging to non-endemic genera show further link of grasshoppers of this region to foreign faunae. The genus *Holopercna* with two endemic spp. in India, is truly a predominantly congolese and north equatorial genus. Likewise the genus *Hieroghyphodes* represented by one spp. each in E.H. and Africa ; the genus *Catantops* with the inclusion of a single endemic spp., *C. erubescens* after the revision of the genus by Jago, 1984, is mostly an African genus with distribution in Oriental and Australian countries. The genus *Chondracris*. known from China, Java, Malaya & Africa, is poorly represented in Indian fauna by a single non endemic spp. *C. rosea*, and fairly distributed over to E.H./W.H./G.P./D. regions.

Next to African genera, the Oriental genera have good representation in the fauna of this region. The genus *Eucoptacra*, with two species of which *S. saturata* is an indigenous one, is purely a Burmese and Chinese representation. The genus *Traulia*, presented by only three endemic spp. in Indian domain, is mostly a Malayasian genus, though it is also known from Indonesia and Taiwan. *Circocephala* with only one spp. recorded from Darjeeling-Himalayas is a Javanese genus. The genus *Alectorolophus* with a doubtful species, *A. bimaculatus*, mostly a remnant of Celebian genus, while the genus *Gerenia*, having three endemic spp. only in India, is again a Burmese, Malayan and Australian element. Another oriental genus, *Phlaeoba*, is represented with eight spp. of which

five spp. are endemic to Indian domain and having *P. assama* and *P. sikkimensis*, restricted to this region. The genus *Eyprepocnemis*, spread over the entire old world, with two wides and three endemics, is represented here by the widely distributed endemic spp., *E. rosea* (also W.H./G.P./D.).

Two cosmopolitan genera *Dnopherula* with 11 species, of which eight are endemic to India and with representation of *D. (A) physopoda* and *D. (A) rubripes*, and the genus *Oxya*, having eight spp. of which two are endemic to India and with the inclusion of *O. parvicina* strictly in the region, are well distributed.

The Palaearctic elements represented by the old world—and cosmopolitan genera, are, however, slightly represented.

The Indian genera, *Pusana*, with two spp. (although *P. rugulosa* described from G.P. is now recorded from Afganistan (Cejhan, 1969), *Parahieroglyphus*, *Hygracris* and *Eupreponotus*, each with two endemic spp., and *Peripolus*, also with two endemic spp. of which one is restricted to Nepal, are well represented in the zone. The absence of any Sri Lankan genus of prominance is significant.

To summarise, the acridid fauna of E.H. biogeographical region reveals high percentage of endemism both in generic (24%) and specific (39%) levels. It proves beyond doubt that the region has a fauna of its own. Region-wise G.P. region shows more close ties with the endemic species of this region. As regards 'wides', the W.H. shows more closeness ; eight spp. are unique. As regards alien influence as evidenced by 'wides', the palaearctic region as a whole, and China, Burma and Sri Lanka are almost on equal footings, while Malaysian and African influence is insignificant. Genera with endemic spp., except the indigenous ones, show strong affinities to African and Oriental regions, while the Palaearctic influence not sufficient but interesting. Sri Lankan influence is almost negligible. Indian genera are, however, well represented.

The Western Himalayas (W.H.)

The western Himalayas include all the hilly areas ranging from Kumaon (U.P.) to Kashmir and also western part of Tibet which extends from the Indus to the region of the holy lake Manasarobar and Rakastat (Fig. 4). The main Himalayas are divisible into three more or less parallel ranges, namely, outer (the lowest), middle and inner (the highest).

Climatically this region is dry and cool, strong wind usually blows in the afternoon. The minimum temperature is exceedingly low, in many places, even in summer, water freezes at night ; in winter, the temperature falls below 0°C. The rainfall including winter snowfall in the Chandrabhaga vallcy is 15°2 cm while in the Ravi valley and at Nagar at Kulu in similar situation is 121°5 cm. In outer Himalayas (Siwalik ranges) is somewhat between 126°C—253.0 cm. Snowfall is of universal occurance during winter.

The vegetation of the western Himalayas is distributed in three altitudinal zones viz , (i) tropical and sub-tropical (up to 1500 m.), (ii) temperate (2000-3500 m.) and alpine (from 4000 m. to the level just below snow line). The southern slope or Indian side, is provided with luxuriant forests with all the usual accomplishments of other forms of vegetation, whereas the northern slope, is practically a barren desert. The luxuriance of vegetation on Indian side gradually decreases from the East to the West.

The vegetation of the western Himalayas differs chiefly from the eastern Himalayas by large percentage of broad leaved forests and conifers and less abundance of *Rhododendron* spp. Dry temperate formation is more, wet temperate is absent (where as in the Eastern Himalayas the condition is reverse).

In outer Himalayas at low levels rich undergrowth of herbs is noteworthy in eastern part while towards the western end this undergrowth becomes less luxuriant—epiphytic orchids, epiphylic ferns are in abundance while at Mussourie and Simla terrestrial orchids and ferns are found instead of epiphytic types. In Alpine zone, the vegetation is mainly glassland, extending to the snow-line, and mixed with many herbs with beautiful flowers.

Once across the Himalayas the vegetation is changed entirely. Trees are absent except a few willows and poplars. In Ladak, a cold desert, stunted trees of *Juniperus religiosa* occur. Besides a number of shrubby plants with cushion like habit occur.

Except valleys there is little organized agriculture of worth mentioning.

Although the grasshopper fauna of western Himalayas has a fauna of its own, it admits an admixture of foreign elements. Specially prominant are the African and Palaearctic elements. The fauna is

comprised of 28 genera and 59 spp. of which six genera and 25 spp. are endemic, with a tune of 21% and 42% endemism respectively (Table 2). Out of six endemic genera, only *Dicranophyma*, a brachypterous genus, having two spp, both localized in the region, is unique; other genera share their representatives with other regions (Table 2).

The region is very rich in its endemic spp. faunal composition, in rank order of endemicity the region takes second place. The extremely rugged conditions of climate and topography, with varied eco-systems, have favoured the growth and speciation of grasshoppers. Of the total 25 endemic spp., 14 are strictly indigenous in distribution; only 11 spp. described elsewhere is recorded from here or vice verse (Table 3). Region-wise, six of these spp. show resemblance with E.H. and G.P., three spp. with I.D., only one spp. *(Para. bilineatus)* to M., and four spp. with D. (Table 3).

The 'wides' of the western Himalayas (leaving aside the common 12 spp.) show maximum relationship (10 spp.) to E H. and minimum (three spp.) to M. (Table 4). The G.P. region shows next minimum (nine spp.) affinity—indicating that movement or migration of grass-hoppers might have occurred from W.H. to E.H., through Central Himalayas and then to eastern part of G.P. or vice versa. The I.D. shows resemblance with four spp., though it is the most closest region, while the D. region have six spp. in common with. Following seven spp. are unique to this region particularly as they are found only here within Indian boundry:- *Chorthippus (Chorthippus) indus, C. (C.) almoranus, C. (Glyptobothrus) hammerstroemi, Gastrimargus africanus sulphureus, Oedaleus rosescens, Pseudosphingonotus savignyi, Sphingonotus kashmirensis.*

The impact of foreign influence over the grasshopper fauna of this region is more pronounced. The palaearctic elements taken together are very remarkable here. Of the 31 spp, 13 spp. belong to Pakistan, six to Afganistan and four to middle East and eight to Armenian Palaearctic. Most of the Pakistani spp. described are likely to have representation in western Himalayan fauna; *C. (C.) indus, G. africanus sulphureus* (which is also known from Nepal), and the *Oedaleus rosescens*, latter two spp. belonging largely to African genera, have restricted distribution to this region and Pakistan. Other spp. of importance are *Chloebora grossa* of a genus with occurrence in Africa, Pakistan, Burma and Sri Lanka, also known in E.H. and I.D. *Heteracris nobilis*, with generic distribution to Palaearctic, African, Central Asiatic countries

with Pakistan and Sri Lanka, is described from Pakistan (Punjab) and recorded from W.H. *Sphingonotus kashmirensis*, again a representative of a prominent and well developed palaearctic genus, is restricted to Kashmir and Afganistan. *C.* (*Glyptobothrus*) *hammerstroemi*, a representative of the cosmopolitan but mostly a palaearctic genus, is found in the region. Another two spp. of palaearctic affinity are *Pseudosphingonotus savignyi*, a rare spp. and *Xenocatantops karnyi.*

The African influence is almost same as that of eastern Himalayan fauna. A few spp. are distributed along with other regions and countries. *Aiolopus t. thalassinus*, also reported from I.D., is extended to Africa, westwards to Palaearctic ; *O. senegalensis* (also known from D.) is recorded from N. Africa, Eremian Palaearctic and Pakistan ; *Sphingonotus longipennis* and *S. rubescens rubescens*, members of mostly a Palaearctic and Central Asiatic desert fauna, are known from Africa and other palaearctic countries.

Compared with that of E.H., the numerical strength of oriental components in the region is almost half. Seven spp. of Burma, six spp of S. China, one spp. of Indo-China, four spp. of Malaya, eight spp. ot Sri Lanka and one spp. of Tibet and three spp. of Japan have members common with W.H.

The African affinity is well represented here by the endemic spp., which is rather very strong and close, compared with eastern Himalayan region. The genera, *Holopercna* and the unique genus *Orthochtha* of western Africa is represented by a single spp., *O. indica*, distributed in this region as well as in the G.P., the genera *Caloptenopsis*, is by a single sub spp., *C. glaucopsis liturifer* ; *Cataloipus*, by the spp. *C. himalayensis* (also known from I.D.) and *Cryptocatantops simlae*, mostly a member of the African genus with only one oriental species, are restricted to this region.

In addition to these, the endemic spp. *Chorthippus* (*C.*) *almoranus*, *Oedipoda himalayana* and *Eyprepocnemis rosea* all of them having good representation in Africa and Palaearctic regions, are available here. The genus *Diabolocatantops*, with *D sukhadae*, is a member of the genus dominantly found in Africa as well as in Central Asia, China and Sri Lanka.

The species *Anaptygus rectus*, 2nd species of the genus, of westeren Chinese, is described from the Garhwal hills. *Sphingonotus fallex* and *S. kashmirensis*, members of palaearctic and central Asiatic desert fauna, are unique to the region. The most outstanding alpine fauna of Central Asian elements, though originally a modified tropical, winged genus of India, are exhibited by the three endemic spp. of *Conophma*, all solely restricted to identical alpine environment of the region and totally lacking in similar habitat in E.H.

The oriental region having its influence in endemic genera or spp. of this region is very noticeably insignificant.

Besides the members of the genus *Diabolocatantops*, the genus *Xenocatantops*, spread over entire Oriental countries, Africa. S. Tibet and Australia, with *X. jagabandhui* Bhowmik, 1985, and the genus *Chondracris*, represented by *C. rosea*, there are no other representation of Sri Lanka or other oriental fauna, other than the Indian genera. The Indian genera include *Pusana*, *Pelecinotus*, *Parahieroglyphus*, and the unique genus *Dicranophyma*.

The western Chinese and Tibetan influence over the fauna of this region, though one might have thought to the contrary, due to their physical closeness, is very poor except in a few cases of winged forms (viz. *Bryodema* spp.). The lofty mountaneous ranges of the north and the barren plateau of Tibet might be the reason, being functioning as natural barrier to grasshopper migration to either sides.

To conclude, the grasshopper fauna of the western Himalayas shows higher percentage of endemisim (42%) in species, although in generic level, it is less (21%) than compared with the eastern Himalayas. This is perhaps the region being in close proximity to Pamir and Armenian chains which had permitted Central Asiatic, Palaearctic and African "intruders" to the region. Regarding 'wides', the highest number, show affinity with the Palaearctic regions' faunae, four to five spp. of more or less widely distributed spp. resemble with African fauna. Oriental fauna unitedly count to 26 species, which is almost half of oriental faunal components of E.H. Only one spp. from Tibet and three spp. from Japan are known. The endemic spp. project, however, a different picture. The African influence is remarkable and numerous ;

palaearctic elements are 2nd to Afrfcan ones but of extreme interest and importance. The oriental influence is poor and unimpressive, while Chinese and Tibetan ones are very poor on account of lack of accessibility to either side of the lofty Himalayan ranges. The distribution pattern points out that the Indian Desertic region acts as a natural barrier as per as W.H. grasshopper are concerned (for which there are minimum common fauna to them and southwards to M. region) and this necessarily implies grasshopper migration route from here to E.H, to G.P. and then to D.

The Indus Plain or Indian Desert (I. D.)

The Indus Plain covers Punjab, Haryana, Himachal Pradesh and Rajasthan lying to the West of Aravalli mountain and the Jumma, Cutch and northern Gujarat. The region can be divided into three divisions depending on climatic factors— (i) Jaisalmir, Jodhpur and Bikaner in the West comprising about 65,000 sq. miles, with an average rainfall of 250 mm. per annum—true desert zone, (ii) other states lying towards East such as Kotch, Ajmer, Dholpur etc. up-to Aravalli and covering Cutch etc. are semi—arid zone having an annual rainfall of 400—600 mm. per annum (iii) and the humid zone covering lower parts of Punjab, Haryana and Himachal Pradesh (below Siwalik ranges) with still higher annual rainfall.

The atmosphere of the desert is very dry, the annual rainfall is sometimes below 220 mm.; there are extreme variations between the seasonal as well as day and night temperatures; in June, the day temperature may reach about 40-46°C while night temperature records 0° to -2 or -3°C. The nature of soil is variable, it may be sand and dunes, solid rock or stone, and gravel.

Indus Plain vegetation exhibits three distinct formation eg. Sand community, gravel community and rock community in the desert and the arid zones while in the humid zone and also in Chittor tropical dry deciduous forest and tropical thorn forests are met with (Fig. 3).

The main characteristic of Indus plain vegetation is that it is adapted to semi-desertic conditions. Shrubby vegetation largely takes the place of trees (trees are very few, they are dwarf and have guarted looks). In rock community (greater portion of Jaisalmir and Jodhpur) the most important feature is the presence of ephemeral heterogeneous herbs which after a shower suddenly burst forth into

blossoms and complete their life cycle including flowering and fruiting in less than a month—these are flora depending directly on rain, Another ecological type is—flora depending on underground water, having perennial plants with long root system. Another important feature of Rajasthan desert vegetation is that it represents all four types of xerophytic plants viz., draught escaping, draught evading, draught resisting and draught enduring.

In the humid zone argiculture is well organized. Rice, wheat, Sugar cane etc. are cultivated. In semi-arid zone, with the h p of irrigation wheat, maize etc. are cultivated. Remaining portion of Rajasthan which has been converted into desertic condition about 300-400 years ago, with no appreciable agriculture.

The Indian Desert vegetation consists of Indo Malayan as well as Perso-Arabia and African elements. The acridid fauna of it, though poorest in the whole of Indian region, reflects more or less the same foreign influence like that of its floral components. There is only one monotypic genus (5% endemism) unique to the region and a total of 31 species of which eight are endemic spp. (26% endemism) (Table 2, 3).

The region is lowest in its endemie spp. composition. The tough desertic conditions associated with abrupt daily and seasonal fluctuation in temperature, scanty rainfall which means lower moisture contents of soil, lowest perhaps required for and lack of luxuriant undergrowth, readily available for the growing nymphs, naturally hinder the population formation and speciation of grasshoppers. These account for the insignificant growth of endemic genus, in the true desert and arid zones, only one monotypic genus *Indomerus* is described from here.

The humid zone of Punjab, Haryana and Himachal Pradesh is, however, rich, both in endemic and non-endemic spp. complexes, and indeed most of the Indian Desert Fauna is described or recorded from here. Of the eight endemic spp., four are indigenour to I.D. (Table 3) of which *Azarea indica* (from Punjab) and *Brachycrotaphus hosiarpuren—sis* (Punjab) are described from this humid zone ; whereas, other two indigenous spp., *Indomerus noxius* (Tej Ajmere) and *Eyprepocnemis bhadurii* from desert zone (though the latter is erroneously recorded in original description to be from Assam). Other four endemic spp , eg., *Parahieroglyphus bilineatus* (widely distributed in India except D.) is

known from Pinjore, Kalka (Haryana) within this zone ; *Pusana laevis* (also extended to rest of India except Peninsular India) is recorded from Hoshiarpore, Punjab) ; *Cataloipus indicus* (also recorded from G.P) from Jaypur and *C. himalayensis* (also from W.H.) are recorded from Pinjore, Hoshiarpur within the region. Region-wise, three of these spp. show resemblance with W.H. and G P., two with E.H. and only one with M. and none with D.

The number of 'wides' to the region is 23, including the 12 common ones. Of these, not to take into account the common ones, four spp. show commonness to E.H./W.H., three spp. to G.P. and two spp each to M. and D. This region is unique having *Truxalis grandis fitzgeraidi*, *Ochrilidia geniculata* and *O. gracilis gracilis*, *Eyprepocnemis alacris impicta* and the most notorius *Schistocerca gregaria.*

The analysis of distributional pattern of non-endemic spp. reveals maximum affinity with Palaerctic countries. Of these *T g. fitzgeraldis* is restricted to this region and arabia, while *C. gross*, *H. oryzivorus*, *H. nobilus* (also from W.H.), are restricted to here and Pakistan. The species *O. geniculata* and *O. gracilis grecilis*, *E a. impicta*, *S. gregaria* etc. are the representatives of Central Asian and Palaearctic countries which share distribution with Africa also. In total 17 spp. of this region show affinity with Palaearctic fauna. African affinity is exhibited by eight spp. only.

The oriental influence though less than that of Palaearctic countries, is not insufficient. At least saven spp. of Burmese, two spp. of Chinese, three spp. of Malayan, six spp. of Sri Lankan and one spp. of Japanese elements are present here.

The endemic spp. of the region present a quite different picture. Here African influence is predominant and palaearctic influence, except in one species from the Central Asia, is almost lacking. The members of the genera *Azarea*, *Brachycrotaphus* (also from Mediterrain region) and *Cataloipus* are mostly and largely African ones ; whereas the genus *Eyprepoenemis* with a wide range of distribution, is exhibited by a single species *E. bhadurii.* The oriental region as a whole, except three spp belonging to three Indian genera, one each of *Pusana*, *Parahieroglyhus* and *Indomerus*, remains totally unrepresented.

To summarise, the Indian Desert region is very poor in its acridid fauna owing to tough semi arid ecological conditions etc. But

the region shows, in keeping with its floral affinity, maximum affinito to African fauna, in respect to endemic spp., though occupies 2nd position in regard to 'wides'. The Central Asian and Palaearctic influence is remarkable specially on in its non-endemic spp. composition.

The Indo-Malayan affinity is moderate and mostly expressed by widely distributed spp.

Lest representation of Desert fauna in malabar to the south anb in G.P. in the east clearly depict and strongly support the idea that, as already discussed, the Indian Desert is a good natural barrier for hindrance of grasshopper migration to eastwards and southwards, where the climax vegegation is quite different.

The Gangetic Plain (G.P.)

This region includes the tracts of land from the Aravalli range and the Jumma to Bengal including Sundarbans and the plains of Sylhet, Lower Assam and the low lying land of Orissa, North of Mahanandi river (Fig 4). This vast botanical provinance has been further sub-divided into three regions e.g

i) an upper dry or upper gangetic plain—it covers all that country drained by the Ganges and its North and South tributaries from North-West of Delhi to as far east of Allahabad ;

ii) a lower humid of Middle gangetic plain—including rest of U.P., Bihar, Orissa and West Bengal (also Bangladesh), Lower Assam etc.

iii) the Sundarbans—Entire Gangetic delta (of West Bengal and Bangladesh).

Climate : Average rainfall is in between 150 cm to 200 cm per annum and prolonged dry season alternating with wet season.

The entire region except the Sundarbans belongs to Tropical wet semi evergreen, tropical moist deciduous sal forest and tropical dry deciduous climax forest types (Fig. 3). Three ecological types viz., mesophytic, hydrophytic and semi xerophytic vegetations are met with. North Indian upper and lower alluvial savanna occurs in this region, which is a degraded Sal forest ; like true Savanna grasses occurring are tall and crowded, they are represented by *Narenga porphyrocoma* (1.5—2.5 m. high), *Cymbopogon nardus* (up to 3 m.) etc.

The characteristic vegetation of upper dry zone is like that of a dry country due to northern cold wind where trees are mostly leafless during dry season, the grasses and other herbs burnt up. The common rose occurs in cold season along with other annual herbaceous plants. Bamboo, unless planted and tented, are almost absent.

The middle gangetic plain is the evergreen country where extensive agriculture has greatly affected natural flora. Among the herbaceous vegetation the aroids (both wild and cultivated) are conspicuous. In the confluence of the Ganges and the Bramhaputra jhils, canals and old river beds are unique by a luxuriance of marsh grasses. In the drier districts, *Acacia arabica* is a characteristic feature.

The Sundarban is unique in having mangrove spp. in Southern coastal strips and south-western part, Heritiera forest in Central zone and Savana type vegetation in the north eastern part.

Agriculturely the Gangetic Plain is the most advanced area— Cereals, millets, pulses, vegetables, some fruits, fiber plants, essential oils, sugar canes and Fumitories and masticatories (narcoties) etc. grow here.

Geographically the Gangetic region occupies a unique position. It is linked more or less with the mighty Himalayas on the north, on the east with Assam-Himalayas ranges which are, in turn, keep physical continuity to Burmese and there from wiih Malayan hills— through this link, even after the continental dript, the Malaysian, Burmese and Chinese elements, get an easy access to G.P. region and thence to peninsular India and/or vice versa. Bordered on the west by the barren Indian Desertic region, this region is separated, an the south by the much higher elevated Deccan plateau and the coastal side of Orissa, up to the north banks of the Mahanandi, which is a ever green area and very narrowly separated from the Decean. This eastern side of the Gangetic region, is, therefore, in a privileged position of becoming the gate-way of grsshopper-migration, which it actually is.

On the basis of these uniqueness of the region, as one would like it to be, it admits an admixture of grasshoppers, chiefly from Oriental countries and E.H. and D. regions, while Palaearctic and African elements less impressive as regards 'wides' but the situation is quite reverse in respect to endemic spp.

The region is poor in its endemic genera and spp. complex, in fifth position, with 13% and 32% endemism of genera and spp.

respectively (Table 2). Out of four endemic genera only one monotypic genus, *Perella*, is indigenous here ; other genus, *Hygraris*, although described from here is now share distribution with other regions (Table 3). There are altogether 18 endemic spp., of which only four spp., *Perella insignis* (Pusa, Bihar), *Oxya grandis* (Gauhati) *Pseudocarsula tarsalis* (Sylhet, Bangladesh), *Caloptenopsis glaucopsis glaucopsis* (Chota Nagpur) are indigenus to the region. Of the remaining spp , region-wise, eight of them show resemblance with E.H., six with W.H., three spp. each with I.D., M. and D.

The strength of non-endemic spp. of the region is quite high. 39 spp. belonging to 28 genera. Region-wise, 17 spp of E.H , nine spp. of W.H. ; three spp. of I.D. ; seven spp. of M. and 18 spp. of D. show commonness with the species of this fauna. Three spp. are unique to the region, these are—*Ceracris deflorata*, *Pusana rugulosa* and *Hieroglyphus annulicornis.*

The exotic influence exhibited by the 'wides' of this region is as one could be expected. The Oriental affinity is maximum ; palaearctic one is moderate, while African one is least. 13 spp. of Burma, seven spp. of China, two spp. of Indo-China, six spp. of Malayan peninsula, 16 spp. of Sri Lanka exhibit commonness with fauna of this region. Japan also exert influence over five spp. The species, *C. deflorata*, is solely restricted to here and Burma ; similarly, *P. rugulosa* to Afganistan, *H. annulicornis* to China, Indo-China and Japan. The Sri Lankan affinity here is equal to E.H. and only less than M. and D. 26 spp. show resemblance to Palaearctic countries, of which 11 spp. to Pakistan, eight spp. to Afganistan, four spp. to Central Asian countries and remaining three to other palaearctic regions. Six spp. of African elements are found common with.

The picture of exotic influence demonstrated by the endemic spp. is altogether different from that expressed by the 'wides' Here the African closeness is maximum ; palaearctic regions exert moderate influence and the oriental is least. Out of 18 endemic spp., four spp. viz. *Q. indica*, *C. glaucopsis glaucopsis*, *C. indicus*, and *C. robustus* are are predominantly belong to African genera. The spp., *P tarsalis*, *T longicornis indica*, *Chondracris rosea* also show African influence jointly in order with Palaearctic, mostly Palaearctic savanna habitus, China-Malaya-Philippine genera. Also the members of the old world genus *Eyprepocnemis* and cosmopolitan genus *Oxya* have in common with the fauna of G.P. Compared with this richness of affinity, the

Palaearctic rigion exerts far less influence—only three spp. jointly with other regions and two spp. from the old world and eosmopolitan genera, are present. Likewise *E. saturata* akin to Burma (also China), *G. bengalensis* to Burma, Malaya and also Australia, and *Chondracris rosea* to Malaya, China, Philippine and also Africa demonstrate mixed influence. So satistically, of the endemic spp., 10 spp. have influence of African fauna, five spp to Palaearctic, four spp. each to Burma, Malaya and China. The region has representation of eight Indian spp. of which only one is indigenous, while Sri Lanka has almost no representation except some exerted by the old world genus *Eyprepoenemis* and cosmopolitan genus *Oxya*, the genera which are well developed in that country.

In a nutshell, the Gangetic Plain region, being in a unique, central position, admits an admixture of grasshopper fauna. It also acts as a gate-way of acridid migration in India, from the mighty Himalayas from the north and from Burma, China and Malayan elements to South, whieh is in geographical closeness from geological ages, after continental dript. The eastern part of the region, being in continuity to the D. region also permits migration from the South including Sri Lanka to North or vice versa. As is expected, the endemic elements are poor ; in fifth position. Region-wise, E H. shows maximum closeness, with 10 endemic and 17 wides ; whereas D. region is with three endemic and 18 wides spp. Of the 39 'wides' only three spp. are indigenous. Regarding exotic influence over gangetic fauna, as per as 'wides' are concerned, oriental region exerts maximum, followed by Palaearctic ; Africa least. Endemic spp. exhibit reverse condition—African elements highest, followed by Palaearctic : Oriental region least, thereby indicating frequent migration within this region due to continuous and physical proximity.

The Malabar (M.)

This region consists of the humid, hilly belt of the country extending from Southern Gujarat to Cape Comrin and the Laccadive Islands. So the region includes major parts of Gujarat, Maharashtra, Karnatak and entire Kerala. The Western Ghats is its main components (Fig. 4).

This region has heavy annual rainfall (400-600 mm) in June and humid climate which characterise its luxuriant vegetation. Its climax vegetation is chiefly wet evergreen, tropical wet semi-evergreen and subtropical wet forests, with formations of tropical dry deciduous and tropical thorn forests in Gujarat State (Fig. 3).

The majority of the flora is Malayan type and is identical with that of Sri Lanka. Teak is abundant but sandal wood *(Santalum album)* occurs is the east and dry flanks of the Ghats. The ravines and shady slopes near the undulating summits are occupied by Thickest of small trees and bushes. These mountain like structures rise from the west to extensive grassy downs and table lands seamed with densely wooded gorges called "Sholas", which are evergreen temperate forests of close canopy. The vegetation of this sholas consists of all types of arboreal, shrubby and herbaceous plants, with tree trunks covered by epiphytic ferns, mosses and lianes of various sorts.

The shores of Malabar are shirted with *Cocos nucifera* (coconut palms) and the villages surrounded with groves of *Areca catechue* (Betel nut palms) and Talipots ; *Veteria indica* is also largely planted in many parts. Black-soil area is famous for cotton cultivation. Other conventional cultivations are of Rice, Wheat, Coffee, Cocoa and Banana etc.

The acridid fauna of the region is characterized by possesion of good endemic spp. (42%) almost similar to W.H. (Table 2). It has seven endemic genera, of which only one interesting genus, *Pasiphimus*, from S Canara, is truly indigenour to the area ; other six genera share distribution with other regions (Table 3).

There are 25 endemic spp. ; only 12 spp. are truly local, remaining 13 are more or less widely distributed within Indian domain (Table 3), but mostly (nine out of 13 spp.), bear close resemblance and restricted to this region and the D. The G.P. region has only one representatation in *Tropidopoda longicormis indica* directly in M. region and by another commonly distributed spp., *P. bilineatus*, jointly with E.H./W.H./I.D. The spp., *Dittopternis venusta* also links up this region that of E.H./D. Thus the Deccan Plateau is very intimately related to M. while other regions, G P. and E H though marely by two spp , other regions each by one spp. only.

The 35 spp. belonging to 'wides' show maximum affinity to 20 spp. of D., then seven spp. each to the regions of G.P./E.H., three spp. to W.H., two spp. to I.D. and has only one unique spp., *Sphingonotus balteatus balteatus*.

The 'wides' exhibit maximum Oriental influence in general, and of Sri Lankan in particular. Of the 35 'wides' 20 spp. show affinity to Sri Lankan fauna, 13 spp. to Burma, seven spp. to S. China, one spp. to

Indo-China, six spp. to Malaya. Japan has also three widely distributed of its fauna infused here. The outstanding Sri Lanka elements are—*Gonista sagitta*, *Leva cruciata*, *Morphacris fasciata sulcata*, *Teratodes monticollis*, *Leptacris filiformis*, *Oxya nitiduia* : these spp. also occur in D.

The Palaearctic affinity of this region is rather poor, only 18 spp, are available, of which 10 belongs to Pakistan, three spp. to Afganistan and C. Asia and only two spp. to other countries of the region. The spp., *Chloebora crassa*, jointly with D., restricted to this region and Pakistan. Other spp. of importance are—*Scintharista blanchardi*, also known from C. Asia and and Africa, and *Hieroglyphus oryzivorus* (also available in D./G.P./I.D.) from Pakistan occur here.

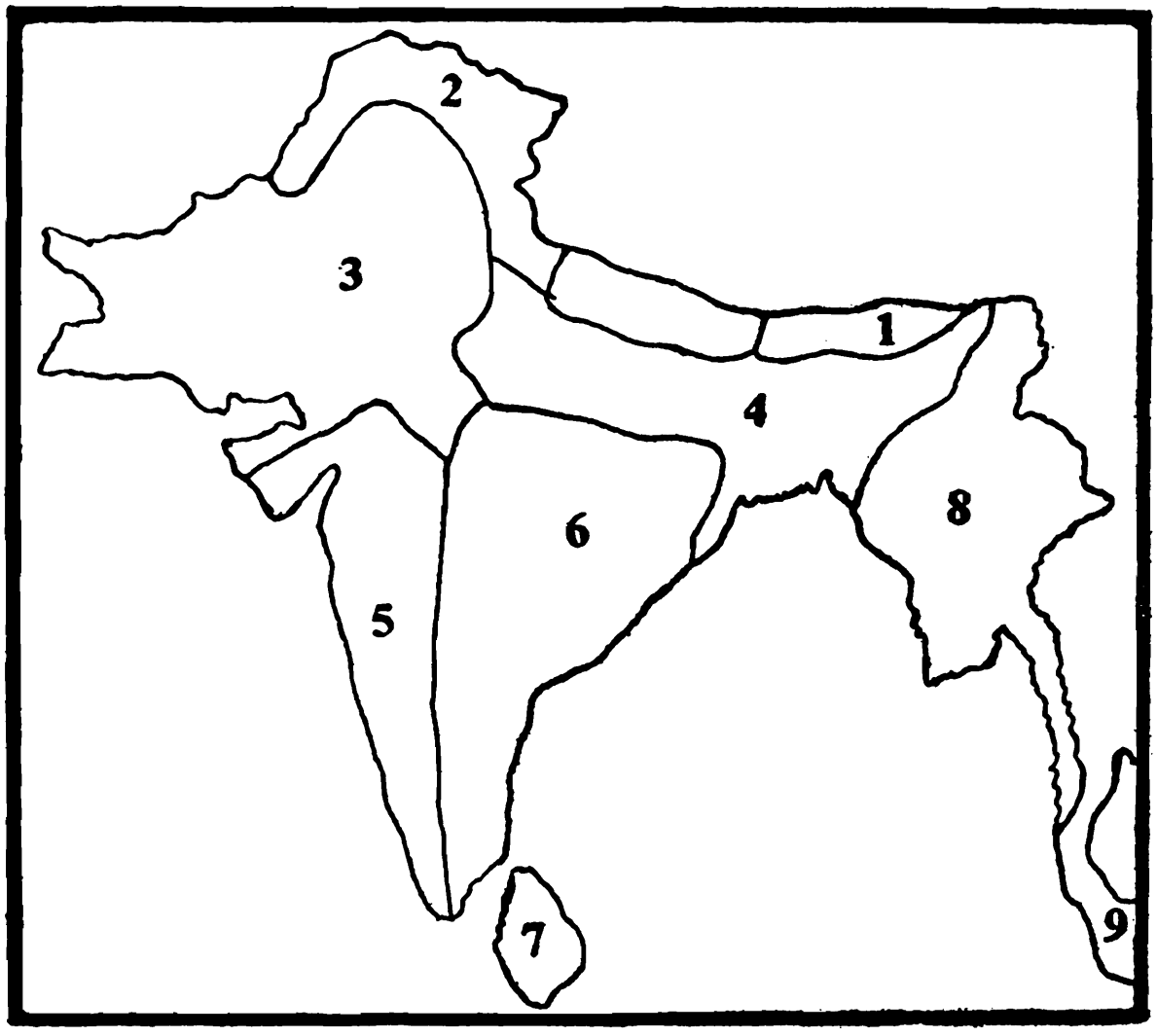

Fig. 1

Map showing phytogeographical regions of British India (after Hooker, 1907).

The African elements are still insignificant in the region. According to Botanists, the Malabar flora is of Malayan type which is identical with Sri Lanka ; the Deccan peninsula as a whole and Malabar

specially has less affinity to African flora, though Malagassy is an exeeption to this theory. The acridid fauna corroborates the above theory. Only five spp. of Africa bear closeness with Malabar acridid.

The 25 endemic spp. of Malabar belong to 19 genera representing the elements of entire old world. The oriental region as a whole amounts the largest members and massive components. Six genera each of Sri Lanka and Burma, five genera of Malaya and six endemic genera of India are available here. The unique genus *Bambusacris*, described from S. India and Sri Lanka, is represented here by a single spp. (Table 3). The genus *Gerenia* known from Burma, Malaya and also Australia has a very rare member, *G. pustulipennis*. The most outstanding endemic spp. is found in *Chitaura* (?) *indica*, a rare and exceptional extended Celebian and New Guinean genus. Another notable presence is that of *Coptacra ensifera* (also to D.) of a South-east Asiatic genus.

Africa has link with eight genera, of which the members of the genera *Gelastorrhinus* and *Caloptenopsis* are solely restrieted to this region. Other spp. of *Dittopternis*, *Leva* (of Oriental and African), *Tropidopola* (mostly of palaearctic savanna and Africa) etc. occur in mixed distributed genera.

Palaearctic elements are markely reduced. All the four genera, *Hieroglyphus*, *Tropidopoda*, *Dnopherula* (cosmopolitan) and *Spathosternum*, belong to widely distributed genera, and are only representative elements of that region here.

To summarise, the Malabar region even though show very close affinity with that of D. region, has a unique fauna of its own as evidenced by high endemism of its species. The fact that nine endemic species share distribution solely with D. and least 20 'wides' show likeness, which is equal to the number of spp. of Sri Lankan affinity, exhibit their inseparable integrity. The gradual decrease of availability of like fauna. both endemic and non-endemic, in G.P./E.H./W.H./I.D., in order, lends support to the theory suggested grasshopper migratory route in India. Regarding exotic influence on the fauna of this bio-geographical region, the Orient together and Sri Lanka separately demonastrate maximum affinity; Malaysian influence is equally important and massive. Burma has also good collaborators, providing further material for north-east to Southern migratory route or

vice versa. 'Wides' provide next best affinity with Palaearctic region and least to African fauna, whereas in case of endemic spp., African contribution is rather comperatively richer than the Palaearctic one

The Deccan Plateau (D.)

The region includes the whole peninsula, a dry plateau of medium height, East of Malabar and south of the Ganges valley (south of the Indus Plain and the Gangetic Plain) together with the coromandelian stripe of coast land. It consists of political provinces of M. P., parts of Gujarat and Maharashtra, Orissa (South of Mahanandi), Andhra Pradesh, South-eastern districts of Karnatak and entire Tamil Nadu (Fig. 4).

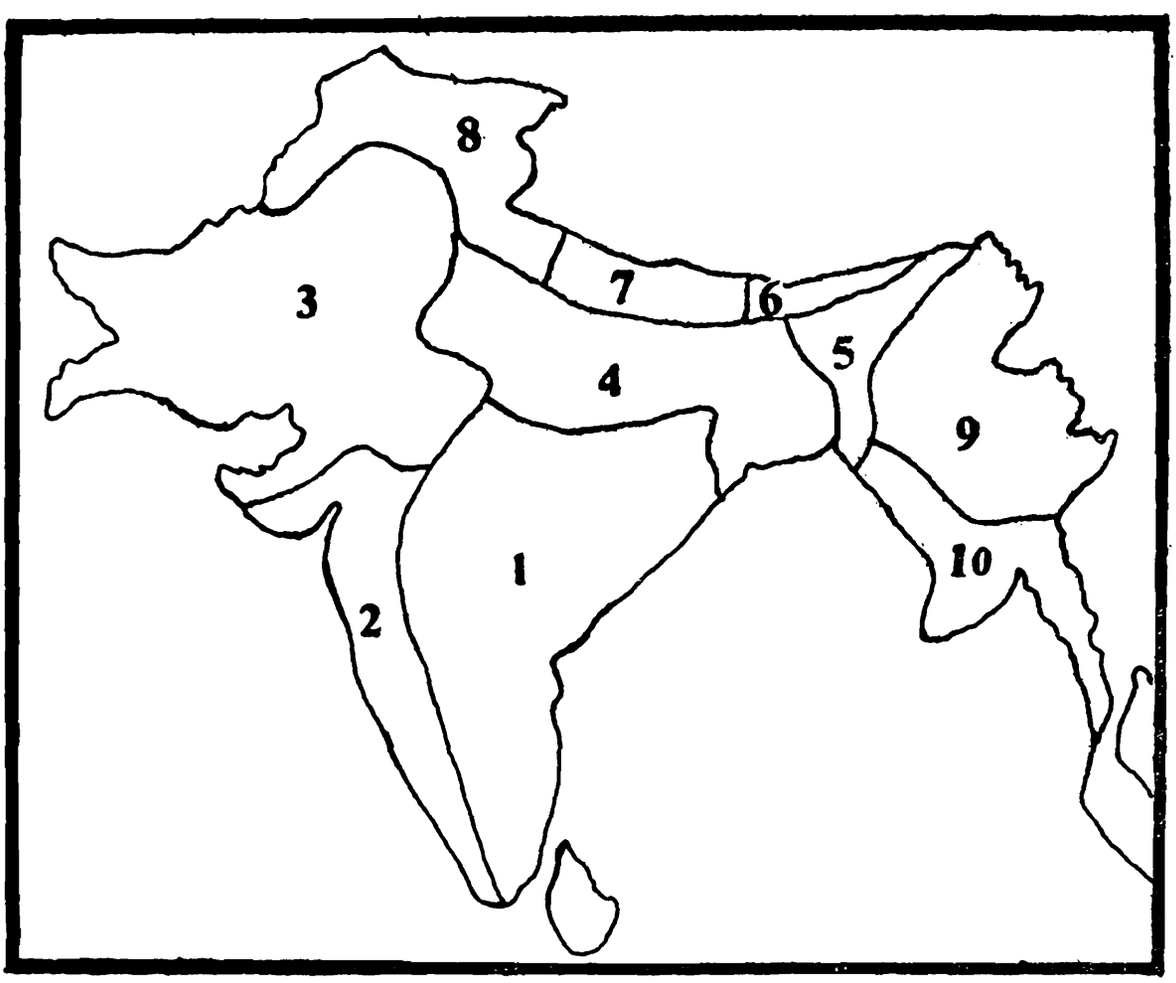

Fig. 2

Map showing phytogeographical regions of British India (after Chatterjee, 1939).

Throughout the Deccan plateau deciduous forests are the conspicious features, evergreen types are noted on the coasts and slopes. Floristically, northern Deccan is linked with the temperate to subtropical flora of eastern and western Himalayas.

The table land of Mysore is often barren and the hills are covered with low shrubby vegetation. But towards the west, the vegetation is more or less similar to that of the Malabar type and sizable forests are found. The steep slopes of the eastern ghats which come normally within the influence of the north-east monsoon are also densely wooded. The black cotton soils, which prevail over large areas in Decan, are unique by an assemblage of many indigenous plants. Low grade mangroves occur in the estauries. Thickest thorny overgreen and deciduous trees and shrubs are found here and there (Fig. 3).

Nilgiri has a very luxuriant natural vegetation. Sub-tropical hill savanna generall exists on the slopes of Nilgiri and Palni Hills between altitude of 1000-2000 m. The flora is chiefly composed of tall grasses and deciduous scattered trees. At the lower altitude is the 'Sholas'; peat bogs are found in depressions of the hills towards their summits. The peat is composed of grasses, sedges, mosses and bushes.

The region is the highest populated area of grasshoppers within India. There are 61 genera in total, of which 24 genera are endemic (39% endemism), of which 19 genera are monotypic; 17 monotypic genera are strictly endemic to the region. The genus *Capulica* has one spp. available here, its other two spp. are described without any specific locality. *Chondronotulus* described from North Bengal is now extented here by the same spp., similarly the genus *Parahieroglyphus* is represented by the spp., *P. colemani*, which is also known from M; whereas *Pelecinotus* is provided with two distinct spp. of which one spp is indigenous here; and *Palniacris* with one common spp. share with M. and by another spp. which is restricted within this region (Table 3).

This region also exhibits the highest degree of endemism in spp. level (55%) (Table 2). Out of the highest number of endemic spp., eg. 63, 45 are truly indigenous as yet, only 18 spp. have mixed distributional range (Table 3). Amist these 18 spp., 11 spp. share distribution solely with Malabar region; the remaining genera occur in mixed distribution pattern. Of these, direct link with W.H. by two spp. eg., *C. glaucopsis liturifer* and *C. illustis*, indicates that these two spp. must be available through the intervening zones, that is, E.H. or G.P. to justify their presence in discontinuous regions which is otherwise almost impossible. Region-wise, 11 spp. of this region are common with M., four spp. each to G.P./E.H./W.H. and non to I.D.

51 spp. of 'wides' of the populous region show affinity, with 19 spp. of M., 17 spp. of G.P. 13 spp. of E.H. Five spp. of W.H. and one spp. *(Hieroglyphus oryzivorous)* of I.D. regions' fauna and have five unique spp.—*Paraduronia simoni, Hilethera oedipodioides, Dubitacris robusta, Pirithoicus ophthalmicus* and *valanga n. nigricornis.*

Like the 'wides' of Malabar region, the D. region also exhibits maximum affinity to Oriental, particularly to Sri Lankan fauna. Next best is Palaearctic including Pakistan ; African elements are very poor as it was in the case of M. also Out of 51 'wides' 33 spp. show affinity to Sri-Lankan fauna, 18 Burma, 11 spp. to China (mostly S. China), 10 spp. to Malaysian including two from Thailand. Indonesia and Japan has also one spp. each common with D. fauna. Among the oriental grasshoppers, only five unique spp. noted above are somewhat may be considered restricted to here.

The exotic influence of palaearctic fauna on Deccan grasshopper is rather poor both in quantity and quality ; only 30 spp. occur, of which 15 spp. belong to Pakistan, eight spp. to Afganistan, three spp. to Central Asia and four spp. to other Palaearctic countries. Tibet has its influence limited to a single common spp. African countries have only six widely distributed spp. common with Deccan 'wides' fauna.

The floral and fauna elements of Sri Lanka though rich and varied and distinct from that of their Indian counterparts have very pronounced and intimate relationship in its endemic fauna. Almost all Sri Lankan genera have somewhat representation to the peninsular fauna. The genera *Paraphlaeoba. Paraduronia, Phlaeobida* and *Zygophlaeoba* are truly and purely Sri Lankan genera, each with one endemic spp. except the last genus which is well-organized with five endemic spp. in D. The genera *Taratodes* and *Clonacris* are also largely Sri Lankan elements, though both the genera occur well also in India and the latter is also with distant relatives in African fauna. The genus *Gerimen* is again largely a Ceylonese one, though also known from Burma and Malaya, has its singular representation in the region. Besides, the oriental genus *Phlaeoba*, the oriental and African and Australian genus *Leva*, Sri Lankan and African genera *Dittopternis* and *Pirithoicus*, the cosmopolitan genera *Dnopherula* (with 6 endemic spp) and *Eyprepoenemis*, all show affinity being prominent in composition in both the countries. In addition this, the region has same members of the *Chitaura* (Celebian and N. Guinean), *Coptacra* (Burma, China and Malaya), *Gerenia* (Burma and Malaya) as that of M.

Out of 63 endemic spp. available here, 26 are produced by 24 endemic genera of Indian domain. The rest, 39 spp. belong to non-endemic genera.

The D. region depicts next highest affinity with African fauna through its endemic spp. Besides, the genera *Orthochtha*, *Brachycrotaphus*, *Mesopsis*, *Caloptenopsis* and already discussed genera *Dittoptermis*, *Pirithoicus*, *Leva*, there are genera like *Spathosternum* and *Chondracris* which are also linked with the fauna of this region.

The European relatlon, at the level of endemic spp. of this region is very inconspicuous. Only the genus *Paraeuprepocnemis* (known from Central Asia and Africa) and the widely distributed cosmopolitan genera *Dnopherula* and *Eyprepocnemis* and the genera occurring in China along with oriental genera are the only faunal linkage between them.

To summaries, the Deccan region holds a unique position by its highest endemism, both in generic and specifi levels. Also it is the most thoroughly explored and populated area in India. It shows maximum affinity to Malabar fauna ; compared with other interregional provinces. The gradual decrease of faunal elements, in order, from G.P. to W.H. via E.H. and its extreme paucity in I.D., indicates and supports South-North, migratary routes via G.P. but presence of large number of endemic genera and species in it, which is qualitatively different from that of the Himalayan elements, prompt one to believe parallel evolution in the two regions. As regards exotic influencc, Sri Lanka separately and Oriental region as a whole show maximum closeless. The African resemblance on endemic spp. of non-endemic genera is more than palaearctic, while in respect of 'wides' the affinity is quite different and reverse, in these two zoogeographical regions.

Studies in endemism (subfamily-wise)

In the foregoing discussion of biogeographical regions, the distribution of endemic genera and spp. have been referred to region-wise. Now concentration will be made on the sub-family-wise analysis of endemic forms before some conclusion and generalization of endemic can be arrived at.

There are 13 sub-families of Acrididae in India of which Calliptaminae shows the maximum endemism among Indian grass-hoppers, with percentage of 60 and 100 respectively in generic and

species-levels ; next highest is Catantopinae, with endemic percentage of 46 and 73 respectively (Table 1). The subfamily Acridinae is represented with five endemic genera (27%) and 23 endemic spp. (70%) ; all the genera are monotypic and are confined to Sikkim (E.H.) and Deccan ; the last named region housing three genera, e.g., *Carliola*, *Duroniopsis* and *Paraphlaeobida*, whereas W.H./I.D./M. unrepresented. The subfamily Truxalinae which is very scanty in Indian fauna, has only one

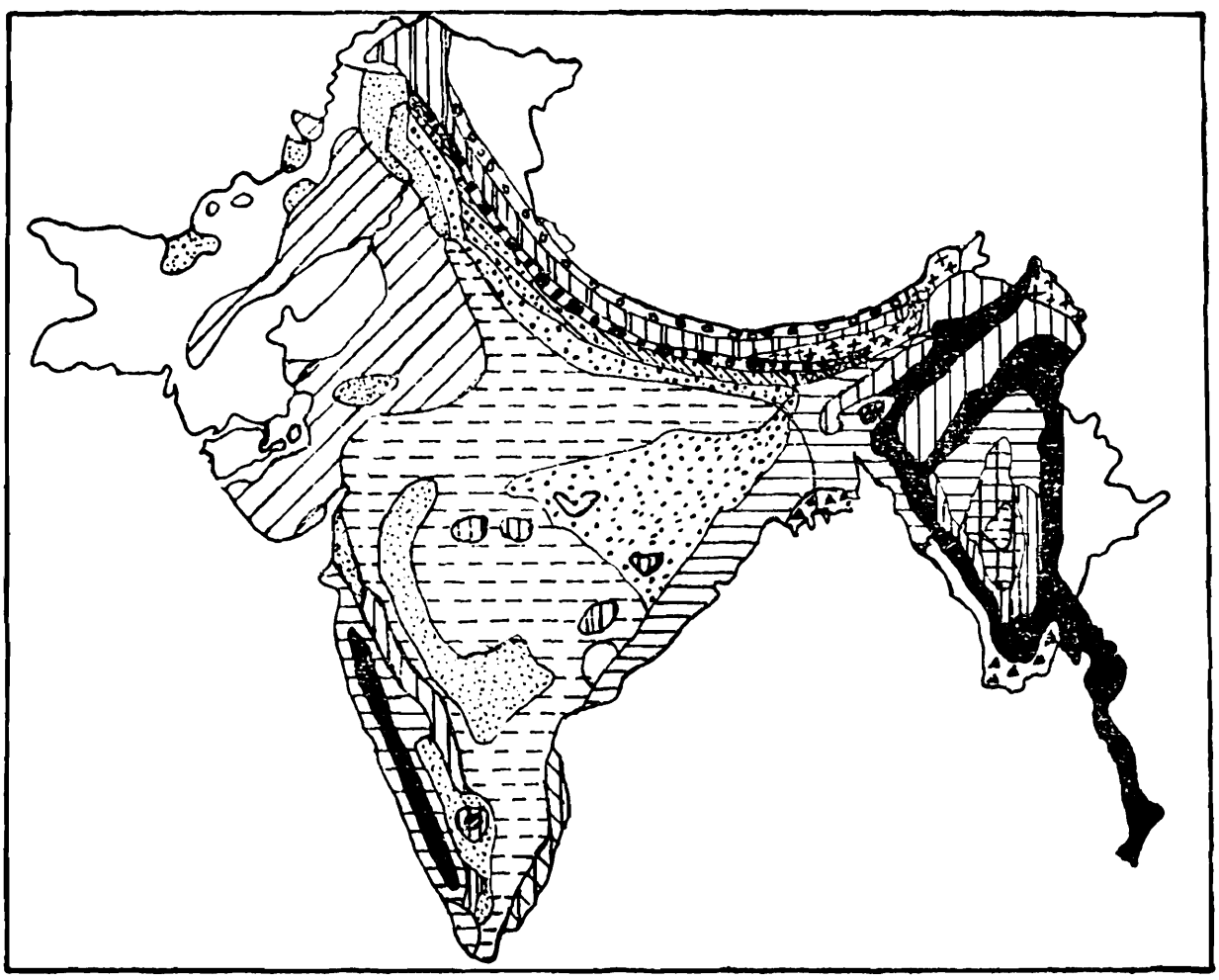

Fig. 3

Climax forest formation types of India and Burma (after Champion, 1939.

non-endemic genus with three spp., there being no trace of endemism. Members of Gomphocerinae, has recorded highest endemism in genera (56%), nine endemic genera out of total 16, and with 37 spp. of which 28 are endemic, with a percentage of 2nd best endemism (76%). Out of these genera, seven are monotypic and all of them are solely restricted to Peninsular India; only the genus *Pasiphimus* is reported from S. Canara (M.); others are confined to D. The distributional pattern of the endemic spp., as a whole, depict almost the picture as that of genera, 19 spp. out of 27 are strictly restricted to the Peninsula; the other three spp. e.g., *B. indicus* Uvarov, 1932, *C. pulla* Bol. 1918 and *C. chrysochraontes* Bol. 1918, though without definite locality, are in most probability belong to this region. Both E.H./I.D. are represented by two spp. each; whereas in W.H. only one very interesting spp., *C. (c.) almoranus*, is confined. The G.P. is on the other hand very insignificantly represented—only one spp., *Mesopsis cylindricus*, described from the D., is now recorded from here by the author (Bhowmik 1985 (1983). The band winged or Oedipodinae, who favour areas of seral soil, are, however, poor in endemism; only three genera, out of 21 genera (with 14% endemism) and seven spp. out of 43 spp. (with 16% endemic percentage) are are contained. All the three endemic and monotypic genera are chiefly confined to E H., though the genus *Chondronotulus* is now also extended to M. and D. regions. The spp. *Pusana laevis*, described from Bihar, is now spreed throughout northern Indians including I.D. and remarkably absent in the Peninsula. Other two spp., *Oedipoda himalayana* and *Sphingonotus fallax* are yet solely restricted to W.H. *Dettopternis venusta* is, however, preminent in the Deccan, although known from E.H. also.

The representation of the subfamily Romaleinae in Indian fauna is scanty, only one endemic genus (33% endemism) and five endemic spp. (with 83% endemism) occur. The genus is distributed in W.H. and D. regions, two discontinuous zones, there being no linking connection through E.H /G.P. or I.D. *Teratodes brachypterus* is confined to D, while the spp. *Kabulia indica*, a member of Afganistani brachypterus genus, described on ♀, is without specific locality known from India. The subfamily Hemiacridinae although well expressed in Indian fauna contains only three endemic genera (50% endemism) and 11 endemic spp. (55% endemism). Of the three endemic genera, the monotypic genus *Hieroglyphodes* is indigenous to Assam (Cacher) and the remaining two, *Castetsia* (monotypic) is mainly confined to the Peninsular India, and of the genus *Parahieroglyphus* one spp., *P. colemani*, is restricted to continental India, while other spp., *P. bilineatus*, is common throughout

entire India barring D. Out of the remaining seven endemic spp. belonging to non-endemic genus, five spp., *Hiroglyphus indicus*, *Spathosternum medium* and *S. abbreviata* and *Clonacris kirbyi* and *C. sila*, are somewhat restricted to the peninsula and two spp., *Leptacris maxima* (from "Himalayas") and *Zeylanacris continentalis* are without exact locality. These are all rare spp.

The subfamily Oxyinae is chiefly represented by the genus *Oxya* which is well-developed in Indian fauna. One of the endemic members of the genus is restricted to E.H. (North-east Assam) while the other is recorded only from G.P. (Goalundo-Gauhati). The unique genus, *Hygrcris*, having two interesting spp., of whieh *H. palustris*, described from Bihar has got extension in upper Assam, while the other spp , *H. malabarious*, is yet a loeal spp. of M. The genus *Chitaura* which is very much well developed in Celebes and New Guinea is solely prevalent in the Peninsula by a doubtful spp. with no endemic elements either in W.H. or in I D. *Coptacridinae*, a small but interesting subfamily has only eight endemic genera and 3 'wides' of a total of six non-endemic genera. There is no endemic genus yet known, though with a high endemic psrcentage of spp. (73%). Of these eight spp., the members of the South-east Asiatic genus *Coptacra*, *C. ensifera* and *C punctoria*, are restricted to the continent, while *C. minuta* is only known from E. Nepal. *Traulia*, mostly a Malayan genus, has three spp. in Indian domain—of which one each is restricted to Assam (Cachar) and great Nicobar island and the rest, *T. aurora*, is without specific locality. The spp. *Circocephalla indica*, and element Javan fauna, first recorded and described from Tarai of the Darjeeling-Himalayas. The endemic elements of the subfamily shun, like that of Oxyinae, the W.H /I D. regions ; the G.P. is more or less links E.H. to D. by a rather widely distributed endemic spp., *Eucoptacra saturata*. The subfamily Tropidopolinae contains seven genera, of which two are endemic (with 29% endemism) and total seven valid spp , out of which five are endemic, with 3rd endemism (71%) in Indian grasshoppers. The two endemic genera, all of which are monotypic ; of these members of *Calamippa* and *Tinnevellia* are purely continental in habitus. Out of three remaining spp., *Bambusacris travancora* and *Pseudocarsula tarsalia* are restricted to M. and G P. respectively, while *Tropidopola longicornis indica*, an element of a Burmese genus, share distribution with G.P /M. Thus the endemic element of this subfamily is lacking its elements in the Himalayan ranges and in the Indian Desert. The subfamily Calliptaminae, mostly grasshoppers of mixed diet and in habitants of cultivation, have fiive genera of which three are endemic (60% endemism, highest

degree in generic lavel) and 12 endemic spp. (with 100% endemism), there being no 'wides'. The genera *Brachyxenia* and *Indomerus*, both monotypic, are restricted to D. and I.D. respectively, while the genus *Peripolus* with two spp. solely found in the Himalayas. The five members of the Indo-African genus *Caloptenopsis*, of which four are indeed of subspecies status, are distributed more or less througoht the the length and breadth of India except *C. punctata* whose exact locality is yet undermined. The three subspecies of the genus *Sphodromerus*, which is largely an important unit of American subregion of Palaearctic, Africa and N.W. India, are known without specific locality records.

Eyprepocnemidinae, one of the largest Indian subfamilies, is well represented with 10 genera, of which three are endemic (with 30% endemism) and a total of 20 spp., of which 12 are endemic and eight are 'wides'—thus eedemic percentage is 60. Among three endemic genera, *Belonocnemis* and *Navasia* are monotypic and are without specific locality ; on the other hand, the genus *Eupreponotus*, a unique one, with two known spp., is spread over in the Himalayas and the G.P. The two spp. of the African genus *Cataloipus*, where it is with large no. of spp., are mostly confined to W.H./I.D. and G.P. ; the continental India and E.H. are without any representation as yet. *Choroedocus robustus*, a large and unique species, describec from E.H. is now extended to D. through G.P., while *C. illustris* is yet restricted to W.H. Similarly, the spp. *Eyprepocnemis rosea*, described from the Himalayas, is now recorded from D. as well as G.P. The spp. *E cyanescens* and *Paraeuprocnemis pictipes* are entirely recorded from D. only.

Catantopinae, the largest subfamily in India, is widely and thoroughly found all over India, possesses 26 genera containing 12 endemic genera (with 46% endemism) and 44 spp. including 32 endemic spp and 12 'wides'—thus the endemic percentage is 73. Of the endemic genera, eight are monotypic : *Bhutanacridella, Indopodisma* and *Rhinopodisma* (restricted to E.H.) ; *Coniocara, Captacrella, Naraikudua, Opharus* and *Siruvania* (restricted to D., only the last genus share distribution with M.) Remaining genera like *Dicranophyma*, with two spp., is the only unique genus confined to W.H , while the genera *Mopla* and *Palniacris*, both having two spp., are restricted to Peninsula. One spp. of the genus *Paracomophyma*, a brachypterus genus allied to Palaearctic genus *Conophyma*, described from Bihar (G.P.), is now recorded from W.H. also ; three of its components are without specific locality.

Of the endemic spp. belonging to non-endemic genera, only a

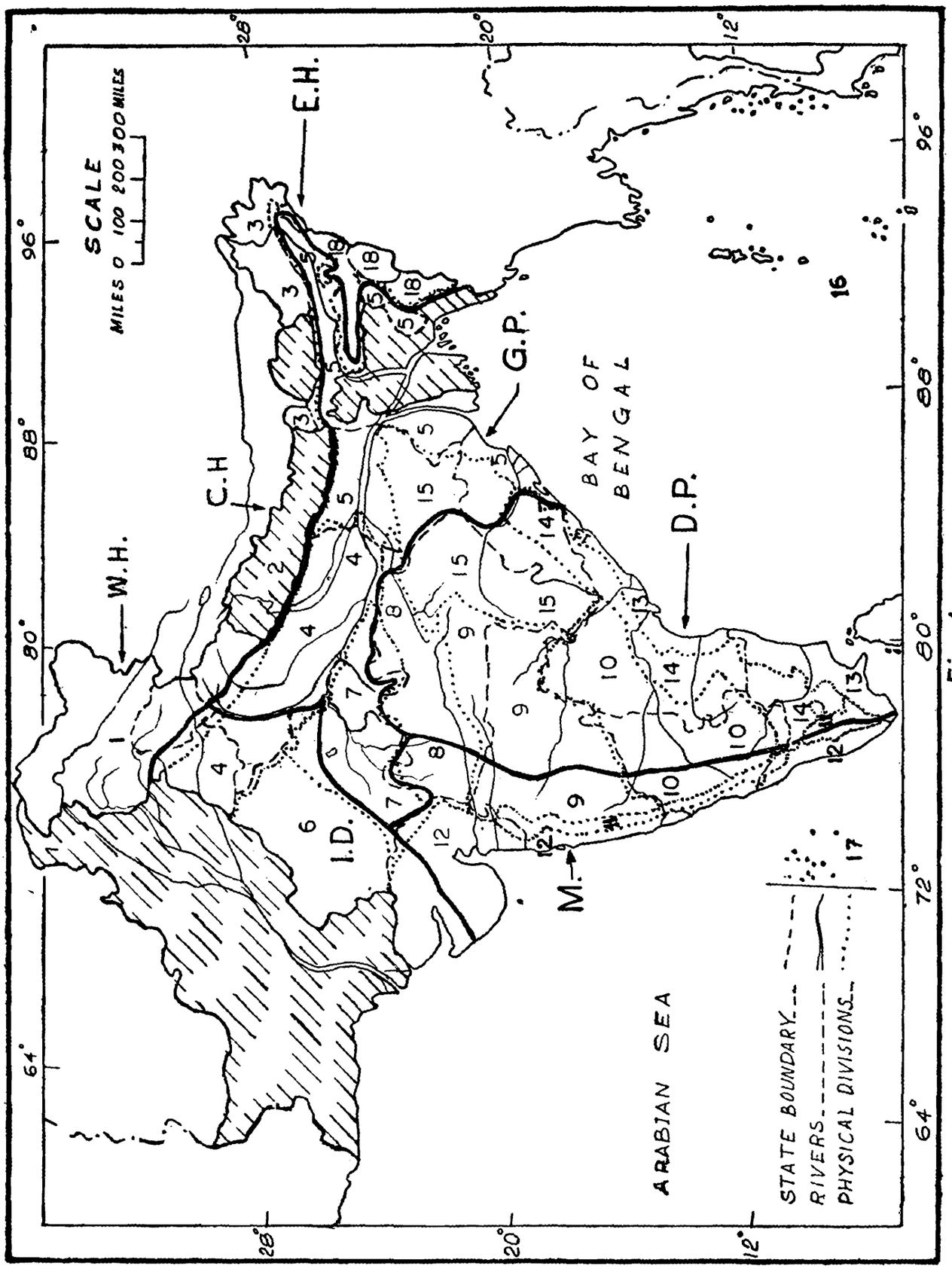

Fig. 4

Proposed bio-geographical regions of India—E. H. (Eastern Himalayas including North-eastern Hills) ; W. H. (Western Himalayas) ; C H. Central Himalayas (Nepal) ; I. D. (Indian Desert) ; G. P. Gangetic Plain) ; M. (Malabar) ; D. P. (Deccan Peninsu'a), with indications of state boundaries and chief river systems. Also with indications of Physical divisions of India numbered as (1) Western Himalayas (2) Central Himalayas (3) Eastern Himalayas 4) Northern Plainland (5) Eastern

Plainland (6) Western Plainland (7) North-Central Tableland (8) South-Central Tableland (9, North Deccan Plateau (10) South Deccan Plateau (11) Western mountaneous belt (12) Western costal lowland (13) Eastern coastal lowland (14) Eastern mountaineous belt (15) Eastern Plateau (16) Andaman Nicobar Islands (17) Laccadive-Minicoy Islands (18) North-eastern Hills.

single spp. of *Alectorolophus* is probably known from Sikkim. Members of the genus *Gerenia* is spread over to E.H./D., through G.P. Central Asiatic alpine genus *Conophyma*, with three unique spp., is limited solely to W.H. ; similarly the genera *Diabolocatantops*, *Cryptocatantops* and *Xenocatantops*, all having a single endemic spp., are indigenous here. The D. division is endowed with a single spp. each of the genera *Genimen* and *Pirithoicus*. The distributional pattern of the subfamily shows that the genera and spp. of it are almost totally absent in the intermediate regions) : I.D. with none whereas the G P. with extension of only two spp. ; M. is also poorly represented while W.H. and D. are the two richer areas. Cyrtacanthacridinae, a subfamily of large sized grasshoppers having preference for forbs and grasses as food and inhabitants of thicket, woodlands and grasses barring cultivated fields, well distributed mostly in Oriental countries, and also in Africa and Central Asiatic countries, is the poorest group as regards its endemic fauna ; at present it contains no endemic genera.

Endemism in India

As India is surrounded by countries and was a part of the large continent, so there is very likelihood of differences of opinion regarding her having a fauna of he own or not. Though the grasshopper fauna of India admits a mixture of surrounding countries like Sri Lanka, Malaysia, Burma, China (specially of S. China), Pakistan, Afganistan, Central Asia, Africa etc. by the widely distributed spp., 'wides' or non-endemic ones, and show affinity otherwise, India has yet a distince fauna (or grasshoppers) of 'her own' for she has not only a rich endemic fauna but also a large number of endemic species.

According to the estimation presented in this communication (Table 1 & 2), total number of acridid spp. is 256 within existing political boundary of India, of which 58% of grasshoppers are endemic, while the rest 42% approx. of the total faunal strength is as 'wides' Naturally and geologically India has three main divisions, Peninsular India or continental India, Extra-peninsular Region or the Himalayas and the intermediate one, the Indo-Gangetic basin. The combined

divisions-Peninsular India and the Himalayas—contain large number of endemic spp. and thus those regions jointly contribute to the high percentage of endemism (26% and 19% respectively). The endemic percentage, of both genera and spp , is presented in details in Table-5. The Indo-Gangetic region, comprising of Gangetic Plains and Indian Desert of this communication, is very poor in this respect (vide Table-5).

Table—5. Showing total number of grasshopper fauna with no. of 'wides' and proportion of endemic spp. in different natural divisions.

Total No. of acridid spp.	Total No. of genera	No. of endemic genera	'Wides' or non-endemic spp.	Endemic spp.			
				Himalayas	Deccan peninsula	Gangetic and Desertic regions	Misc. without specific locality
256	129	41	108	49	66	11	23
Percentage		32 approx.	42 approx.	19 approx.	26 approx.	4 approx.	9 approx.

42% approx.

58% approx.

100%

This result corroborates with results obtained in the study of endemism in dicotyledonous species of India (11, 124 spp.) by Chatterjee 1939, 1960). An analysis of the results obtained further points out that there had been a parallel evolution of grasshopper fauna in the peninsular India and a Himalayas, each producing its own type of endemic spp. As we will see later, the rise and development of the great Himalayas and its releted history with that of the Deccan exhibit their physical separation for long period and justify such parallelism.

The "age" of endemic genera and species of Indian Acrididae is linked up with the history and development of 3 natural, physical divisions of India.

Historically, the peninsular shield of the Daccan plateau was a part of the southern continent called "Gondwana". There are floral and faunal evidences that indicate that this Gondwana was existing from the upper carboniferous, about 350 million years ago, and which

have been broken up during Cretaceous period, about 140 million years ago, "either by the sinking of marginal strips or by the drifting apart of the component parts" The island of Sri Lanka, Australia, South America, Antarctica and South Africa were continuous with the adjacent part of S. India, until this drifting, while Madagascar was attached to S. India until the middle cretaceous (about 9o million years ago) being a barrier between the Narmada Valley and the main area of Indian Ocean.

At the same time of Gondwana formation, there occurred a great orogenic revolution, in northern continent, which affected large part of Asia and Europe, with creating the great mountain ranges and a great Mediterranean occean called "Tethys". This sea was extending from the region of Atlas mountains and Pyrenes in the west, through the areas now occupied by the Alps, Carpathians, Caucasus, the mountains of Asia, mountains of Asia Minor and Iran into the Himalayas and farther east into Burma-Arakan-Andamans and the southern border of the East Indian Archipelago e g, Java and Sumatra.

The great Himalayan ranges owed its "birth" to the orogenic activities of thc Tethys by shallowing in the upper cretaceous and continued throughout the teritary, 65 million years ago, and spreading over 64 million years which brought into being the great equatorial mountain chains including the Atlas, the Pyreanees, the Alps, the Caucasus, the Himalayas and the Burma-Andaman Arc.

Thus during the Middle Miocene (about 25 million years ago) the Himalayas including the Siwalik system acquired thered their major features and the Tethys disappeared somewhat completely, being replaced by mountain ranges etc (Krishnan, 1968).

The Gangetic alluvial plains owed its origin to the formation of the Himalayas and the disappearance of the Tethys during Middle Miocene. A depression called 'trough or foredeep' was formed between the rising ranges and the peninsular mass of Gondwana. In course of time this 'foredeep' was filled up with sediments (alluvium) from both sides.

It transpires, therefore, that the Deccan Peninsula is much more 'ripe' in age (about 350 million years) than the Himalayas (120 to 140 million years) and the Gangetic plains, the youngest one (about 25 million years).

The geological history of India prompts one to believe that the most primitive stocks should apparently be members mostly of Africa, Sri Lanka, Australia, Celebes, New Guinea of continental days. With the final settlement of continental drift and rise of the Himalayas these countries were isolated by large intervening water bodies. For most of the Ethiopian fauna, it was virtually impossible and unpracticable to cross-over to peninsular India or to the Himalayas due to long physical as well as ecological barriers or vice versa. This accounts for insignificant African affinity to Deccan peninsular, in particular, as regards 'wides'. Same is the case with Australian and Far east countries influence. Some link with peninsular fauna by endemic species of Africa or vice versa is due its continuity until middle cretaceous (about 90 million years ago) when Madagascar finally severed its connection with S. India. Though primitive, these genera of continental days, many of them are yet in flourishing state in Africa or Sri Lanka and as such their representatives in India, cann't be termed as 'relics' (vide Ridley, 1922). On the other hand, the picture is quite reverse to the Northern side of the continental India.

The Tethys sea separated continental India from the western and southern China (including Tibet), and also present day Burma, Thailand, Malaya, Java and Sumatra; their proximity to India was established only after the emergence to the Himalayas.

The only land connection between peninsular India and China and Angaraland (Asia to the East of Orals, down of the Paccific coast

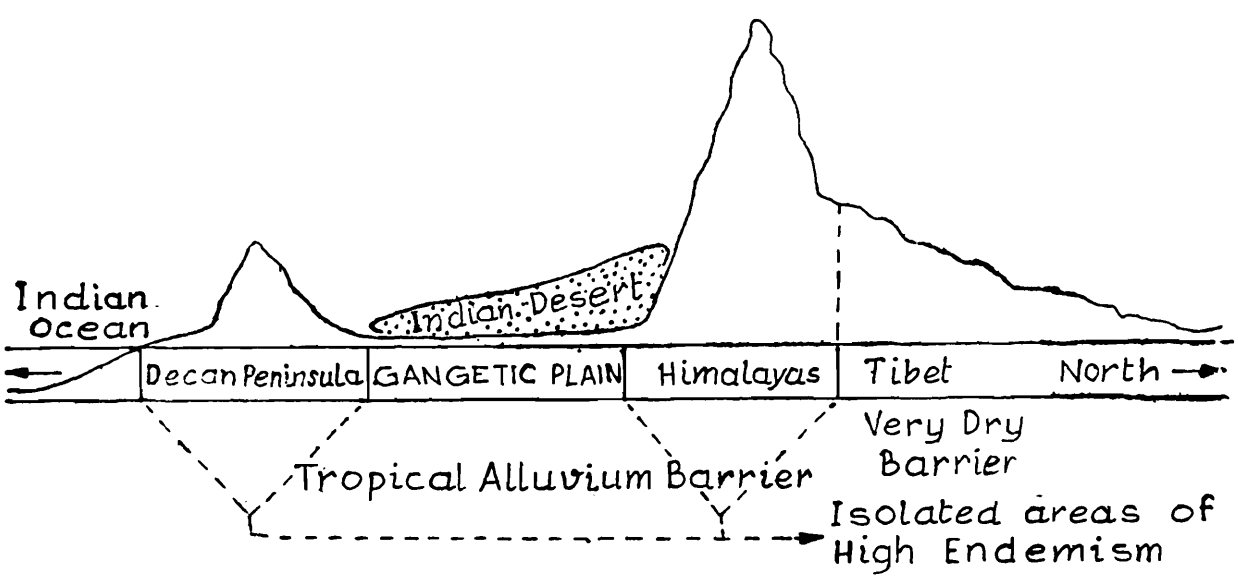

Fig 5

Figure showing the influence of barriers in the induction of endemism in Peninsular India and the Himalayas.

and to the north of Korea and Mongolia) in lower Gondwana (i.e., Carbo-permian, some 290 million years ago) was through the volcanic islands of Pinjal Trap of Kashmir. These islands were scattered at the beginning and came closer only during Cretaceous and Tirtiary when the Tethys disappeared. However, some Angara and Eur-American flora and fauna might have migrated to through this land-bridge. But though this route permitted a few spp. of flora to eross over to Indian side, before or after emergence of the Himalayas, as 570 monotypic European genera, an impressive number, are present in Indian flora (Calder, 1937), only a few spp. of grasshoppers could overcome the hurdle of diverge climatic differences. Discovery of *Anapterygus indica* in Garwhal Himalayas and some *Bryodema* spp. of Tibetan origin might have occurred later. To the East, the extension of Burmese, S. Chinese, Malaysian, Celebian and New Guinean elements could only be migrated to India through mountaneous link of eastern Himalayas after its emergence.

It is clear from the above discussion, spp of continental days (i.e., Glossopteris fauna of Permo-carboniferous period) are really of primitive stocks. The largest no. of Indian endemic spp. (94 nos.) belong to non-endemic genera ; the remaining endemic spp. might have originated locally or might have migrated to India later through Central Asiatic mountain-knots, rarely crossing Karakoram from Angaraland of geologists or from Tibetan plateau or through the eastern side of the Himalayan ranges from S. China, Burma, Far. east islands, along with 'wides', and settled and modified here due to changed ecological factors, both biotic and abiotic, into new spp. Similarly, some of the Indian spp. which got access to alien influence changed morphologically and turned into new forms, viz , the tropical Indian genus *Conophyma* (and the Himalayan genus *Dicranophyma*), mostly having fully winged relatives, extended to Central Asian alpine fauna, lifted with rising Himalayas and migrated there, were greatly modified structurally, as wingless spp , due to severe climatic conditions ; similar is the case of Central Asian Alpine Eumastacinae (genera *Gomphomastax* Brunner and *Podomastax* C. Bolivar) (Uvarov, 1927c). In this conversion, may spp. might have died out. Anyhow, a large no. of the Indemic genera (41 nos.) & spp. (55 nos) should be considered of geologically recent origin. Judged in this line, the endemic spp. of grasshoppers give a reverse picture to that of floral one (Chatterjee op. cit.). The Deccan, the oldest land mass, provides house for maximum no. of endemic spp. (63 nos.), the Himalayan ranges the 2nd best (54 spp.) while the warm Indo-Gangetic alluvial plains minimum (26 spp). As has been pointed

out earlier often that the Indus plain to the west and the warm alluvial plains in the most spp. to migrate either to the South or to the North because of ecological differences (Fig. 5) ; only a few endemic spp. and some 'wides' with high capacity of flight could only overlook and overcome this central, physical barrier. The new forms called 'neo-endemics' were produced from stocks capable of change and getting no opportunity to migrate into new areas, majority of them, barring certain exceptions, became localized and are not distributed over extended areas. This partially supports Willis' (1922) "age & area theory" The Deecan, particularly the stete Tamil Nadu, with its varied vegetation for fostering grasshopper population and speciation, top the list. In the Himalayan, to the contrary, the winter is very cold, and which a very cold, and which is a very unfavorable factor for grasshopper population. However, in the Himalayas the temperate and alpine faunas have freely formed new spp., by flatural crossing and mutations among themselves, within the area, but being barred by adverse physical and ecological barriers, almost and all fronts (Fig. 5), remain bounded. Its endemic percentage is sufficiently high. Finally, it made be deduced that unlike Ridley's theory, grasshoppers for majority of cases do not present relic spp. although some originated from primitive stocks, and contrary to Willis's theory, geologically the oldest place represents maximum endemism and not dependent to the geological age of the plece of occurrence.

TABLE—1 Status of Indian genera and species of Acrididae (Purely Indian fauna limited on the existing political boundary of the country) (All sub spp. are counted as spp. for convenience, throughout this communication.

Name of sub families	No. of genera				No. of Species					
	Endemic (a)	Non-endemic (b)	Total (a) & (b)	% of endemism	Endemic (in endemic genera) (c)	Endemic (in non-endemic genera) (d)	Total (c) & (d)	Non-endemic species (e)	Total (c), (d) & (e)	% of endemism
I. Acridinae	4	11	15	27	4	19	=23	=10	33	70
II. Truxalinae	0	1	1	0	0	0	= 0	= 3	3	0
III. Gomphocerinae	9	7	16	56	11	17	=28	= 9	37	76
IV. Oedipodinae	3	18	21	14	3	4	= 7	=36	43	16
V. Romaleinae	1	2	3	33	3	2	= 5	= 1	6	83
VI. Hemiacridinae	3	6	9	50	4	7	=11	= 9	20	55
VII. Oxyinae	1	2	3	33	2	3	= 5	= 6	11	45
VIII. Coptacridinae	0	6	6	0	0	8	= 8	= 3	11	73
IX. Tropidopolinae	2	5	7	29	2	3	= 5	= 2	7	71
X. Calliptaminae	3	2	5	60	4	8	=12	= 0	12	100
XI. Eyprepocnemidinae	3	7	10	30	4	8	=12	8	20	60
XII. Catantopinae	12	14	26	46	18	14	=32	12	44	73
XIII. Crytacanthacridinae	0	7	7	0	0	1	= 1	8	9	11
Grand Total 13 sub-families	41	88	129 (Genera)	32	55	94	149*	107	256 spp.	58

Notes— * 1. Includes 8 subspecies belonging to 3 spp.

(+)2. Includes 24 subspecies belonging to 16 spp., also includes 12 spp.

\+ Without specific locality and 2 spp. of doubtful existence.

TABLE—2. Distribution of Indian genera and species*, biogeography-wise (Figures differ from that of table 1 as same genus/species represented elsewhere are counted each time separately).

Bio-geographic region	No. of genera		% of endemism	No. of species		% of endemism	Remarks
	Endemic	Non-endemic		Endemic	Non-endemic		
1. Eastern Himalayas (E. H.)	10	32	24	29	46	39	8 genera monotypical of which 7 genera are unique.
2. Western Himalayas (W. H.)	6	22	21	25	34	42	Only 1 genus, *Dicranophyma* with 2 spp. is unique.
3. Indian Desert (I. D.)	1	18	5	8	23	26	Only 1 monotypic genus and unique to the region.
4. Gangetic Plain (G. P.)	4	28	13	18	39	32	Only 1 unique monotypical genus *(Perella)*.
5. Malabar (M)	7	28	20	25	35	42	Only 1 monotypical and unique genus.
6. Deccan (D.)	24	37	39	63	51	55	17 monotypic genera - largest no. and all of them unique to this region.

Notes—*1. 23 endemic species and 12 non-endemic spp. are without specific locality.
2. 2 non-endemic species, availability of which is doubtful in India.
3. 12 non-endemic spp. widely distributed and common in all regions in India.

TABLE—3. Endemic species of Indian Acrididae—showing interregional distribution.

Name of species	Regions					
	E.H.(1)	W.H.	I.D.	G.P.	M.	D.
S.F. *Acridinae*						
*1. *Acridia indica* Dirsh 1954						
2. *Anaptygus rectus* Ragge 1954		+				
3. *Azarea indica* Singh 1979			+			
4. *Carcharacris chloroticus* Bol. 1914	+					
5. *Duraniopsis bitaeniata* Bol. 1914						+
6. *Gelastorrhinus* (?) *laticornis* (Ser. 1839)					+	
7. *Holopercna darjeelingensis* (Bol. 1914)	+	+				
8. *H. sukhadae* (Bhowmik, 1965)	+					
9. *Orthochtha indica* Uv. 1942		+		+		+
10. *Paraduronia carinata* (Bol. 1907)						+
11. *Paraphlaeoba platyceps* Bol. 1902						+
12. *Paraphlaeobida gracilis* Will. 1951						+
13. *Perella insignis* Bol. 1914				+		
14. *Pasiphimus sagittaeformis* Bol. 1914					+	
15 *Phlaeoba assama* Ramme 1941	+					
16. *P. ramakrishnai* Bol. 1914					+	
17. *P. rotundata* Uv. 1929						+
18. *P. sikkimensis* Ramme 1941	+					
19. *Phlaeobida angustipennis* Bol. 1902						+
20. *Pholina pictipennis* Bol. 1914						+
21 *Phonogaster cariniventries* Henry 1940						+
22. *Zygophlaeoba atractocera* Bol. 1914						+
23 *Z. faveopunctata* Bol. 1914						+
24. *Z. collina* Uv. 1929						+
25 *Z. sinuatocollis* Bol. 1902						+

	Name of species	Regions					
		E.H.(I)	W.H.	I.D.	G.P.	M.	D.
26.	*Z. truncaticollis* Bol. 1902						+
	S. F. *Gomphocerinae*						+
27.	*Aulacobothrus collinus* (Uv. 1926)					+	+
28.	*A. decisus* (W. 1971)					+	+
29.	*A. infernus* (Bol. 1902)						+
30.	*A. jaganathi* Bhowmik, 1985						+
31.	*A. strictus* (Bol. 1902)						+
32.	*A. socius* (Bol. 1902)					+	+
33.	*A physopoda* Navas, 1904	+					
34.	*A. rubripes* (Navas, 1905)	+					
35.	*Bababuddinia bizonata* Bol. 1918						+
36.	*Brachycrotaphus hoshiarpurensis* Singh, 1978			+			
*37.	*B. indicus* Uv. 1932						
38.	*B. longiceps* (Bol. 1902)						+
39.	*Capulica alata* Uv. 1929					+	+
40.	*C. pulla* Bol. 1917						+
41	*Carliola carinata* (Uv. 1929)						+
42.	*Catabothrus nilgiriensis* Uv. 1962						+
43.	*Dhimbama dawsoni* Henry 1940						+
44.	*Leva apicalis* (W 1871)					+	
45.	*L. mundus* (W. 1871)					+	
46.	*L. trapezoides* Bol. 1914						+
47.	*Julea indica* Bol. 1914						+
48.	*Madurea cephalotes* Bol. 1902						+
49.	*Mesopsis cylindricus* (Kirby, 1914)				+		+
50.	*Phonogaster cariniventries* Henry, 1940						+
51.	*Chorthippus (C.) almoranus* (Uv. 1942)		+				
52.	*C. (C.) indus* Uv. 1942		+				
	S. F. *Oedipodinae*						
53.	*Chondronotulus bengalensis* (Sauss. 1888	+				+	+
54.	*Dittopternis venusta* (W. 1870)	+				+	+
55.	*Meristopteryx rotundata* (W 1870)	+					

	Name of species	Regions					
		E.H.(1)	W.H.	I.D.	G.P.	M.	D.
56.	*Oedipodacris aberrans* Will. 1932	+					
57.	*Oedipoda himalayana* Uv. 1926		+				
58.	*Pusana laevis* Uv. 1921)	+	+	+	+		
59.	*Sphingonotux fallax* Mist 1937		+				
	S. F. *Romaleinae*						
*60.	*Kabulia indica* Ramme 1928						
61.	*Pelecinotus brachypterus* Bol. 1902						+
62.	*P. intermedia* Bh. & Dutta 1965	+					
63.	*Teratodes brachypterus* Carl 1916						
64.	*P. cristagalli* Bol. 1902						+
	S F. *Hemiacridinae*						
65.	*Clonacris kirbyi* (Finot 1903)						+
66.	*C. sila* Rehn 1944						+
67.	*Castetsia dispar* Bol. 1902						+
68.	*Leptacris maxima* Karney 1907 (Himalayas)						
69.	*Parahieroglyphus bilineatus* (Bol 1902)	+	+	+	+	+	
70.	*P. colemani* (Bol. 1912)					+	+
71.	*Hieroglyphodes assamensis* Uv. 1922	+					
72.	*Hieroglyphus indicus* Mason 1973					+	
73.	*Spathosternum abbreviata* Uv. 1929						+
74.	*S. medium* Uv. 1929					+	
*75.	*Zeylanacris continentalis* Will. 1962						
	S.F. *Oxyinae*						
76.	*Chitaura* (?) *indica* Uv. 1929					+	+
77.	*Hygracris malabaricus*					+	
78.	*H. palustries* Uv. 1921				+	+	
79.	*Oxya grandis* Will. 1925				+		
80.	*O. paravicina* Will 1925	+					
	S F. *Coptacridinae*						
81.	*Bambusacris travancora* Henry 1940					+	
82.	*Calamippa prasina* (Bol. 1902)						+
83.	*Circocephala indica* Bh. & Halder 1982	+					
84.	*Coptacra ensifera* Bol. 1902					+	+
85.	*C. punctoria* (Walk. 1870)						+

	Name of species	Regions					
		E.H.(I)	W.H.	I.D.	G.P.	M.	D.
86.	*Etesius waterhousei* Bol. 1918						+
87.	*Eucoptacra saturata* (W. 1870)	+			+		
88.	*Pseudocarsula tarsalis* (W 1870) (Sylhet-Bangladesh)				+		
89.	*Tinnevelli andrewi* Henry 1940						+
*90.	*Traulia aurora* Will. 1921						
91.	*T cachara* Kr. 1914	+					
92.	*T incompletus* Will. 1921 (Great Nicobar Island)						
93.	*Tropidopoda longicornis indica* Uv. 1937				+	+	
	S. F. *Calliptaminae*						
94.	*Brachyxenia scutifera* (W. 1870)						+
95.	*Caloptenopsis insignis insignis* (W. 1870)					+	
96.	*C. glaucopsis glaucopsis* (W. 1870)				+		+
97.	*C. glaucopsis liturifer* (W. 1870)		+				+
98.	*Caloptenopsis glaucopsis colling* Uv. 1950 (S. Himalayas)						
*99.	*Caloptenopsis punctata* Kr. 1914						
100.	*Indomerus noxius* Diresh 1951			+			
101.	*Peripolus pedarius* (Stal 1878)	+	+				
*102.	*Sphodromerus luteipes rubripes* Uv. 1943						
*103.	*S. undulatus pedestris* Uv. 1943						
*104.	*S. u salinus* Uv. 1943						
	S. F. *Eyprepocnemidinae*						
*105.	*Belonocnemis elongatulus* Bol. 1914						
106.	*Cataloipus indicus* Uv. 1942			+	+		
107.	*C. himalayensis* Singh 1978		+	+			
108.	*Choroedocus illustris* (W. 1870)		+				+
109.	*C. robustus* (Ser. 1839)	+				+	
110.	*Euprepocnemis bhadurii* Bh. 1968			+			
111.	*E. cyancscens* Uv. 1942						+
112.	*E. rosea* Uv. 1942	+	+		+		+
113.	*Eupreponotus inflatus* Uv. 1921	+			+		
114.	*E. punctatus* Singh 1978		+				
115.	*Navasia insularis* Kr. 1914 (Narandam Island, India)						
116.	*Paraeuprocnemis pictipes* Bol. 1902						+

	Name of species	Regions					
		E H (I)	W.H	I.D.	U.P	M.	D.
	S. F. *Catanlopinae*						
117.	*Alectorolophus bimaculatus* Kr. 1914	+					
118.	*Bhutanacridella elegans* Will. 1962	+					
119.	*Catantops erubescens* (W. 1870)	+					+
120.	*Coniocara rubropicta* Hanry 1940						+
121.	*Conophyma indicum* Mist. 1950		+				
122.	*C. kashmirensis* Mist. 1950		+				
123.	*C mitchelli* Uv. 1921		+				
124.	*Coptacrella martini* Bol. 1902						+
125.	*Cryptocatantops simlae* (Dirsh 1956)		+				
126.	*Diabolocatantops pulchellus* (W. 1870)						+
127.	*D. sukhadae* Bhowmik 1985		+				
128.	*Dicranophyma hingstoni* Uv. 1921		+				
129.	*D. babulti* Uv. 1925		+				
130.	*Genimen prasinum* Bol. 1918						+
131.	*Gerenia bengalensis* Bh. & Halder 1983	+			+		
*132.	*G dorsalis* (W. 1870)						
133.	*G. pustulipennis* (W. 1871)					+	
134.	*Indopodisma kingdoni* Uv. 1927	+					
135.	*Mopla guttata* Henry 1940						+
136.	*M. rubra* Henry 1940					+	
137.	*Naraikadua carmichaelae* Henry 1940						+
138.	*Opharus ballardi* Bol 1918						+
139.	*Palniacris maculatus* Henry 1940					+	+
*140.	*P. rugulosa* (Bol. 1902)						
141.	*Paraconophyma scabra* (W. 1870)		+		+		
*142.	*P polita* Uv. 1921						
*143.	*P. punctata* Uv. 1921						
144.	*Pileolum kirbyi* Bol. 1918						+
*145.	*Pirithoicus femoratus* (Bol. 1902)						
146.	*Rhinopodisma assama* (Uv. 1930)	+					
147.	*Siruvania dimorpha* Henry. 1940					+	+
148.	*Xenocatantops jagabandhui* Bhowmik, 1985		+				

*indicates spp. without known locality.

TABLE—4. Distribution of Non-endemic spp. in Indian fauna of Acrididae, with extra-territorial locality. (*indicates widely common species found in all regions) (12 spp.)

	Name of species	Regions						Extra territorial distribution
		E.H.	W.H.	I D.	G.P.	M.	D·	
	S. F. *Acridinae*							
1.	*Acrida exaltata*	+	+		+			Bangladesh, Sri Lanka, Pakistan, Afganistan, S. E. Persia, Arabia, S. E. Tibet.
2.	*Ceracris deflorata*						+	Burma.
3.	*C. nigricornis nigricornis*	+	+		+			Central Himalayas and Burma.
4.	*C. nigricornis laeta*	+		+				S. China (Tonkin), Taiwan.
5.	*Gonista filata*	+			+		+	China.
6.	*G. sagitta*					+	+	Sri Lanka, Burma.
7.	*Paraduronia simoni*						+	Sri Lanka.
8.	*Phlaeoba antennata*	+	+		+			Malayan peninsula.
9.	*P. infumata*	+	+	+	+			E. Nepal, Burma.
10.	*P. panteli*	+	+		+		+	Afganistan.
	S. F. *Truxalinae*							
11.	*Truxalis eximia*							India, Pakistan, Middle east countries.
12.	*T nasuta*					+	+	Cosmopolitan.
13.	*T grandis fitzgeralis*			+				Arab.
	S. F. *Gomphocerinae*							
14.	*Chorthippus (Chorthippus) indus*		+					West Pakistan.
15.	*Chorthippus (Glyptobothrus) hammerstroemi*		+					Siberia, China.

	Name of species	Regions						Extra territorial distribution
		E.H.(1)	W.H.	I D.	G P.	M.	D.	
16.	*Dnopherula (Aulacobothrus) bolivari*				+		+	E. Afganistan.
*17.	*D. (Aula) luteipes*	+	+	+	+	+	+	Burma, China, Japan, Europe and N. America.
18.	*D (Aula) sinensis*							N. Nepal, Burma.
19.	*Leva cruciata*					+	+	"Indies oriental" (t.c.), Sri Lanka.
20.	*L. indica*				+		+	Sri Lanka.
21.	*Ochrilidia geneculata*			+				Pakistan, Afganistan, Iran, Soudi Arabia, N. Africa.
22.	*O. gracilis gracilis*			+				Middle East, Africa.
	S. F. Oedipodinae							
23.	*Acrotylus humbertianus*				+	+	+	Sri Lanka, Pakistan, Afganistan.
24.	*A. insubricus insubricus*							India, Pakistan, Afganistan, Central Asia, Palaearctic and Africa.
*25.	*Aiolopus thalassinus tamulus*	+	+	+	+	+	+	Oriental and Australian regions, China, Japan, Philippines.
26.	*A. t. thalassinus*		+	+				Africa, Westwards to Palaearctic.
*27.	*A. simulatrix simulatrix*	+		+	+	+	+	India except W.H., Burma, Central Asia, Africa, Isles of Ocean westwards to Seychelles.
28.	*Bryodema luctuasum indum*							Himalayas Tibet.
29.	*Chloebora crassa*					+	+	Pakistan.
30.	*C. grossa*	+	+	+				Pakistan.
31.	*C. marshalli*				+		+	Sri Lanka.

	Name of species	Regions						Extra territorial distributions
		E.H (I)	W.H.	I.D.	G.P.	M.	D.	
32.	*Dittopternis zebrata*							India, Burma.
*33.	*Gastrimargus africanus africanus*	+	+	+	+	+	+	Africa.
34.	*G. africanus sulphureus*		+					Nepal, Pakistan.
35.	*G. marmoratus*	+						S.E. Asia from Assam, Sumatra, New Guinea, Japan.
36.	*Hilethera Oedipodiodes*						+	Sri Lanka.
*37.	*Heteropternis respondens*	+	+	+	+	+	+	E. Nepal, Sri Lanka, Burma, Far East Isles.
38.	*Locusta migratoria migratorioides*							Old world except Europe.
39.	*L. m. danica*							Old world.
40.	*Morfacris fasciata sulcata*					+	+	Sri Lanka, W. Africa.
*41.	*Oedaleus abruptus*	+	+	+	+	+	+	Nepal, Sri Lanka, Burma, Thailand, Pakistan, Afganistan.
42.	*O. rosescens*		+					N.E. Pakistan.
43.	*O. senegalensis*		+				+	Pakistan, Eremian Palaearctic, N. Africa.
44	*Pseudosphingonotus savignyi*		+					W. Pakistan, Afganistan, Central Asia, Russian, N. Africa.
45.	*Pternoscirta bimaculata*							Sri Lanka.
46.	*P cinctifemur*	+					+	E. Nepal, Sri Lanka.
47.	*Pusana regulosa*				+			Afganistan.
48.	*Scintharista blanchardi*		+			+		Pakistan, Central Asia, Africa.
49.	*S notabilis pallipes*							India, Iran, Afganistan.
50.	*Scientharista notabilis cinctipes*							"W. India" (Probably Pakistan).

	Name of species	Regions						Extra territorial distribution
		E.H.	W.H.	I.D.	G.P.	M.	D.	
51.	*S. n brunneri*	+		+				
52.	*Sphingonotus balteatus balteatus*					+		Arabia.
53.	*S caerulans*							"Himalavas" Europe, Africa.
54.	*S kashmirensis*		+					Afganistan.
55.	*S. longipennis*	+	+		+			E. Nepal, Central Asia, Europe, Africa.
56.	*S. montanus*							India, Arabia.
57.	*S. rubescens rubescens*							India, Central Asia, Afganistan, W. Pakistan, Europe, Africa.
*58.	*Trilophidia annulata*	+	+	+	+	+	+	Entire oriental region.
	S.F. *Romaleinae*							
59.	*Teratodes monticollis*					+	+	Sri Lanka.
	S.F. *Hemiacridinae*							
60.	*Gesonula punctifrons*	+			+			Japan.
*61.	*Hieroglyphus banian*	+	+	+	+	+	+	Sri Lanka, Burma, Palae, C.A. and Japan.
62.	*H. annulicornis*				+			China, Indo-China and Japan.
63.	*H concolor*	+						Bangladesh, Burma & China.
64.	*H. oryzivorus*			+	+	+	+	Pakistan.
*65.	*H nigrorepletus*	+	+	+	+	+	+	Pakistan.
66.	*Leptacris filiformis* (=*L. Greeni* : Uv 1923)					+	+	Sri Lanka.
67.	*L. vittata*	+					+	Sri Lanka, Pakistan, China & Indonesia.

	Name of species	Regions						Extra territorial distribution
		F.H.	W.H.	I.D.	G.P.	M.	D.	
*68.	*Spathosternum pra prasiniferum*	+	+	+	+	+	+	China, Pakistan, W. Africa & Thailand.
	S.F. *Oxyinae*							
69.	*Oxya diminuta*	+						Oriental countries including the Andaman Islands.
70.	*O fuscovittata*	+			+	+	+	Pakistan, Burma, Afganistan.
*71.	*O. hyla hyla*	+	+	+	+	+	+	Sri Lanka, Pakistan, Africa, North of Sahara.
72.	*O. japonica japonica*	+			+	+		Sri Lanka, China, Indo-China, Japan and Far East Isles.
73.	*O. nitidula*					+	+	Sri Lanka.
74.	*O. velox*	+			+		+	Burma and China.
	S.F. *Coptacridinae*							
75.	*Apalacris varicornis*	+						Chittajong (Bangladesh).
76.	*Epistaurus sinetyi*				+		+	Sri Lanka.
77.	*Eucoptacra praemorsa*	+				+	+	Burma and China.
78.	*Oxyrrhepes obtusa*	+				+		Sri Lanka, Burma, China and Far East countries.
79.	*Tristria pulvinata*	+			+	+	+	Sri Lanka.
	S.F. *Eyprepocnemidinae*							
80.	*Catailopus cognatus* (?)							North India—its availability in India doubtful.
81.	Choroedocus capensis (?)							African sp. (?). Its availability in India doubtful.

	Name of species	Regions						Extra territorial distribution
		E.H.(1)	W.H.	I.D.	G.P.	M.	D.	
82.	*Eyprepocnemis al. alacris*	+			+		+	Sri Lanka, Pakistan, Afganistan, E. Persia.
83.	*E. al. impicta*			+				Pakistan, S.W. Persia, Iraq, S.E. Arabia. (Recorded from Punchula—Haryana).
84.	*Heteracris nobilis*		+	+				Pakistan (t. c.)
85.	*H. pulcher*	+	+		+		+	Sri Lanka.
86.	*Shirakiacris shirakii*	+	+					Oriental, Japan, China, S. Russia.
87.	*Tylotropidius varicornis*					+	+	Sri Lanka, Burma, E. Nepal.
	S.F. *Catantopinae*							
88.	*Assamacris striata*	+						Burma.
89.	*Cingalia dubia*	+						Nagaland and Sri Lanka.
90.	*Coptacridia dorsalis*	+						China.
91.	*Dubitacris robustus*						+	Sri Lanka.
92.	*Pirithoicus ophthalmicus*						+	Sri Lanka.
93.	*Diabolocatantops pinguis*	+ (Sikkim)						China.
*94.	*D. innotabilis*	+	+	+	+	+	+	Sri Lanka.
95.	*Stenocatantops splendans*	+					+	Sri Lanka, Burma, Java, Andaman-Nicobar Islands.
96.	*Xenocatantops humilis*	+			+		+	Entire oriental, S. Tibet.
97.	*Xenocatantops brachycerus*	+						China, Taiwan, Described from N. India.

Name of species	Regions						Extra territorial distributions
	E.H (I)	W.H	I.D.	G.P.	M.	D	
98. *X. karnyi*		+				+	"Entire India except Eastern India", China, Taiwan.
99. *X. henryi*					+	+	N. Burma.
S.F. *Cyrtacanthacridinae*							
100. *Anacridium flavescens*					+	+	Sri Lanka.
101. *Cyrtacanthacris tatarica*				+		+	Oriental countries, Africa.
102. *Pachyacris vinosa*	+	+		+	+	+	Nepal, Burma, China.
103. *P. violascens*					+	+	Sri Lanka.
104. *Patanga (Patanga) succincta*					+	+	Sri Lanka, China, Far-East Isles., Africa.
105. *P. (P.) japonica*	+						Burma, Pakistan, China. Japan.
106. *Schistocerca gregaria*			+				Pakistan, Central Asiatic countries, Africa.
107. *Valanga nigricornis nigricornis*						+	Malayan archipelego.
108. *Chondracris rosea*				+			China, Java, Philippines.

SUMMARY

On the strength of chief phytogeographical regions, in relation with their main features and an analysis of the distribution of the Acrididae as has been studied by various authors on general as well as specific groups of grasshoppers, six biogeographical regions are recognized for the present political India and one for Nepal.

The Eastern Himalayan biogeographical region has an acridid fauna with a fair degree of endemism and distinct influence of South Chinese, Burmese and Western Himalayan elements. As a whole the region shows an admixture of fauna, having sppreciable likeness with G P. and Deccan among intraregionals in India, and with Burmese, Indo-Chinese, a few Japanese from the east; Pakistan, Afganistan, Central Asia and Palaearctic countries (through the western Himalayas) from the West; a fair representation of Sri Lanka elements are also found. The influence of Malaysian and African elements are, however, insignificant. A few unique alpine members well developed in W H. remain unrepresented here.

2. The Western Himalayan region, in keeping with its varied and peculiar climatic conditions and floral contains, has developed a high degree of endemism; the temperate and alpine genera have freely formed new spp It bears close resemblance to Pakistani, Palaearctic and African fauna, while western Chinese and Tibetan components are very poor. Unlike the eastern Himalayas, it contains far less Oriental elements; within Indian regions it is more close to E.H. and to some extent to G.P. but finds I.D. as a natural barrier, which check faunal migration southwards to Southern India from here.

3. The Indian Desertic region camprises of common and widely distributed spp., with rather weak endemism. The affinity exhibited by its acridid fauna almost follows its floral affinity. It shows strong resemblance to Palaearctic countries in its 'wides' components and to African one by its endemic spp. The representation of Oriental elements are moderate. Since the region acts as a natural buffer state, it has very incosspicuous elements common with other Indian regions.

4. The Gangetic Plain region because of its unique geographical position allows an admixture of grasshopper fauna, through between E.H. and D. regions as a gate-way of migration from the north-eastern to South or vice-versa. Its endemic components are rather poor. The

'wides' in order of decreasing orders, show alikeness to Oriental countries, Palaearctic and African countries, while regarding endemic the order is quite reverse. It also acts as a warm alluvial plain barrier to between most Himalayan and the Deccan grasshoppers, although exhibits maximum affinity to E.H. region.

5. The Malabar region has a fauna with fairly good endemism, and shows a decided influence of Sri Lankan elements. Keeping conformity with its floral affinity the region exhibits pronounced affinities to Sri Lanka and Malayasian than the Ethiopian fauna. It also has rather pronounced affinities with the fauna of Burma, S. China, Indo-China, Malaya and Japan, in decreasing order, indicating southern migration through E.H. and G.P. Distant countries like Celebes, New Guinea and Australia have also some influence over here, pointing out their primitiveness and remaining their affinity of continental period antiquity. Among intraregionals, the Deccan, because of its very close proximity and inseparable boundary, shows maximum affinity.

6. The fauna of the Daccan Region is the most populated one and is characterized by a high degree of endemism, both at generic and specific levels, and like the M. region, exhibits a distinct relation with the Sri Lankan fauna in particular and Oriental countries in general. It shows affinity next best with Ethiopion region by endemic spp. and to the Palaearctic region by 'wides' Within Indian domain it bears maximum closeness to M. and then to G.P. and least to E.H./W.H. and almost non to I.D.

7. The Ethiopian influence is more on Indian fauna an endemics whereas the Palaearctic exerts more influence as 'wides' spp.

8. The studies on endemism of 13 sub-families reveal that Calliptaminae exhibits maximum percentage of endemism at generic and specific levels (60% and 100% respectively). On the basis of the study, it also shows that India has a distinct fauna of grasshopper of her own, although she contains a fairly good non-endemic spp. (42%) also distributed in other countries.

9. Judged on the basis of 3 natural divisions of India, the Deccan, the oldest land mass, geologically speaking, depicts maximum endemism (Table 5) ; the Indo-Gangetic plain, the lowest. The parallel evolution in the Himalayan, the Peninsular fauna and factors responsible for are considered.

10. Isolation, whatever be its form, is the main factor which encourages endemism. Natural barriers like water-bodies to the South, lofty mountaneous ranges in the North, and the arid climate of Rajasthan and warm alluvial plain in the centre control acridid distribution and delimit their movement, both within and outside the country. The eastern border of the G.P. seems to act as a gate-way of acridid migration within India.

11 The endemic spp. belonging to non-endemic genera, mostly of Africa, and of Sri Lanka of continental days linkage, are of primitive stocks and not of relic or survival types. Indian endemic genera and spp. are, however, largely of recent origin and have nothing to do with 'age' in the evolution of the place. These are both in contradiction to principles applicable to endemic plants of India.

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