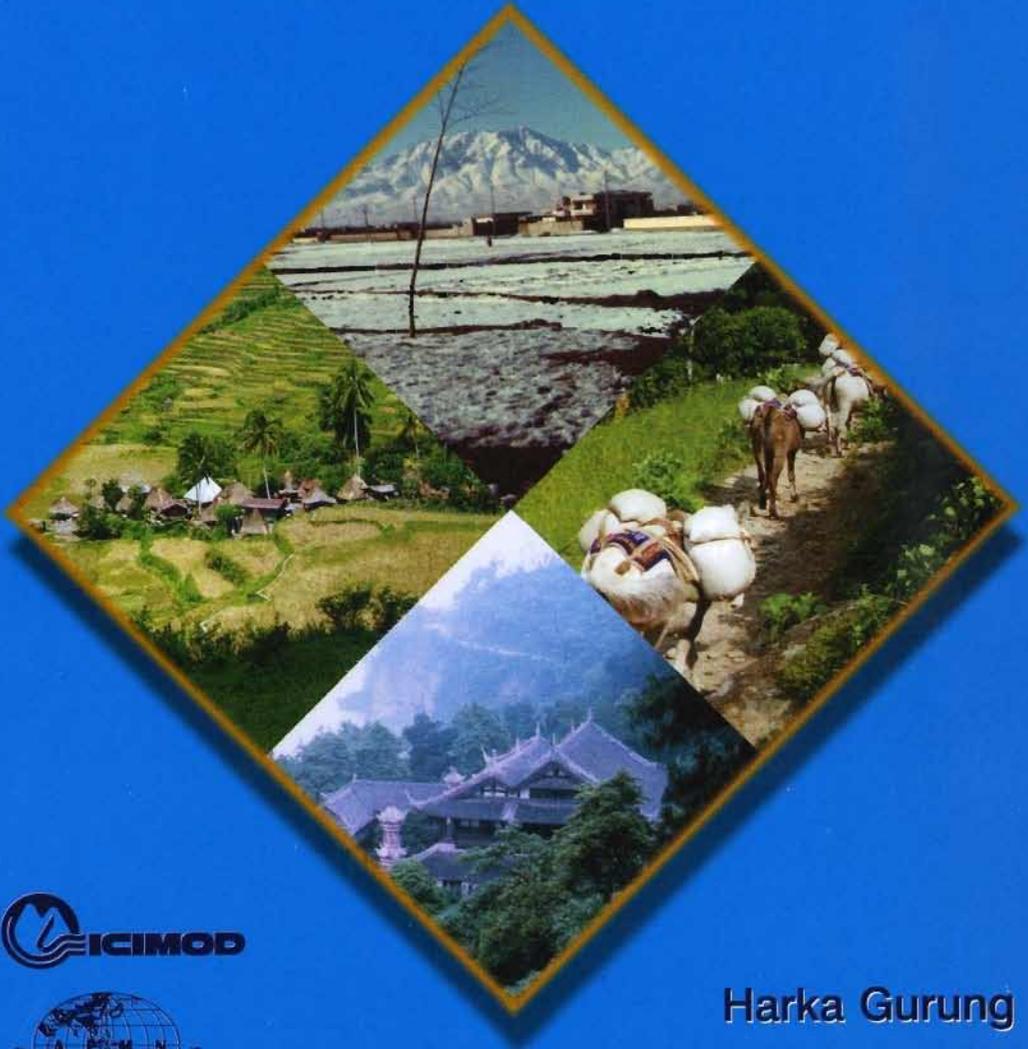


Mountains of Asia

A REGIONAL INVENTORY



Harka Gurung





International Centre for Integrated
Mountain Development



Asia Pacific Mountain
Network

Mountains of Asia

A Regional Inventory

Harka Gurung

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Snow in Kabul - Madhukar Rana (top)

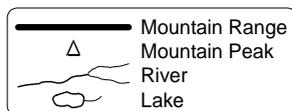
Transport by mule, Solukhumbu, Nepal - Hilary Lucas (right)

Taoist monastery, Sichuan, China - Author (bottom)

Banaue terraces, The Philippines - Author (left)

The Everest panorama - Hilary Lucas (across cover)

All map legends are as per Figure 1 and as below.



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Preface

Mountains have impressed and fascinated men by their majesty and mystery. They also constitute the frontier of human occupancy as the home of ethnic minorities. Of all the continents, it is Asia that has a profusion of stupendous mountain ranges – including their hill extensions. It would be an immense task to grasp and synthesise such a vast physiographic personality. Thus, what this monograph has attempted to produce is a mere prolegomena towards providing an overview of the regional setting along with physical, cultural, and economic aspects. The text is supplemented with regional maps and photographs produced by the author, and with additional photographs contributed by different individuals working in these regions.

I wish to thank ICIMOD for giving me this opportunity to learn more about the mountains. Therefore, I would like to express my appreciation to Mr. Egbert Pelinck, Director General, for the assignment and Dr. Mahesh Banskota, Deputy Director General, for the necessary support. Kathmandu is not the ideal location to search for literature on mountains beyond the Hindu Kush-Himalayas. This made me venture beyond, to Bangkok and Kuala Lumpur. In Bangkok, Mr. Kiran Pyakuryal made it possible for me to use the ESCAP Library, despite it being closed for the ESCAP's annual session. In Kuala Lumpur, Ms. Siti Rafeah Shamsudin of the APDC Library was most helpful. The regional maps were fine-tuned by Mr. A. K. Thaku of ICIMOD. Mr. Chandra Man Singh of New ERA typed the draft. I wish to thank them for their cooperation.

Foreword

As the International Centre for Integrated Mountain Development, ICIMOD's foremost focus has been and is the Hindu Kush-Himalayas. Notwithstanding, the Centre has always acknowledged the linkages and interfaces that exist between these mountains and other ranges in Asia. For this reason, the Centre had, with the help of the Swiss Development Cooperation (SDC), established the Asia Pacific Mountain Network (APMN) in early 1996. It is through this network that the Centre maintains important linkages through meaningful interfacing with other Asian mountain regions. One example of this has been the successful Council for Sustainable Development of Central Asia (CoDoCA) conferences on the mountainous countries of Central Asia.

This current document is a result of ICIMOD's search for linkages—ways of reaching out through partnerships to other mountain areas in Asia, so that we can share the most useful areas of our work with the mountain peoples on this continent and beyond. It provides a useful overview and insight into the mountain regions as dynamic entities in themselves. A glance through its pages gives readers some idea of the immense variety and richness of species, including the human species, that inhabit these interesting and challenging areas of the earth's surface. They have much in common and much that is unique to specific ranges.

ICIMOD would like to thank Dr. Harka Gurung for agreeing to take on such an unwieldy task in such a short period of time. I would also like to take this opportunity to thank the APMN programme of ICIMOD for helping to facilitate its publication in print and on the APMN section on Internet. The ICIMOD Publications' team has responded to the idea of having a printed version ready for the Mountain Forum conference in Cuzco, Peru, by working with alacrity to edit and process the document for printing.

We hope to show that all mountains of Asia have their commonalties, but we also hope to emphasise their uniqueness and the value they do bring and will bring to life on earth in the 21st century.

Egbert Pelinck
Director General

Abstract

This book provides a description of Asian mountain and hill ranges according to geographic grouping. There is a heavy emphasis on the Himalayas since the text is based on documentation available in the Himalayan region, given the fact that travel outside the Hindu Kush-Himalayas was limited within the specific time frame. Nevertheless, the author has used his ingenuity to supplement the information on other ranges from many sources, including internet. He describes 110 mountain and hill ranges in 37 countries. A qualitative account of salient features is given. The mountains of Asia have been divided into six regions; namely, South Asia, West Asia, Central Asia, North-East Asia, South-East Asia, and Australasia. This book will be of great interest to those who are unfamiliar with the mountain areas of Asia and to those who are familiar but need ready reference to them. It has a valuable, comprehensive bibliography and a mountain glossary of indigenous terms for physical features and land use in 35 languages. Each region has its own map focussing on its mountain ranges.

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Chapter 1

Introduction

1.1 Purpose

Mountains everywhere constitute a dominant feature of the landscape and pose a challenge to human endeavour. Since the dimension of human endeavour covered in this survey is basically economic, there is minimal treatment of mountain peaks and the exploits of alpinists. The basic approach to this enquiry is to portray mountain areas as composite entities encompassing both pedestals and pinnacles. Much of current mountain research, whether for scientific or application purposes, tends to be either too sectoral or too area specific. Even in the case of geography, a discipline supposed to study phenomena of places, the recent emphasis is on behavioural aspects without considering physical factors (Soffer 1982). Unidisciplinary investigations may enrich systematic knowledge, but their lack of areal context creates problems in terms of comparability and replicability. Hence, the rationale for a synthesis of diverse factors to produce a general systems' overview for comparative analysis. The main purpose of this study is to establish a broad spatial framework for mountain areas in the Asia-Pacific region. This has necessitated positioning their physical, cultural, and economic aspects into a holistic regional setting. Such a composite landscape is based on description of the geological structure, physiographic expres-

sion, natural environment, and human occupancy. The output is a set of regional templates of coherent spatial phenomena that facilitate the contextualisation of specialised investigation and research.

The mountains of Asia are spread over a vast area and an investigation of such dimensions needs to reconcile the hierarchy of scale. In this context, the three levels of building blocks visualised are: (1) individual ranges as micro-components, (2) their grouping as meso-regions, and (3) finally, the continent as the macro-realm. The intermediate meso-level constitutes the logical vantage point of convergence for micro-analysis and macro-synthesis. Therefore, the focus of this study is on the regional level.

The next six chapters provide a description of Asian mountain and hill ranges according to geographic grouping. There is an obvious imbalance in information about the regions owing to the lack of access to publications about areas outside the Himalayas. Moreover, there is a greater amount of literature on the Himalayas than on other areas because the region has a longer history than the other mountain regions of Asia in terms of exploration and adventure. Surfing the Internet yielded some information, but this was mainly on tourism and mountaineering rather than about



1. **What is a Mountain?** Mount Everest from the south. The highest peak in the world at 8,848m peeps over Nuptse-Lhotse ridge in Khumbu, Nepal. Strong westerly winds deflect the cumulus clouds from the highest summits. The alps in the foreground provide summer pasture for yaks.

scientific facts. As an example, the Asia-Pacific section of IUCN's 'The Regional Mountain Profiles' includes 59 mountains of Asia but, of these, 42 are ranges, 11 individual peaks, and six are given by territorial names in Indonesia (IUCN 1988). Hence, providing balanced information about different areas of this region meant pruning out materials on the Himalayas and fleshing out information on other mountain areas through map interpretation.

The survey describes over 110 mountain/hill ranges spread over 37 countries. Since demographic information and economic (statistical) indicators follow administrative/political units, it was not possible during this exercise to disaggregate these by mountain areas. The emphasis, therefore, has been on giving a qualitative account of selected salient features. Finally, mountain areas provide a refuge for relict cultures. This is apparent from the mountain glossary (Appendix I) of indigenous terms for physical features and land use which contains terms from 35 languages.

1.2 Definition

What is a Mountain?

Literature on mountains is extensive and voluminous. Yet, there is no rigorous definition of

universal acceptance of what constitutes a mountain. Most discussions on mountains and their development merge the concept of *montaigne* (Old French, meaning a considerable height) with the concept of the old English term *hyll* (small mound), and these are not the same. Such transposition is also evident in the poetic imagery of Wilfrid Noyce (1954, p 294):

Everest: terror and love:
 No veil is upon you, no cloud
 Doubts the huge hump, mighty monument set on earth,
 Harp of the wind, snow-song and avalanche tears,
 And tinier tale of men. But men are so proud,
 Their mole-story is hill-high (see Plate 1).

According to Geoffrey Winthrop Young, a mountain is "*earth set on earth a little higher.*" Thus, it is relative and subjective—that is, whatever strikes fire in the imagination. Therefore, one person's mountain is another person's knoll (Hanson 1988, p.8). The definition provided by a classic on mountain geography (Peattie 1936, p 1) is similar:

"A mountain, strictly speaking, is a conspicuous elevation of a small summit area. A plateau is a

similar elevation of a larger summit area with at least one sheer side. An essential yet indefinite element in the definition of a mountain is the conspicuity. Conspicuity, like height, is a relative matter, and depends upon the evaluation or the standard by which it is measured.”

In other words, a mountain is a mountain because of the part it plays in popular imagination. Therefore, the cult of the mountain (*shugendo*) as a sacred place and poetic eulogies such as those characteristic of *Meghadut* (Kalidasa, 5th Century), *Die Alpen* (Albrecht von Haller, 1708-77), *Wilhelm Tell* (Johann Christoph Friedrich von Schiller, 1759-1805), and *Childe Harold* (George Gordon, Lord Byron 1788-1824). Mountains may be considered sacred, sublime, and beautiful. They also happen to be marginal areas for human occupancy due to their high altitude and steep gradient. Yet, the mountain is not an amorphous mass but a composite of elevation zones. This is evident from indigenous terms from the mountains of Nepal such as *pahar* (hill without snow), *lekh* (ridge with winter snow), and *himal* (range with permanent snow). These terms are indicative of socioeconomic zones with intensive land use at lower levels, extensive use at intermediate levels, and no use at upper levels.

This regional survey of a land mass as large as Asia needs objective criteria. Thus, only those ranges and plateaus that exceed 1,000 masl have been considered as mountains; and this includes high hills also. Thus, the enquiry has been confined to altitudinal zones of *hochgebirge* (glaciated) and *mittelgebirge* (non-glaciated) mountains as defined by natural science. An overview of this kind, focussing on conspicuous ranges, cannot

provide an in-depth regional analysis of a composite environment and its interaction with the adjacent lowlands. Hence, the preference given to the term mountain area instead of mountain region, as this is the appropriate terminology for the spatial aggregation.

1.3 Asian Context

It is estimated that some 40 million sq.km. or 27 per cent of the total land area of the world lies above 1,000 masl. The break down of this elevated land surface is as follows: 24 million sq. km. at 1,000 - 2,000 m, 10 million sq. km. at 2,000 - 3,000 m, and six million sq. km. above 3,000m (Louis 1975). Another earlier source put the total area worldwide, defined as ‘mountain type’, to be 50 million sq. km. (Trewartha et al. 1968). Accordingly, such areas account for 35 per cent of the world’s total area. The mountain types defined by elevation range were hills (0-300m), low mountains (300 - 900m), and high mountains (above 900m). Eurasia dominates all other continents in terms of low and high mountains (Table 1). Arab geographers in the Middle Ages, in their imaginative way, regarded the Eurasian landmass as a desirable woman clothed in nothing but a long chain girdle about her ample waist. This girdle was of mountains studded with snowy peaks that stretched from the Pyrenees through the Alps, Balkans, Caucasus, and Elburz to the limits of the known world in the Hindu Kush and Himalayas. Most of the mountain areas of Eurasia are concentrated in the Asian sector.

Asia is unique among the continents in that it is mountain-hearted (Ginsberg 1958, p3). The vast

(in per cent)

Mountain Type (Elevation range)	Africa	Australia	Eurasia	North America	South America	World
High Mountains (900m +)	4	1	23	16	11	13
Low Mountains (300 - 900m)	13	12	21	10	11	14
Hills (0 - 300m)	11	12	10	18	5	8
Total	28	25	54	44	27	35

Source: Trewartha et al. 1968, p 231

complex of mountains and plateaus around Tibet forms the core of the Asian mountain system. This heartland is bounded on the south by the Himalayan arc, on the west by the Pamir, on the north by the Tien Shan, and on the east by a complex of ranges. The mountain core acts as the hub of a colossal wheel, the spokes of which are provided by some of the greatest rivers in the world. The ranges and plateaus of mainland Asia, extending west/south-west and east/north-east for nearly 8,000 kilometres, constitute the largest mass of highlands in the world. According to a list of 121 peaks exceeding 6,100m prepared by the National Geographic Society, those ranked from the first to 66th place and above 7,000m are all from Asia. Furthermore, the Nepal section of the Central Himalayan Range alone has over 1,300 peaks and pinnacles that exceed 6,000m in elevation (Gurung and Shrestha 1994). The Pamir knot acts as the pivotal node from whence the main ranges diverge into three directions: south-east, west, and north-east. In west and central Asia, the ranges merge into vast desert expanses. To the south and east, they descend to high relief hills and also extend as the spine of island chains. The prominent ranges included in this overview are listed by region (Annexes A-F). Various aspects of the Asian mountains are described according to the following six regions: viz., 1.) South Asia, 2) West Asia, 3) Central Asia, 4.) North-East Asia, 5) South-East Asia, and 6) Australasia.

A region or sub-region, of whatever hierarchy, assumes internal cohesion and external bound-

ary. Therefore, in demarcating Asian mountains into regions, an explanation of the methodology is needed. The main bases for demarcation were conventionally recognised geographic ones such as (1) South Asia, south of the Pamir, (2) West Asia, beyond Afghanistan, (5) South-East Asia, and (6) Australasia. More problematic was recognition of the boundary between (3) Central Asia and (4) North-East Asia. An arbitrary approach was taken in this delimitation: political in the north and physiographic in the south. Thus, Mongolia was taken as the eastern extension of Central Asia in the north and ranges contiguous to the Tibetan plateau were considered to be Central Asian in the south. The other ranges of China were included in North-East Asia.

The recognition of discrete ranges within each region is based mainly on their contiguity internally and the existence of major rivers and land depressions externally. However, two exceptions should be considered. These are the sub-division of the Himalayas of South Asia into sections and the island individuality in South-East Asia. In the case of the former, recognition has been given to the conventional three sections of arid west, transitional central, and humid east (Table 2). In the latter case, each island chain is given a separate identity with the surrounding sea as their boundary. Regional treatment is in a clock-wise sweep, commencing from South Asia and ending with an outward loop towards Australasia. The sequence of regional description, therefore, is as follows: South Asia, West Asia, Central Asia, North-East Asia, South-East Asia, and Australasia.

Chapter 2

South Asia

South Asia, corresponding to the Indian sub-continent, has three major physiographic components based on geologic structure and terrain. These are: (1) the Himalayan and associated fold mountains, (2) the ancient crystalline block of Peninsular India, and (3) the alluvial Indo-Gangetic lowland in between the two. The last component is an extensive plain and lies outside the mountain realm. Nevertheless, its genesis owes much to the deposition of materials from the adjoining highlands. The vast thickness of its sediments, up to 6,500 metres along the foothills, is indicative of the dynamic processes operating in the Himalayan Mountains. The mountain ranges of the first two physiographic components are grouped into five units: the Karakoram, the Himalaya, north-east ranges, peninsular ranges, and north-western ranges (Figure 1 and Annex A). They are described in a clock-wise sequence starting from the Karakoram in the extreme north.

2.1 The Karakoram

The name **Karakoram** (black gravel or stone) is derived from the Karakoram Pass (5,570m) which does not even cross the main range but lies further east. Although the crest zone of the Great Karakoram is conventionally so called, the individual sections of high mountains are known as *muztagh* (ice mountain). The Karakoram Range

forms the water-parting between drainage into the Indian ocean and into the deserts of Central Asia. It is also an important geological link between the Hercynian Pamir and the Alpine Himalaya.

The Karakoram Range extends over 350 km in an east-south-east/west-north-west direction from the Siachen-Shyok confluence in the south-east to the Ishkuman River in the north-west. The high mountains are bounded by the Indus gorge and the Ladakh Range to the south, desolate plateau to the east, the Aghil Mountains to the north, and the Hindu Kush westwards beyond the Kurumbur River. Structurally, the Karakoram Range is composed of three units: the northern sedimentary zone, the central metamorphic zone with a plutonic core, and the southern volcanic schist zone.

“Still puzzling, and certainly one of the most fascinating future studies, are the connections of the N-S-striking Nanga Parbat elements of the Himalayas with the here almost E-W-striking Karakoram” (Gansser 1964, p38).

Such geological complexity is matched by extreme relief as the Karakoram Range has the greatest assemblage of giant peaks, with 33 over 7,325m, among which is K-2/Godwin Austin (8,611m). The area is the most heavily glaciated

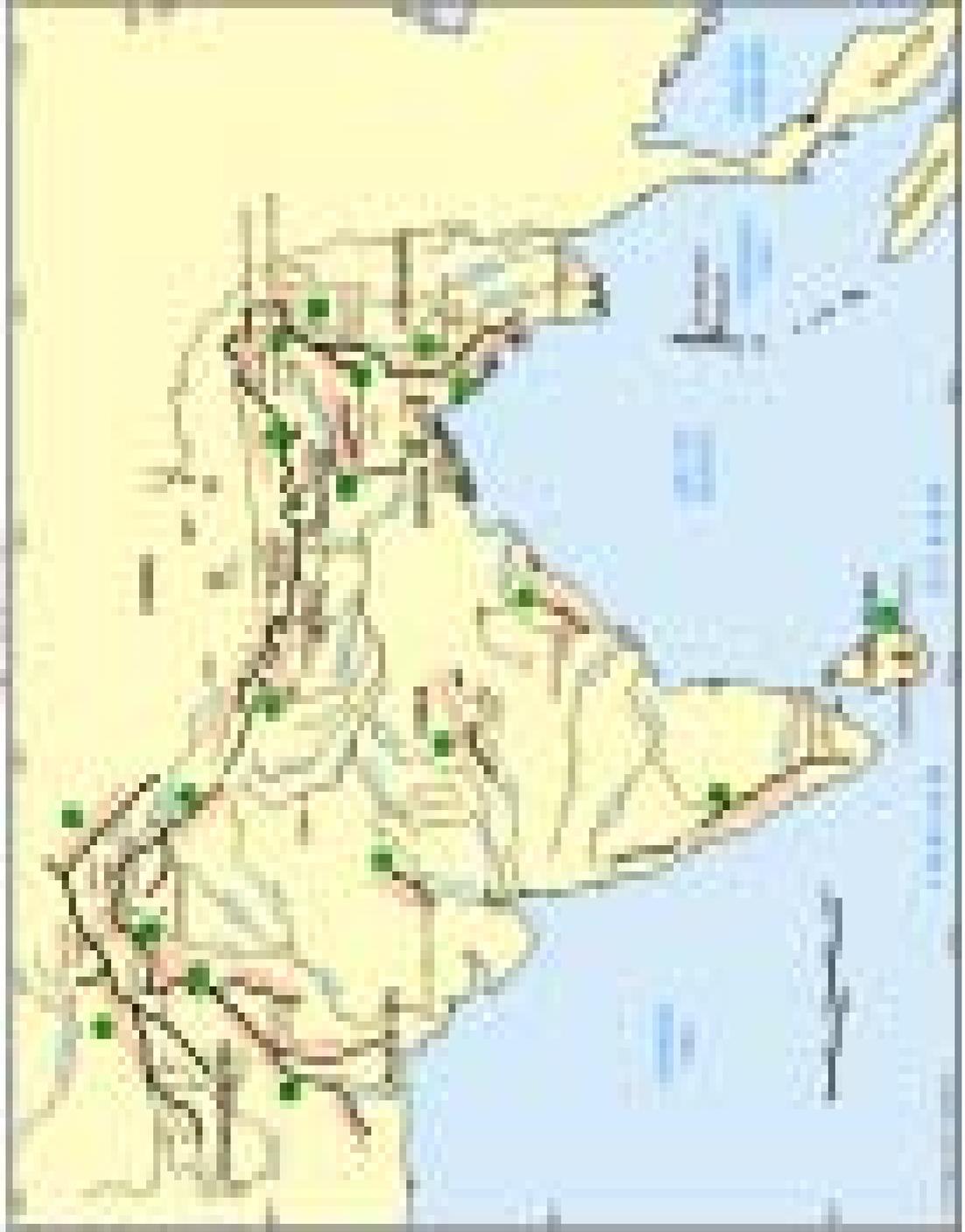


Figure 1: South Asia



Author

2. Karakoram Landscape, Pakistan. Section of Indus River and Karakoram Highway, south of Gilgit. Hamlets are spread on two levels of talus terraces irrigated by long channels from tributary streams. The lowest terrace beside the Indus has an army camp for road maintenance.

outside sub-polar latitudes: 28 to 50 per cent compared to eight to 12 per cent for the Himalayas and 2.2 per cent for the Alps. Therefore, it contains some of the longest glaciers outside sub-polar regions.

Much of the area is wild and rugged. Westwards, in Gilgit and Hunza, settlements are located on river terraces and hanging valleys at elevations ranging between 1,850m and 2,200m (Plate 2). Higher up, pastures extend from 2,000m to 3,500m. Tiny fields and orchards are irrigated by elaborate channels of melt-water. Some Hunzakut terms for varied land use are *bassikish* (orchard), *harkish* (cultivated land), *ter* (high pasture), and *tog* (irrigated meadow)). Two-thirds of the population of Hunza is Burusho, the rest being Wakhi (19%) and Shinaki (13%) and a minority of Dom (1.1%) (Kreutzmann 1993). Originally a Shiite island in Sunni Pakistan, the area has become a stronghold of the Ismailiya faith. Fruit cultivation is of the utmost importance in these valleys. In Baltistan, further east, barley cultivation depends on the snow. The hot summer enables the cultivation of a wide variety of fruit species. Aksai Chin, the northern glacis of the Karakoram itself, merges into a harsh plateau where even pasto-

ralism is difficult. In the past, the remote valleys of the Karakoram provided a passage for hardy traders and pilgrims across domains of feuding chieftains. Their turbulence has since been replaced by major rivalries between India and Pakistan in Kashmir, and China and India in Aksai Chin. These military conflicts have opened up the area with stupendous roads, such as the 753km Karakoram Highway, that also sustain the local economies through providing access to markets.

2.2 The Himalaya

The word Himalaya is a compound of Sanskrit words, hima for snow and alaya for abode, referring to the lofty range between the Indo-Gangetic plain and the Tibetan plateau. It extends nearly 2,400 km in a vast southerly arc between the bend of the Indus marked by Nanga Parbat (8,125m) on the west to the Brahmaputra bend around Namcha Barwa (7,755m) in the east. The Himalayan Range is the loftiest mountain complex on earth with 31 peaks exceeding 7,600m in height. The extreme elevation and rugged relief are the result of rapid mountain-building forces and vigorous erosion processes. Therefore, the Hima-

layan chains are not massive elevations but narrow ridges. In places, they are traversed by extremely deep river gorges resulting in great vertical contrasts over very short horizontal distances.

The Himalayan Range is a singular entity of immense physical dimension. Therefore, the use of its plural form, Himalayas, in geological and geographic context. The former pertains to the north-south transverse section of structural formation while the latter refers to the east-west longitudinal sections of regional units. The well-recognised geological units rising in echelon from the south to north are the Siwalik, the Lesser Himalaya, and the Great Himalaya. The Siwalik Range, also called the sub-Himalaya, is the youngest of all, and abuts the plains as foothills dipping to the north. It extends from the Indus almost to the Brahmaputra with one gap of over 300 km from the Sapta Kosi to the Manas River where the fierce monsoon erosion has almost worn it away completely. The second, the Lesser Himalaya, is older and higher than the Siwalik Range, but with the same strike alignment. The structure is more complex, being contorted by uplift into recumbent folds with older sedimentaries overthrusting younger ones. The Great Himalaya, the axis and crystalline core of the whole range, is composed mainly of intruded granites and gneisses with

some sedimentary remnants on the summits. Apart from at river gorges and some passes, the crest of the Great Himalaya rarely falls below 5,500m. Between the Indus and the Brahmaputra, the main range has been breached by four rivers only: the Sutlej, the Karnali, the Kali Gandaki, and the Arun.

The above three-fold geological division of the Himalaya has a general consensus. In contrast, the division of the Himalaya into east-west sections is much at variance, according to authority and approach. Although most delimitations are based on major rivers and political units, the number of sections range from Burrard's four to Bose's nine (Table 2). A standard survey on Himalayan exploration recognised five sections (Mason 1955). These were (1) the Punjab Himalaya between the Indus and Sutlej rivers, (2) the Kumaon Himalaya between the Sutlej and Mahakali-Sarda rivers, (3) the Nepal Himalaya with three sub-sections between the Mahakali-Sarda River and Singalila ridge, (4) the Sikkim Himalaya corresponding to the Tista basin, and (5) the Assam Himalaya, east of Sikkim to the Brahmaputra-Dihang. Another authoritative regional study on the Indian sub-continent proposed eight sections (Spate 1957). It further designated Kashmir and the Karakoram as western;



3. Gurung Village, Nepal. Naiche (1,402m) is a compact village of 54 houses perched on a ridge to save level ground for fields. The economy is based on maize and paddy cultivation along with sheep herding. Most households have a member serving in a foreign army.

Table 2: Sections of the Himalayan Range

Source	Western		Central		Eastern		No.	
Bose (1972)	Jammu & Kashmir	Himachal Pradesh	Chagra	Gandak	Sikkim	Bhutan	Assam	9
Gansser (1964)	Punjab	Kumaon	Nepal		Sikkim/Bhutan		NEFA	5
Spate (1957)	Karakoram Kashmir	Himachal Pradesh	Nepal		Sikkim	Bhutan/Assam		8
Mason (1955)	Karakoram & Punjab		Karnali	Nepal	Sikkim	Assam		5
Burrard (1907)	Punjab		Nepal		Assam		Assam	4
Km	0	870	1,670	2,470				

Section Boundary

Primary ————

Secondary - - - - -

Tertiary



4. Traditional Bhutanese Dance

Himachal Pradesh, Kumaon, and most of Nepal as central; and east Nepal, Sikkim, Bhutan, and the NEFA as the eastern Himalaya. A more logical division seems to be that of Bose (1972) which has nine sections (Table 2) grouped into three primary divisions, each with three secondary sections. Thus, (a) the Western Himalaya includes Jammu & Kashmir, Himachal Pradesh, and Uttarakhand; (b) the Central Himalaya includes the Ghagra (Karnali), Gandak, and Kosi basins of Nepal; and (c) the Eastern Himalaya, the sections of Sikkim, Bhutan, and Assam. The whole area hosts a variety of settlement patterns and peoples (Plates 3 and 4).

The Western Himalaya, extending 870 km from the Indus to the Mahakali-Sarda rivers lies in political India. West of the Ravi, the width of the mountain proper is close to 483 km with parallel ranges of the Siwalik, Pir Panjal, Main Himalaya, Zaskar, and Ladakh. The climate is influenced by the westerly cyclones and is markedly dry. The economy is partly agriculture with irrigation and partly nomadic. East of the Ravi, the range systems of the Siwaliks, Dhaula Dhar, and Main Himalaya are much more compressed than the 483 km of the mountain proper. Crop cultivation is general, although the nomadic *Gaddi*, a group similar to the *Bakarwal* of Kashmir (Casimir and

Rao 1986), practice seasonal transhumance (Box 1). Forest resources also become important. Culturally, Himachal Pradesh and Uttarakhand are decidedly Hindu in contrast to the predominance of Islam in Kashmir and Buddhism in Ladakh.

The Central Himalaya, extending 800 km from the Mahakali-Sarda to the Mechi rivers, corresponds to the longitudinal extension of Nepal encompassing the Karnali, Gandaki, and Kosi basins. The main ranges include the Chure (Siwalik), Mahabharat *Lekh*, Lesser Himalaya, and Main Himalaya. West of 80° longitude, a tributary range diverges north-west from the Himalayan axis to mark the watershed between the Ganges and the Tsangpo. Of the world's 14 peaks exceeding 8,000 metres, eight are in the Central or Nepal Himalaya. The climate is very much influenced by the rhythm of the monsoons. Subsistence crop farming is predominant and the humid east has a higher population density than the west. The ethnic interface is apparent with a predominance of caste Caucasoids in the western and lower zones and of tribal Mongoloids in the eastern higher zones.

The Eastern Himalaya, extending another 800 km east of Nepal, is mostly in political India, a gap being formed by Bhutan. The main axis is

Box 1

Land Use Diversity in the Himalaya

The Himalayan Range extends over nine degrees of latitude and 22 degrees of longitude. Thus, there is significant variation in ecological environment. The first variation is latitudinal in that the upper timber-line rises from 3,400 - 3,800m in the southern ranges to 4,400-4,600m in Tibet¹. The second variation is zonal and related to altitude, from the tropical valley bottom to the alpine snow heights. The third variation is due to the climatic asymmetry from the humid south-east to the arid north-west. Land use is influenced by the biogeographical regime expressed in the type of flora and fauna. Transhumance, sedentary agriculture, and shifting cultivation are three types of divergent responses to highland use. They not only represent varied stages of land occupancy but can also co-exist as complementary economies.

1. **Transhumance:** The example of transhumance is from the Western Himalaya. The basic characteristic of the highland is vertical zonation of resources, and people have to be mobile in order to use them. This is best represented by the seasonal movement of people with their animals. This pattern of land use is particularly pronounced in the arid Western Himalaya. The Bakarwal, a nomadic group, practise sheep and goat husbandry, exploiting the various biotopes of different altitudes². This extends over 250 km from Kathuwa in Jammu to Dras in northern Kashmir. They winter in the foothills in Jammu (500-1,000m) where their herds feed on Acacia-Carissa woodlands. The upward migration commences in mid-April and passes through sub-montane, montane, and alto-montane vegetation zones in succession. The summer pastures until the end of August are between 3,000-4,000m in elevation. En route, they have to contend with both settled agriculturalists and forest administration. Such an extended system of land use is a strategy to maximise a subsistence livelihood (Plate 5).



5. Forests and Meadow, Kashmir. Horses of Bakarwal herders grazing on the north slope of Pir Panjab. The main herd consists of sheep and goats that traverse seasonally between Dras in Summer and Jammu in Winter.

2. **Sedentary Agriculture:** The example of sedentary agriculture is from the Central Himalaya. Kakani area, north-west of Kathmandu, is at 1,250-1,650m and includes agricultural land of two types³. Lower irrigated fields have terraces with horizontal surfaces and bunds to retain water for paddy. The upper fields have outward sloping terraces and grow crops such as maize and millet (Plate 6). Still higher up are common shrublands for animal grazing. The most pervasive environmental risks are landslides on upper slopes and floods in the valley bottom. What farmers know about landslides is closely connected to their assessment of land for agricultural use. There are two divergent responses. One is de-intensification whereby irrigated land is used for dry crops with lower labour input and lower yield per unit of land. Decisions to intensify imply in-

creased hardship to the household and are made only in the face of lack of resources for restoration. On the other hand, pressing household needs induce the tendency to upgrade all land to its most intensive use. The more valuable the land and every practicable effort is expended to protect it. Encroachment on marginal land on higher and steeper slopes is one of the causes of erosion in the highlands of Nepal. Overall, the higher the productivity of the land, the greater the effort for maintenance to minimise environmental risks.



6. Terraced Field on Mountain Slopes



7. Burning Fields for Shifting Cultivation (*Jhuming*)

Tang Ya

3. **Shifting Cultivation:** The example of shifting cultivation is from the Eastern Himalaya where the humid climate supports luxuriant vegetation. Shifting cultivation or *jhum* (collective in Assamese) is the easiest, cheapest, and most profitable technique of land use available to tribal communities in north-east India⁴. A suitable patch of hill slope is selected for clearance based on type and growth of vegetation, depth and texture of soil, and exposure to sunshine. The vegetation is cut and left to dry before it is set on fire (Plate 7). Big trees are not felled. The alkali content of the ash neutralises the

acidic content of the humid soil. No animal power is used and seeds are either dibbled with a stick or broadcast with little disturbance to the land surface. The method basically involves cultivating sloping ground without terracing and other permanent investments. What is exploited is the natural fertility of the land. When the soil loses its fertility, the patch is abandoned and another area is cleared for cultivation. Long rested *jhum* land is usually fertile and can be used for two to three years. A number of patches of land are thus locked under a *jhum* cycle. Environmental problems under shifting cultivation has generally to do with the length of the rest period: the shorter the cycle of *jhum* with population pressure, the greater the soil erosion.

Source: Harka Gurung. 'Mitigation of Environmental Risks in the Highlands'. Paper presented at IFAD Project Implementation Workshop for the Asia and Pacific Region, Chengdu, China, 22 Oct-2 Nov 1990

1. Troll 1967
2. Casimir and Rao 1986
3. Johnson et al. 1982
4. Barthakur 1981

emphatic despite being comparatively low where some of the lowest passes in the Himalaya occur. In this section, the Lesser Himalaya appear quite prominent in Sikkim and Bhutan. Further

east, the range is more compact, scoured by only a few rivers. The climate is decidedly humid with rich vegetation, and shifting cultivation is common. Sikkim, enclosed between Nepal and Bhu-

tan, has three distinct population groups. The autochthonous Lepcha practice slash-and-burn agriculture following a seven-year rotation cycle (Bhasin et al. 1984). The Bhotia of the north engage in transhumance with herds of yaks and sheep. The southern area has been overwhelmed by migrants from east Nepal who practice sedentary cultivation of rice and maize. Cardamom, as a cash crop, was introduced at the beginning of this century. Bhutan is the least populated state in South Asia with much of its forests still in a pristine state. The population is predominantly Bhotia with some Monpa tribals in the south-east. The people of the East Himalaya are Mongoloid, practising Lamaist Buddhism in Sikkim and Bhutan while others are mostly animists. The tribal groups east of Bhutan are the Aka, Monpa, Nishi, Miri, and Abor (Rustomji 1971).

2.3 The North-East

The Himalayan wall, which runs due east-west from Sikkim through Bhutan, bends north-east culminating in the Namcha Barwa (7,755m). It is possible that the Himalayan fold systems extend eastwards into China. However, there is a sharp contrast in tectonic structure west and east of the Dihang-Brahmaputra gorge: south-west/north-east in the NEFA and distinctly north-south further east. This is expressed by a succession of ranges trending south along the Indo-Myanmar border.

The first section of mountain barrier between India and China, east of the Dihang Gorge, is the Mishmi Hills with a high point at Kadusam (5,106m). Drained by the Dihang and Lohit rivers, the area is rugged with dense forest. Then follow the Patkai, Naga, Chin, and Arakan Ranges along the Indo-Myanmar border. These form the great Arakan arc made up of tightly packed parallel ridges and valleys with trellis drainage patterns. Geologically, they are of Mesozoic formation in Arakan, Tertiary in the Naga hills, and Precambrian further north. The ridges rarely exceed 2,000 metres, although some peaks in the Chin, Naga, and Patkai Ranges exceed 3,000 m, the highest being Dalphi Bum (4,578m).

The area is mostly hilly and mountainous. With monsoon rainfall exceeding 2,000 mm, the ranges have dense vegetation of tropical evergreen and deciduous species. The people are a mosaic of Mongoloid tribes. Their villages tend to concentrate on ridge tops to avoid malarial valleys and for defence. Shifting cultivation, known as *jhum* or *taungya* (mountain field), is common for cultivating upland rice, maize, and millet with the aid of dibble sticks. Forest products, such as bamboo, honey, wax, and lac, are sources of supplementary income. Lying on the frontier of India and Myanmar, these lands once harboured raiding parties of rival head-hunters. Such rivalries have been superseded now by conflicts over ethnic nationalism (Lintner 1996).

The Assam Plateau, more appropriately Meghalaya (Abode of Clouds), is a detached block of the Peninsula beyond the Ganges-Brahmaputra plain. It is formed mainly of pre-Cambrian crystalline rocks with granite intrusions. It extends 240km east-west with an average elevation of 1,830m. Its south flank of sandstones presents a steep slope scoured by the highest rainfall in the world (10,800 mm). Northwards are fragmented outliers of the Mikir and Rangma hills. The plateau is densely forested, although the lower ridges have been converted to secondary woodland through centuries of shifting cultivation. The main crops are maize and upland rice along with potatoes and oranges as cash crops. The people belong to the Garo, Khasi, and Jaintia tribes that speak Mon-Khmer or Tibeto-Burman languages. A matrilineal society persists despite exposure to missionary influence.

2.4 The Peninsula

The peninsular massif of India is made up of hard igneous and metamorphic rocks and generally has gentle gradients produced by prolonged weathering and erosion. Despite its vast expanse south of the Indo-Gangetic plain, ranges that exceed 1,000m in elevation are localised as residual plateaus. These are the Eastern and Western Ghats, Satpura-Maikal, Aravalli, and highlands of Sri Lanka.

The Eastern Ghats or uplands along the eastern side of Peninsular India have no structural or topographic continuity. Neither are they really ranges like the Western Ghats but rather uplifted plateaus separated by major basins. These have been recognised as being in four sections: (1) north of Mahanadi, (2) between Mahanadi and Krishna, (3) between Krishna and Penner, and (4) south of Penner converging to the Western Ghats. The northern section is formed of intrusive igneous rocks with a banded iron formation. The prominent ridges run north-south with heavily forested deep valleys. A few peaks are just over 1,000m. South of the Mahanadi, the Ghats run south parallel to the west coast. They comprise of metamorphosed sedimentaries giving rise to smooth, hummocky hills. In places, intrusive granites form rugged hills with surfaces covered with large blocks and tors. Their average elevation is 1,100m, the highest point being Mahendragiri (1,501m). The third section, the Nallamala Range, extends from Guntur to Cuddapah in an arcuate form with concavity to the east. Despite the low average elevation (760m), the range is rugged with jagged peaks and steep slopes. This is the home of the Chenchu, a primitive food gathering tribe. The fourth section, west of Madras, includes the Palkonda, Javadi, and Shevaroy hills. Mostly composed of charnockite massifs, they have steep sides with rolling topography on the top. North of the Cauvery River, the Shevaroy hills merge into the Nilgiri hills, a part of the Western Ghats.

Before turning to the Western Ghats, it seems logical to deal with the Sri Lankan highlands as they are a geological extension of the Peninsular system. This refers to the igneous intrusions of the Khondalite series of old gneisses and schists. The Central Highlands constitute a plateau of from 1,800-2,000m in elevation that extends over 70 km between the Hatton and Welimada peaks. The western section has a series of ridges, while the eastern section has gentle rounded forms with some deep gorges. Although their structure is complex, the highlands have two erosional surfaces, indicating successive uplift movements. The upper plateau or 'up country' becomes domi-

nant south-west of Kandy where the prominent peaks include the Pidurutalagala (2,524m), which is the highest on the island, and the spectacular Adam's Peak (2,243m). The highlands have been much eroded by rivers that drain out in a radial pattern, and some have waterfalls that have been used for hydropower. The highest zones receive heavy rain from the south-west monsoon and originally had dense forest. Natural vegetation has been largely cleared since the early 19th century for plantation of cash crops. The sequence of plantation crops here is an interesting instance of the varying effects of physical and economic factors. The first cash crop to be introduced was cinnamon, then followed coffee, cinchona, and finally tea; the latter being the principal crop today.

The Western Ghats, *Sahyadri* in Sanskrit, run for about 1,600 km along the western border of the Deccan from Cape Camorin to the River Tapti. Their average elevation is 1,200m. They are not true mountains but rather the faulted edge of an upraised plateau. There is a contrast between the deep ravines and canyons along the scarp facing the Arabian Sea and the flat-topped spurs intersected by mature valleys to the east. The three sections of the Western Ghats roughly correspond to their extensions in the states of Kerala, Karnatak, and Maharashtra. The southern section, on either side of the Palghat Gap (300m), has the highest ranges in the Peninsula. Anai Mudi (2,695m), the highest peak, is a nodal point from which three ranges radiate - the Anaimalai to the north, Palni to the north-east, and the Cardamom hills to the south. The last range, approaching closely the southern tip of India, is also called the Southern Ghats. The heavy rainfall, averaging 5,000mm per annum is conducive to the growth of rich forests. The Palni hills are much more accentuated towards the west, rising to 2,506m. The hill station of Kodaikanal (2,195m) stands at the southern edge of the central part. The Anaimalai Range is a series of plateaus intersected by deep valleys. Its forests contain large timber trees such as teak, ebony, and rosewood. These southern hills support large coffee plantations. The Nilgiri (Blue Mountain), a compact plateau north of

Palghat, is the point at which the Eastern and Western Ghats converge. The highest peak is the Dodda Betta (2,637m). Its rich vegetation has affinities to the humid flora of Assam. Plantation crops of tea and coffee dominate, while the tribal Toda tend buffaloes on the grasslands. Ootacamund in the Nilgiri hills is the leading holiday resort in south India.

The second section of the Western Ghats extends 650 km north from Gudalur to Belgaum. The rocks are mainly granitoid gneisses, and the range runs very close to the coast. The Jog Falls, with a sheer drop of 250m, are in this area as also the peak of Kudramukh (1,894m). Heavy rainfall favours dense forest growth. Much of this forest has been affected by shifting cultivation (*kumri*). The third section of the Western Ghats extends 650 km from 16° N latitude to the Chandor hills south of the Tapti. These are mainly composed of horizontal sheets of lava. They are 50 to 60 km from the coast and have an average elevation of 550m. Northwards, they show a monoclinical fold, the western limb of which dips gently towards the sea. Further south, the range steeply faces towards the coast and gently slopes eastwards. More important eminences include the Kalsubai (1,646m) in the Harishcandra Range and the Mahabaleswar (1,478m) which is on another range of the same name.

The Satpuras (Seven Folds) extend 900km east-west between the Tapti and Narmada rivers in central India. The western-most part, locally known as the Rajpipla hills, is a steep-sided Deccan lava block with a high craggy ridge. The more extensive central part has the Gawilgarh hills to the south and the Mahadeo hills to the north. The former is another Deccan lava horst and the latter is formed of Gondwana quartzite with precipitous scarps. The highest peak of the Satpuras, Dhupgarh (1,350m) near Pachmarhi hill station, lies in the Mahadeo hills. The eastern part of the Satpuras is known as the Maikal hills, crowned by the Amarkantak (1,065m). This plateau is tilted north-west and much dissected by streams draining into the Narmada. The upper slopes still carry forests that support lumbering

and charcoal making. Shifting cultivation is practised by various Gond tribes who are also engaged as forest workers.

The Aravalli, the oldest mountain range in India, extends nearly 700km from Gujarat to Delhi. Its main south-west/north-east strike is remarkably regular, and it is marked by a central range of ancient gneisses and schists. The Aravalli Range culminates (1,315m) in the headwaters of the Sabarmati River near Udaipur. However, the highest point, Guru Sikhar (1,722m) on Mount Abu, lies off the main axis in the extreme south-west. The well-defined range near Udaipur, called the Mewar hills, presents a steep scarp on the western side. Then commence two ridges running parallel for 100 km, separating the Marwar (Region of Death) on the west and the Mewar on the east. Near Ajmer, they separate out into a number of jagged hills of quartzites. North of Jaipur, the range is marked by low ridges half-buried in the alluvium. On the frontier of the Thar desert, the land experiences frequent drought. The hill forests are xerophytic and degraded. The people on the west side are semi-nomadic and range widely to graze their cattle. In the comparatively more humid east, Bhil tribes practise shifting cultivation.

2.5 The North-West

West of the Indus, the mountain rim confining South Asia from the central mass turns south-west in a series of parallel ranges. This great bend, the western syntax, commences around Batura (7,785m) above Hunza and continues west and south. These can be described in three sections: the Hindu Kush, Northwest Frontier, and Balochistan Ranges. The Hindu Kush (Hindu Killer) turns south-west from the Pamir and forms the watershed between the Wakhan Corridor and the Chitral Valley. This used to be the great frontier where once the British, Chinese, and Russian imperial interests converged (Keay 1977). The highest peak in the Hindu Kush is Tirich Mir (7,690m) which, according to legend, is guarded by giant frogs (*boguzai*) and phantom maidens who meet climbers with bowls of milk or blood:

drinking the blood leads to certain death. The lower slopes have grasslands and forests and the tree-line is between 3,600 to 4,000m. The economy of Chitral is based on animal husbandry and fruit trees. The astonishing variety of people here includes descendants of Alexander's Greek army to newly arrived Afghan refugees. The inaccessible areas are the home of the Kafirs (infidels) with Indo-Aryan speech and a pagan religion. The range continues west as Koh-i-Baba (Grandfather), the central highlands of Afghanistan along the Kabul-Herat axis. These highlands, including well-wooded Nurestan, are conventionally considered to be part of South Asia. However, their geological structure and xerophytic environment are more in line with the features of West Asia.

The highlands of the North-West Frontier commence first as a watershed between the Gilgit and Yarkhun rivers in the extreme north. These highlands trend south-west as the Mohmand Hill and Malakand Ridge. This mountain area, mostly of gneiss and granite, has been eroded into deep narrow valleys. Local vegetation includes forests of pine and deodar as well as grasslands under the influence of the western precipitation. The people belong to at least a dozen tribes who speak Pushtu and practice transhumance. South of the Khyber Pass (1,067m), the north-east/south-west frontier ridge turns sharply east-west as the Safed Koh, culminating at Sikaram (4,761m). The hills trending south between Safed Koh and Bannu are mostly arid and are composed of bare lime-

stones and sandstones. Further south, as far as the Gumal Gorge, the border range becomes arcuate and convex to the west. The sinuous strikes of the area between the Kabul and Gomal rivers express the buckling caused by the meeting of the alpine crust movement with the rigid peninsular block. The area is the habitat of ever-warring tribes whose political fragmentation corresponds to the extremely broken terrain (Spate et al. 1972, pp 490-491).

The mountain ranges of Balochistan are knotted together into the complex of the Quetta node where Zargun attains a height of 3,578m. The bifurcating ranges are the Toba Kakkar to the north-east, Sulaiman to the east, and Central Brahui to the south. The Toba Kakkar with Tanishpa (2,964m) demonstrates a slight convexity to the south-east. The Sulaiman Range is a series of north-south trending ridges that finally turn west towards Quetta as the Bugti hills. South of Quetta, the prominent north-south trending ranges are the Central Brahui adjoining the Kalat plateau and the Kirthar further south. The western half of Balochistan is traversed by two ranges with an east-west alignment: the Chagai in the north and Makran in the south. The leading features of the climate are aridity and great variation in temperature. The vegetation, mainly xerophytic, has been much reduced by overgrazing. In drier areas, water is brought down from the adjacent hills to settlements and fields by means of *karez* (underground channelled irrigation system) tunnels.

(see Figure 1)

Annex A: Ranges of South Asia			
S.N.	Range (Subsidiary)	Prominent Peak (Metres)	Location
1.	Arakan Yoma	Pauksa Taong (1,708)	India/Myanmar
2.	Aravalli Range	Guru Sikhar (1,722)	India
3.	Central Highlands	Pidurutalagala (2,524)	Sri Lanka
4.	Chin Hills	Mt. Victoria (3,053)	India
5.	Ghats, Eastern	Mahandragiri (1,501)	India
6.	Ghats, Western	Anai Mudi (2,695)	India
7.	Himalaya, East	Namcha Barwa (7,756)	China
8.	, , Central	Mt. Everest (8,848)	China/Nepal
9.	, , West	Nanga Parbat (8,126)	Pakistan
10.	Hindu Kush	Tirich Mir (7,690)	Pakistan
11.	Karakoram Range	K-2 (8,611)	China/Pakistan
12.	Malakand Range	Falaksir (6,257)	Pakistan
13.	Meghalaya	Shillong Peak (1,961)	India
14.	Mishmi Hills	Kadusam (5,108)	India/China
15.	Naga Hills	Saramati (3,826)	India/Myanmar
16.	Patkai Hills	Dalpha Bum (4,578)	India/Myanmar
17.	Safed Koh	Sikaram (4,761)	Afghanistan/Pakistan
18.	Satpura-Maikal Range	Dhupgarh (1,350)	India/China
19.	Toba-Kakar (Makran, Kirthar, Sulaiman)	Zargun (3,578)	Pakistan

Chapter 3

West Asia

The landmass of West Asia, also referred to as the Middle East or South-west Asia, has a unique geographic position as a nexus joining Asia, Europe, and Africa. The region is composed of three major physiographic divisions: (1) the mountains and plateaus of the north, (2) a central depression aligned to the Persian Gulf, and (3) a peninsular mass with ranges along the south-west margin. The northern high ranges are recently folded segments of the great alpine system of Eurasia. The main ranges diverge from the central nucleus represented by the Armenian knot. Those in the peninsula are fragments of ancient stable block marked by fracture and rifting. The highlands of West Asia have been grouped into the Iran plateau, Trans-Caucasus, Anatolia, and Arabia and are described in an anti-clockwise sequence (Figure 2 and Annex B).

3.1 The Iran Plateau

The plateau of Iran is fully encircled by a series of mountain ranges. The eastern rampart, almost athwart the boundary of Iran, is made up of parallel but broken ranges. The high point of the range, Kuh-e-Taftan (4,042m), lies south of the Iran-Afghan-Pakistan tri-junction. The scanty population is composed of semi-nomadic tribespeople who graze animals on the higher slopes above 1,500m. Some areas support agri-

culture based on irrigation by means of underground channels known as *qanat*. The plateau is bounded on the north by a range system with three sections. The eastern section includes the parallel ranges of Aladagh and Kapet Dag which define the Iran-Turkmenistan boundary. In the central section lies the Elburz Range, rising sharply from the southern shore of the Caspian Sea. Its main peak, Damavend (5,604m), is the highest summit in West Asia. It is a volcanic cone that towers just north-east of Teheran. Large areas of these highlands are used for grazing sheep and goats. The lower slopes below 1,200m with sufficient rain produce a large variety of crops. The western section, the Tavalish Range, turns north-west towards Azerbaijan and its highest peak is the Sabalan (4,814m). A series of fault-block ranges enclose valleys that grow wheat as the major crop.

The south-western part of Iran is dominated by the Zagros Mountains that diverge south-east from Kurdistan as far as the Strait of Hormuz. The mountains consist of parallel ranges that are high and rugged. This highland complex has an average width of 300 km. The northern part, which receives over 400mm mean annual precipitation is better developed agriculturally. The highest peak, Zard Kuh (4,547m), is in the central part of the range, west of Esfahan. In northern Zagros,



Figure 2: West Asia

pastoral and semi-nomadic Kurd tribes are found. Central and Southern Zagros have numerous tribes who practise transhumance. Their migration with sheep and goats is basically vertical from permanent winter bases (800m) to summer pastures higher up (1,800 to 2,200m). East of Esfahan, the Jebal Barez Range trends south-east, parallel to the Zagros alignment.

3.2 Trans-Caucasia

This mountain area is distinguished by two parallel ranges running from the Caspian Sea in

the east to the Black Sea in the west. The northern one, the Greater Caucasus, extends about 1,200 km along the southern boundary of Russia. It is a young mountain range of great height with many glaciers. Although folded ridges are predominant, the highest peak, Mount Elbrus (5,642m), is an extinct volcano; evidence of intrusion. The range acts as a climatic barrier between the wet west and arid east sides. Grasslands on upper slopes support sheep grazing as the main economic activity. Reconstruction of climatic change over the last 100 years showed the equilibrium line of glaciers to have

retreated 300-500m higher due to a decrease in precipitation over the period in the nival-glacial zone (Krenke et al. 1991). In the lower zone (500-12,000m), the forested area has decreased significantly due to human impact. The southern range, the Little Caucasus, is a part of the faulted Armenian plateau extending into Iran and Anatolia. It is connected to the Greater Caucasus by the low (c. 500m) Suram Range. Elsewhere, the two are separated by the Kura and Rioni valleys. The Little Caucasus has numerous extinct volcanoes and is subject to frequent earthquakes. Mount Ararat (5,161m) is found in its south-western section which intrudes into Turkey. The Trans-Caucasia presently includes four political units: Armenia, Azerbaijan, Georgia, and Russia. However, the area has been a natural refuge for various peoples over the centuries. It is an area of immense ethnic diversity where over 40 different languages are spoken.

3.3 Anatolia

The Armenian plateau is an important nodal point from where ranges diverge east to Iran, south to Kurdistan, and west to Anatolia. They enclose high plateaus, of which interior Anatolia is the most extensive. It is confined by Tatos Daglari in the north and Toros Daglari in the south. The Tatos range, also called the Pontic mountains, commences at the Armenia-Turkey border and continues due west south of the Black Sea. It has numerous high peaks, including the Kacker Dag (3,937m), along its 400 km stretch from north of Erzurum to Sivas. Its western extension, Ilgaz Daglari, reaches 2,600m north of Ankara. The northern slope facing the Black Sea is important agriculturally for both crop and livestock production. In contrast, the south slope is mostly treeless steppe and more suited to grazing.

The western part of Inner Anatolia is largely a treeless steppe. It has hot, dry summers and cold winters. Much of the precipitation occurs during the spring. The area is a major producer of grains, with wheat and barley being the main crops. It is

also important for livestock raising. The eastern part, the Armenian plateau, is extremely dissected with steep slopes. Summers are short and dry, and the main crop is spring wheat. Cattle and sheep are the main livestock.

The Toros Mountains stretch along the southern rim of the Anatolian plateau in an arcuate form, parallel to the Mediterranean coast. The sea-facing slopes have steep terrain, although the highest peak, Erciyes Dag (3,916m), lies far inland. West of Egridir Lake, the range splays out in a north-south direction to complete the confinement of the Anatolian plateau. The area is under the influence of a Mediterranean climate. Tree crops and vineyards abound on lower (below 1,200m) slopes, while upper (above 1,500m) slopes are used for livestock raising.

3.4 Arabia

The Arabian peninsula is ringed by mountains along the western and southern side. The first ranges trending north-south, parallel to the Mediterranean coast, commence in Lebanon (Plate 8). They are aligned on either side of the rift valley as far south as the Gulf of Aqaba. In Lebanon, the highest point is Qurnot-as-Sawda (3,086m) in the western range, while the Lebanon-Syria boundary is marked by another range, Anti-Lebanon, further east. The western range, approaching an elevation of 3,000 m, is the highest in the area. Its eastern slope drops sharply into the fault valley of Bekka. The eastern ranges are the Anti-Lebanon (c. 2,100m) in the north and Herman (c. 2,800m) to the south. Towards the south, these ranges confine the River Jordan and the Dead Sea across Israel and Jordan. They are composed of largely massive beds of folded limestone with rugged relief. The western side of the ranges has a Mediterranean climate favourable for orchards, vineyards, and winter crops. Precipitation decreases from north to south. Like the area's compartmentalisation into mountain ranges and structural valleys, the economy is a contrast of intensive horticulture westwards and nomadic herding in the arid east.

Author



8. Desert ranges, Lebanon. Snow ranges of Lebanon steeply sloping towards the fault valley of Bekka. The low ranges to the right are Herman (lower) and Ani-Lebanon (upper) traversed by a river.

The nomads include various Bedouin tribes with flocks of sheep, goats, and camels.

In Saudi Arabia, the western highlands form a rocky upland carved from ancient crystalline complex. They form a linear plateau capped by mountains with scarp face towards the Red Sea. The rugged topography is the making of diastrophism, vulcanism, and mass wasting. Their elevation varies from 900m in the north to 3,700m in the south. The range reaches its maximum elevation in Yemen, on Jabal an-Nabi (3,760m), west of Sana. The range then makes a sharp, north-easterly turn through Hadhramaut to Dhufar in South Oman. Despite their proximity to a vast desert, the highlands receive some rain. Precipitation varies from about 130 mm during winter in Arabia to over 1,000 mm during summer in Yemen. Jabal Akhdar (Green Mountain) is at the eastern end of the Arabian peninsula beyond the depression of Rab-al-Khali (Empty Quarter). Structurally, these uplands in Oman are an extension of the fold mountains of Zagros in Iran. The main range is fairly high with Jabal-ask-Sham (3,035m) as the pinnacle. Despite topographic features of upthrusts and graben-like depressions due to faulting, much of it has plateau-like topography and is cut off from all sides, by either sand or water. The highlands of Yemen and Hadhramaut have terrace cultivation facilitated by heavy precipitation. They grow sub-tropical fruits and cereals such as wheat and barley. Elsewhere, nomadic tribes with sheep and goats shift seasonably to find pastures. With the expansion of the petroleum economy, tribal warfare and pillaging of oases by the Bedouin have become a thing of the past.

(see Figure 2)

Annex B: Ranges of West Asia			
No.	Range (Subsidiary)	Prominent Peak (metres)	Location
1.	Al-Akhdar, Jabal	Jabal ash-sham (3,035)	Oman
2.	Asir	Jabal an-Nabi (3,760)	Yemen
3.	Caucasus	El'brus (5,642)	Georgia/Russia
4.	Elburz Mountains (Kapet Dag)	Damavand (5,604)	Iran
5.	Hakkari Daglari	Mt. Ararat (5,122)	Turkey
6.	Lubnan Jabal	Qurnot as-Sawada (3,083)	Lebanon
7.	Tatos Daglari	Kackar Dagi (3,937)	Turkey
8.	Tavalish, Kuhha-ye	Kuye Sabalan (4,814)	Iran
9.	Toros Daglari	Erciyes Dagi (3,916)	Turkey
10.	Zagros, Kuhhayeh	Zard Kuh (4,547)	Iran

Chapter 4

Central Asia

Central Asia occupies a pivotal position in the orographic structure of the continent. It is from this highland core that mountain chains diverge to the west, north-east, and south-east. The main physiographic units of the region are extensive plateaus and depressions ringed by high ranges. This highland complex is described below in seven components: the Tibetan plateau (Plate 9), Hengduan, Kun Lun, Pamir, Tien Shan, Altai, and Urals (Figures 3 and 4 and Annex C).

4.1 The Tibetan Plateau

The plateau of Tibet, roof of the world, owes its extreme elevation to tectonic uplift as a result of the collision of the Gondwana plate with the Angara plate. The land surface slopes towards the south-east with an average elevation of 5,000m. The plateau extends 2,600 km from west to east and is about half as wide from north to south. It is rimmed by high ranges in the south (Himalaya), west (Karakoram), and north (Kun Lun). In the east, the barrier is one of multiple ranges with deep gorges. Much of the interior is a tangled wilderness of mountains and plateaus interspersed with numerous lakes. One authority, Pierre Gourou, in his book *L'Asie*, claimed that there were 36 different mountain ranges in Tibet alone.

The structural strikes and thrusts on the plateau are mainly east-west oriented with a north-west loop in the west and a south loop in the east. The alignment of major relief features conforms to such a pattern. This is most evident from the long trench of the Indus-Brahmaputra which demarcates the Trans-Himalaya in Tibet from the Main Himalaya to the south. The parallel ranges of Nganglong and Gangdise in the west are a structural extension of the Karakoram and Ladakh Ranges. The high points are the Alung Kangri (6,450m) in the Nganglong and the famous Kailash/Kang Rimpoche (6,660m) in the Gangdise Range. The highest peak of all in the area is the Gurla Mandhata (7,739m) which lies south of Kailash across the Manasarovar Lake. The Gangdise Range forms the watershed between the continental plateau and the Indian Ocean drainage systems.

The Gangdise continues as an emphatic range as far as the longitude 90°E. Further north, the Tanggula Range is aligned east-west, traversing the vast expanse of the Changthang (Northern Plain). It has some peaks approaching 6,900m. The Nyaingentanglha Range, north-east of Lhasa, is much dissected and rugged. Its spurs are linked to the Tanggula in the north and the Hengduan towards the east. The highest point, Namjubarwa (7,353m), lies about 200 km north-west of the

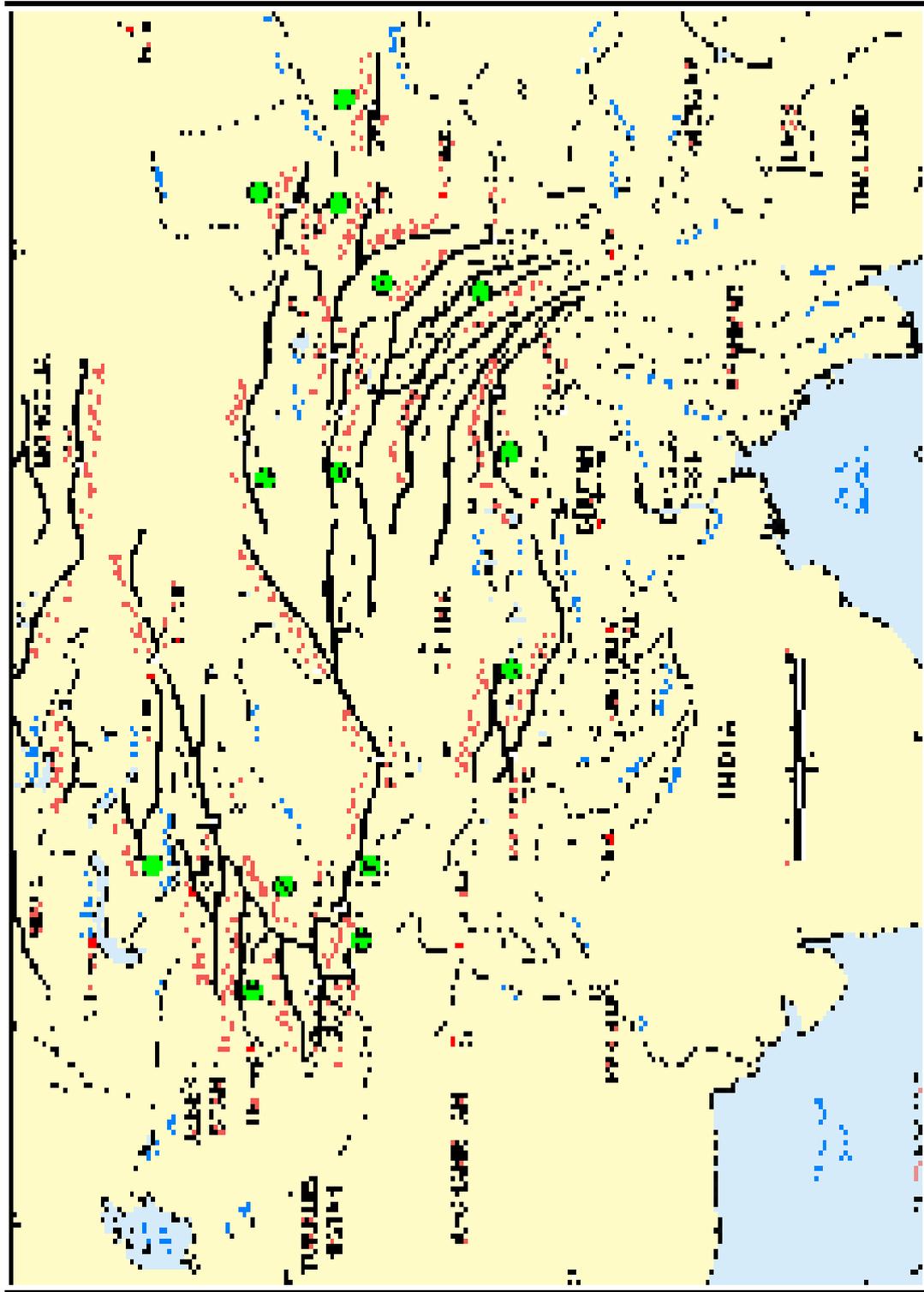


Figure 3: Central Asia (A)

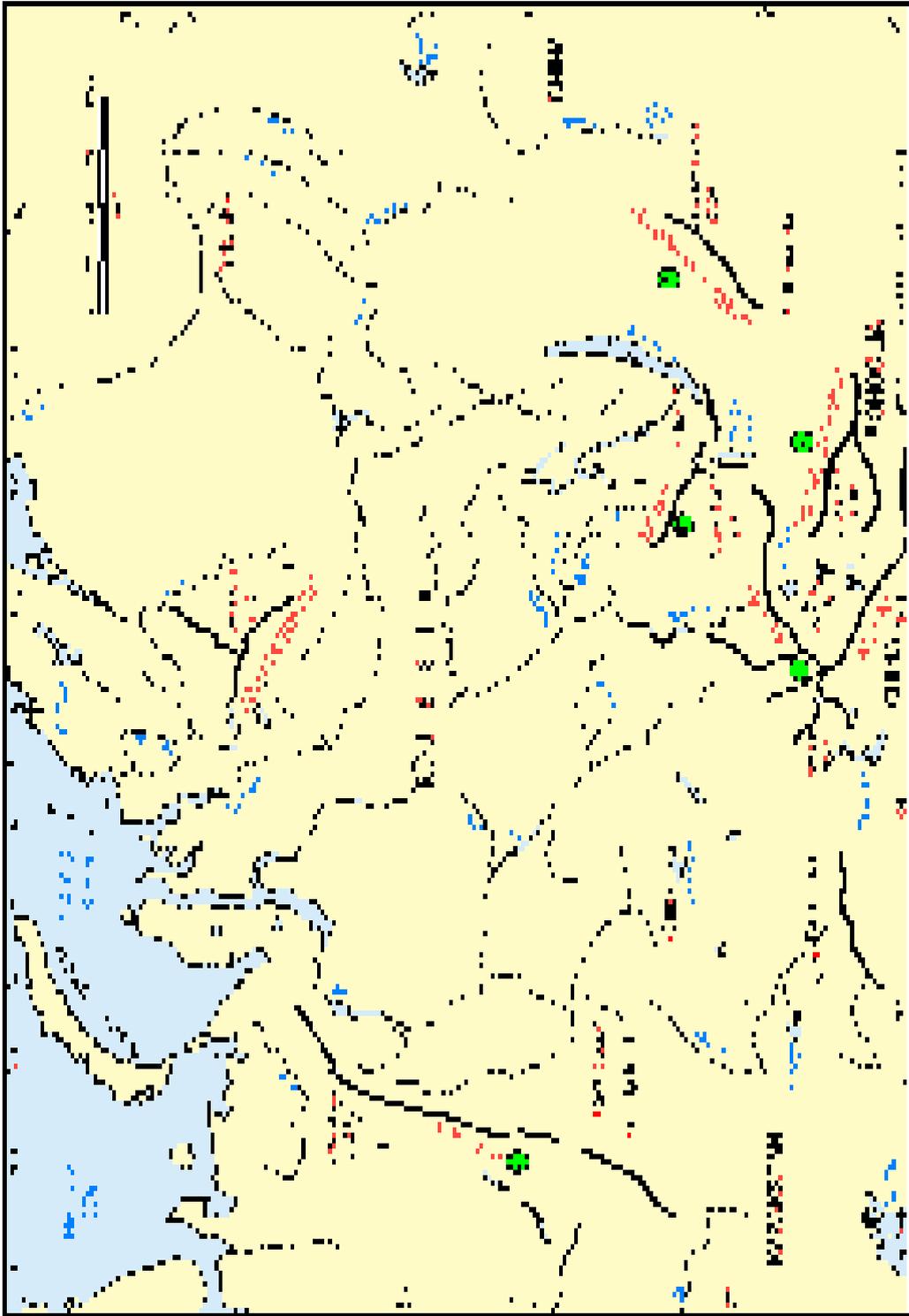


Figure 4: Central Asia (B)



9. **Environs of Lhasa, Tibet.** The wide valley is drained left to right by the Kyi Chu of the two hillocks on the plain, the left one is crowned by Potala palace between the old town (middle distance) and new complex (foreground). The western hillock, Choghuri, had a medical university in the old days.

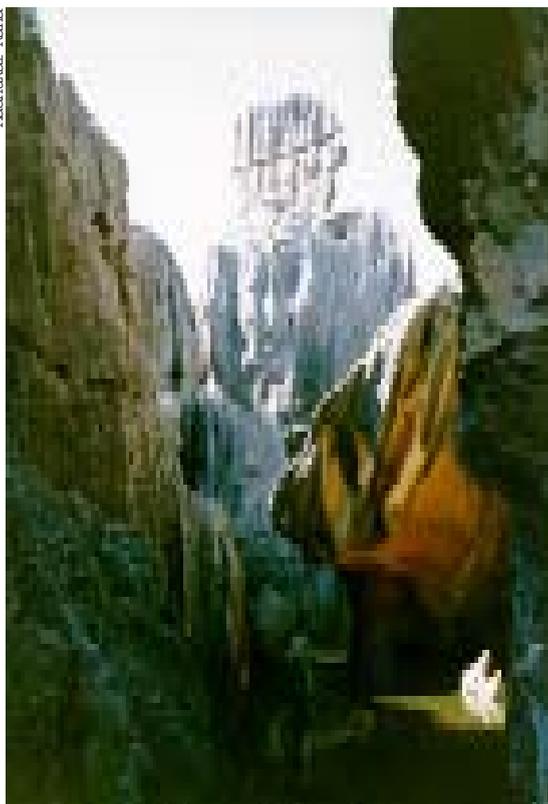
Tsangpo-Dihang bend. Namchabarwa massif's south side is fully exposed to the monsoon regime, with an annual mean precipitation of 2,276mm, while the north side only receives 510mm. Thus, the south has nine forest zones compared to only six in the north (Peng et al. 1997). Further east, there are three parallel ranges aligned north-west/south-east. These are the Ning Ling at the head of the Mekong River, the Bayan Har at the head of the Yangtze River, and the Anyemaqen at the head of the Huang He. The last range also marks the boundary between the Tibetan plateau and the Qaidam basin. It extends east through the rugged Min Shan which has two branches. One branch trends south as the Qionglai Shan and another farther east as the Daba Shan. The average elevation of the former is 2,500m and that of the latter above 2,000m.

The desert climate situation of the western section of the plateau supports only nomadic pastoralism. The chief population centres are in the south-east, mainly along the Tsangpo and valleys further east. The encapsulation of the harsh physical environment led to the evolution of social mechanisms such as fraternal polyandry that

prevented land fragmentation and decreased aggregate fertility (Goldstein 1981). Yet it was this remote plateau that spawned Lamaism, a form of tantric Buddhism, that radiated far and wide, including Mongolia. Therefore, while other mountain people are referred to as cultural groups, the Tibetans are associated with a civilisation that is basically mountain-based.

4.2 Hengduan

The Hengduan Mountains constitute a series of ranges that descend east from the Tibetan plateau to form the highlands of Sichuan (Four Rivers) and Yunnan (South of the Clouds) (see Plate 10). Although the area is physiographically linked to Central Asia, its environment and economy are more akin to those of the sub-tropical highlands of South-East Asia. The Hengduan Mountain Ranges represent a truly rugged terrain, but there is no complexity to their configuration. Basically, they are north-south aligned parallel ranges, alternating with deep gorges that block east-west travel, hence the name Hengduan which means 'cut across' in Chinese (Chung 1978, p42). They are also sometimes referred to



10. In the Stone Forest, Yunnan Province

as Transverse Mountains and as River Gorge Country. The first range, Gaoligong, between the Irrawady and Salween rivers runs along the Myanmar-China boundary. The second range, the Tiantaweng with Moirigkawa Garbo (6,809m), lies between the Salween and Mekong. The third, Ningjing-Yun Ling, separates the gorges of Mekong and Yangtze (Jinsha Jiang). East of the Yangtze, the ranges of the Shaluli and Daxue on either side of the Jiang River are fairly extensive. Altitudes vary from 2,000-2,500m in the south to 7,000m in the north. The highest peak, the Gongaa Shan/Minya Konka (7,556m), is in the Daxue Range. This range marks the transitional zone between the dry Tibetan plateau and the wet Sichuan basin. Limits of various ecological belts are 3,000m higher on the west side due to the mass-elevation effect of the Tibetan plateau (Thomas 1999). Large areas of primary deciduous and coniferous forest have been cleared

through commercial logging. The Shaluli Shan is marked by the spectacular Xia-qiao-tou (Tiger Leap Gorge) of the Yangtze around Yulongxue Shan/Jade Dragon Mountain (5,569m). The Hengduan area with its wide altitudinal range and heavy monsoon rain has very rich and varied flora and fauna. Extensive areas are under dense forest, varying in type by elevation and aspect and including as many as 550 species of medicinal plants. Timber logging has become an important economic activity. Cultivation is generally practised below 3,000m. The rotation cycle for swidden agriculture for maize and dry rice ranges from three to 12 years (Harris and Ma 1997). In the past, opium poppy cultivation was widespread. The area is home to numerous ethnic minorities with distinct languages and customs (Box 2). Some of the better known are the Bai, Dai, Jingpo, Lisu, Miao, Naxi, Lhoba and Yi. Of these, the Naxi have an ancient tradition of script-writing in pictograph form known as Dongba.

4.3 Kun Lun

Kun Lun, meaning 'the South', in the language of Hotan on the ancient Silk Road, extends 2,500 km from the Pamir to the Sichuan highlands. The main range, exceeding 6,000m, encloses the Tibetan plateau from the north. Its eastern extremity, Qin Ling, marks a climatic divide between the arid north and humid south. West of Qin Ling, the range system broadens to enclose the Qaidam basin in Qinghai with two ranges. The northern one, the Qilian Shan, continues west and converges on the main range as the Altun Shan. The southern one, between the Tibetan plateau and Qaidam basin, is represented by the Anyemaqen, Burhan Budai, and Ho Xil sections culminating in Muztag Feng (6,973m). It then extends west as a single range separating the Tibetan plateau to the south and the Tarim basin to the north. The highest peak in the range, Mount Kongur (7,649m), lies in Tibet. The Yarkand River that drains Sinkiang (The New Frontier) has its source south of the range, and it turns north around the mountain complex where the Kun Lun, Karakoram, and Pamir meet. The Kun Lun rises above desolate deserts, yet its glaciers and snows

Box 2

Mountains and Minorities in China



11. Tibetan Nomads

D. Miller

Nearly two-thirds of China's landmass of 9.6 million sq km is made up of mountains and plateaus of considerable elevation. These highlands, located mostly in interior border areas, are the habitat of 55 designated minority nationalities. Their total population of 91 million account for 8 per cent of China's national population. Of these, 18 ethnic groups exceed a population of a million each with the Zhuang being the largest. The majority of larger groups are sedentary farmers. Fifteen groups range from 100,000 to 700,000 in population size. Another 16 groups have a population of 10,000 to 100,000. The last six groups with populations of less than 10,000 are mainly shifting cultivators or herders (Plate 11).

The 55 minority nationalities represent eight language families. Fourteen nationalities with the Sino-Tibetan language family constitute the largest group with 37.4 per cent of the total minority population (Table below). They are localised mostly in the south-eastern region. The second largest population group, 16 with the Tibeto-Burman language family, are from the west and south. The Altaic group has 13 nationalities from the north-east, while the Turkic group has 6 nationalities from the north-west. The rest are Arabic and Slavonic from the north-west and Austro-Asiatic from the south.

Table : Language Group of Nationalities

<u>S.No.</u>	<u>Family</u>	<u>Nationalities</u>	<u>Population</u>	<u>Per Cent</u>
1.	Altaic	13	17,467,111	19.2
2.	Arabic	1	8,602,978	9.5
3.	Austronesian	1	400,000	0.4
4.	Austro-Asiatic	3	449,716	0.5
5.	Sino-Tibetan	14	33,899,379	37.4
6.	Slavonic	1	13,504	0.0
7.	Tibeto-Burman	16	21,400,393	23.4
8.	Turkic	6	8,517,636	9.4
Total		55	90,750,717	100.0

In regional distribution, the highlands of Sichuan, Tibet, and Yunnan converging on the Hengduan Ranges have a concentration of 22 national minorities. Ethnic diversity is most pronounced in Yunnan province from whence ethnic group have also spilled-over into Myanmar, Thailand, Laos, and the highlands of Vietnam. These are mostly of Sino-Tibetan and Tibeto-Burman language groups. Xinkiang with the Altai, Pamir, and Tien Shan Ranges and Gansu with the Qin Ling Shan in the north-west have 14 nationalities. The majority of

these belong to the Turkic language group. The southern hills of Guizhou, Guangxi, and Kiangsi include 12 nationalities of the Sino-Tibetan and Austro-Asiatic language groups. Inner Mongolia and Heilungkiang across the Great Khingan are the home of seven nationalities that belong to the Altaic language group.

The livelihood pattern of national minorities has evolved according to the resource base of their habitat. These are predominantly livestock herding in the north, shifting cultivation in the south-west, and sedentary agriculture in the south. In the latter region, rice is the main crop with tea growing among nationalities such as the Blang, De'ang, Hani, Jinuo, and She. Other specialist groups are the Doxiang, Jingpo, Salar, and Uygur in horticulture and the Hui and Tartar in trade.

Source: Appendix II

feed several major rivers such as the Huang He, the Mekong, and the Yangtze. The climate is arid with mean annual precipitation ranging from 30-60mm to 100-300mm on higher slopes. The general pattern of land use is oasis agriculture below 1,500 m, farming and winter grazing at 2,000-3,000 m, and summer grazing at 3,000-4,200m (Zhang 1995).

4.4 The Pamir

The name Pamir, or the *Bam-i-dunya* (Roof of the World) of Persian writers, is actually derived from the broad valleys in south-east Tadzhikistan, but

since has come to include all the mountains between the Amu Darya (Oxus) River and Alay Range. The Pamir knot is the convergence area of several high ranges. These include the Hindu Kush from the south-west, the Karakoram from the south-east, the Kun Lun from the east, and the Tien Shan from the north-east. Geologically rich and complex (Plate 12), the area's strike lines make a sharp arcuate facing north towards Ferghana. This high mountain complex between the Tarim and Karakum basins is inclined to the west and drained by the Amu Darya. Most of the area lies in Tadzhikistan but the highest summit, Muztag Ata (7,719m), is in a north-south range in China.



Pi teambur Shaema

12. A view of the mountains from Ala Archa National Park, west of Bishkek, Kyrgyzstan

Tadzhikistan is dominated by mountainous relief, as 61.5 per cent of its land surface exceeds 2,000m in elevation. These uplands support only 5.7 per cent of the country's total population due to the severity of the climate (Belkin 1992). The central part is in the form of an enclosed plateau where the Karakul Lake is situated. Westwards, parallel ranges trend towards the south-west. These also have numerous high peaks, of which Pik Kommunizma (7,495m) is prominent. Among these ranges, the Alayskiy Khrebet marks the northern limit of the Pamir. The area has extensive snowfields and many glaciers. The climate is cold and arid and vegetation sparse. The land is deeply dissected and also affected by intensive seismic processes. It is equally diverse in ethnic composition. The Tadzhik are early migrants from Persia, and they are mostly agriculturists. The Kazakh, Kyrgyz, Turkman, and Uzbek belong to later waves of Mongoloid herders of horses and sheep with their traditional central Asian yurts. The Tadzhik in the north-west are more sedentary and depend on irrigation for crops and fruit cultivation. The Kyrgyz are mostly nomadic and keep flocks of sheep, cattle, and yaks.

Under the Soviet regime, the Central Asian republics were much affected by centralized planning.

This not only involved a colonial type of exploitation of minerals and forest resources but also the organized migration of people (Badenkov 1990). This is evident from the composition of the populations of the Republics. Uzbekistan has a population that is 75 per cent Uzbek and ten per cent Tadzhik and Kazakh. In Kyrgyzstan, 58 per cent of the population is Kyrgyz followed by 14 per cent Uzbek, while Kazakhstan has 46 per cent Kazakh and the majority are from other groups. Since the transition from central planning to a market economy, there has been both increase in product diversity and revival of old traditions.

4.5 Tien Shan

The Tien Shan (Celestial Mountains) extends nearly 3,000 km from Kyrgyzstan, through Sinkiang, to the Mongolian frontier as a barrier between vast depressions. The range has more than thirty peaks approaching 6,000m or more. In contrast to the north arcuate structure of the neighbouring Pamir, strike lines of the Tien Shan are distinctly east-west oriented. This is expressed by a series of parallel ranges around the drainage of the Naryn River and the Issyk-Kul Lake (Plate 13) which, it is claimed, is the second largest mountain lake in the world. These western



13. Tornado over Issyk-Kul Lake, Kyrgyzstan

ranges, called Alai or Alay, average 4,600m in altitude and enclose numerous inland lakes. East of the Issyk-Kul Lake, the range becomes narrower and reaches the highest point on Tomur Feng (7,435m). Continuing east, a southern spur separates the Tarim and Turfan depressions, while the main eastern range separates the deserts of Turfan and Dzungaria. The Bogda Feng (5,570m) in the latter range, due north of Turfan Pendi, lies 154 masl. West of Turfan, a subsidiary range, the Borohoro Shan, trends north-west to join Dzungarkij Alatan on the Kazakhstan border. The Tien Shan is a land of extremes in terms of temperature range. The ranges average from 3,000 - 5,000 masl and the northern slopes are exposed to air currents from the Arctic Ocean and are moister than the southern ones. The Kazakh and Kyrgyz inhabitants are pastoralists with large herds of animals, mainly of horses, yaks, sheep, and goats. Since the abandonment of state farms that emphasised large herds, animal stocks in the Kyrgyz Republic have declined from 18 million in 1989 to 14 million in 1994 (Wilson 1997). The region is important for mining copper, gold, lead, antimony, and tungsten. Gas, oil, and hydropower are important energy resources of these mountain republics.

4.6 Altai

Altai or the Altay Range is a long chain traversing the borders of Russia, Kazakhstan, China, and Mongolia. They are fault block mountains trending south-east with their steep fronts facing south-east. The highest point, Mount Belukha (4,506m), lies to the north in the headwaters of the Ob and Irtysh rivers in Russia. The ranges generally exceed 3,000m in elevation and descend towards the south-east in Mongolia. The north-western part receiving heavy precipitation has rich coniferous forests. The lower easterly ranges have extensive grasslands. The Altai extends nearly 1,600 km in west Mongolia as the highest elevations in the country. In central Mongolia, the Changajn (Hangayn) Range runs 800 km parallel to the Altai. The third range, the Chentejn

or Hantiyn, is aligned south-west/north-east between Ulanbaatar and the Russian border. A subsidiary range of the Altai trends east of Mt. Belukha along the northern border of Mongolia. North of the Uvs lake, it is referred to as the Tannu Ola Range. The most easterly extension of the Altai is the Sayan Range between the Yenisey River and Baikal Lake. It commences with a northerly bend and then turns south to the Mongolian border. The Kazakh, west of the Altai, and Mongol to the east are nomadic herders raising horses, camels, sheep, and goats. For most, mobile herding is an entire culture and way of life (Goldstein and Beal 1994). Since the growing season is short due to extreme cold, herders keep their flocks alive on 'senescent vegetation' for nearly eight months of the year. Apart from livestock, Mongolia's major economic resources come from mineral exploitation.

4.7 The Urals

The Ural Range extends about 2,400km from the Arctic Ocean in the north to the plains of Kazakhstan in the south. It is a remnant of old mountains with the highest point, Gora Norodnaya (1,894m), in the extreme north. Despite its mature and rounded topography, the Urals stands out as a distinct feature amidst the surrounding lowlands and form a physical boundary between Asia and Europe. The range can be considered in three sections. The northern section beyond 61° north is narrow and craggy with a sub-polar climate. Reindeer herding is an important economic activity, while the leading industries are forestry and timber products. The central section, between 51° and 61° N is very low and well forested. However, mining is the most important industry in the area. The southern section has three parallel chains divided by intramontane basins. Woodlands constitute an extensive part of the area. The main occupations are agriculture and specialisation in horse-breeding and apiculture. The aboriginal population are the Khanty and Mansi in the north and the Bashkir in the south.

(see Figures 3 & 4)

Annex C : Ranges of Central Asia			
S.N.	Range (Subsidiary)	Prominent Peak (Metres)	Location
1.	Altai/Altay	Mt. Belukha (4,506)	Russia
2.	Anyemaqen Shan	Magen Kangri (6,282)	China
3.	Bayan Har	- (5,490)	China
4.	Changajin Nuruu	Olton Tenger (4,031)	Mongolia
5.	Chentejn Nuruu	Asralt-chairchan (2,800)	China
6.	Daba Shan	- (2,798)	China
7.	Daxue Shan	Gongga S. (7,556)	China
8.	Gangdise Shan	Gurla Mandhata (7,739)	China
	(Nyanglong Kangri)	- (6,450)	China
9.	Helan Shan	- (3,577)	China/Pakistan
10.	Hengduan Shan	Moirikawgarbo (6,809)	China
11.	Kun Lun	Mt. Kongur (7,649)	China
	(Altun Shan,	(6,025)	China
	Burhan Budai,	(6,224)	China
	Ho Xil Shan)	(6,415)	China
12.	Min Shan	Xuebao Ding (5,614)	China
13.	Nyaingentanglha Shan	(7,353)	China
14.	Pamir:		
	(Alayskiy Khrebet,	Muztag Ata (7,546)	China
	Shakhdarinskig K.	(5,642)	Kyrgyzstan
	Yajgulemskiy K.	Pk. Karl Mark (6,723)	Tadzhikstan
	Zaalaskiy K.)	Pk. Communizm (7,495)	Tadzhikstan
15.	Qilian Shan	- (5,687)	China
16.	Qin Ling	Taibai S. (3,767)	China
17.	Sayan Khrebet	Munku Sardyk (3,491)	Mongolia/Russia
18.	Taihang Shang	Wutai S. (3,058)	China
19.	Talasskiy-Alatau	- (4,528)	Kyrgyzstan
20.	Tanggula Shan	Purog Kangri (6,929)	China
21.	Tien Shan	Tomur Fang (7,435)	China/Kyrgyzstan
	(Bogda Shan)	- (5,570)	
22.	Ural	Gora Narodnaya (1,894)	Russia

Chapter 5

North-East Asia

The north-eastern protuberance of the Asian continent extends from Baikal Lake to the Bering Straits. Much of this landmass falls in eastern Siberia and the remainder is in north China. Fronting the Pacific coast are two peninsulas, Kamchatka and Korea, enclosing the islands of Japan. The tectonic structure of mountain ranges revolves around Precambrian exposures in Manchuria. The surrounding Palaeozoic/Mesozoic folded areas have an east-west strike in China and a north-west strike in Russia. The Siberian section north of Baikal Lake is mostly of flat sedimentary rocks. Lava plateaus are exposed around Kamchatka, while the island chain further south with extinct volcanoes is an active seismic zone. The mountain ranges are less imposing than those of Central Asia and have comparatively low relief. Therefore, the highest peaks in the region are not in the continental section but on the island chain of Taiwan (3,997m) and Japan (3,776m). The mountains of the North-East are described in the following four groups: Eastern Russia, North and East China, the Korean Peninsula, and the Japanese Archipelago (Figures 5 and 6 and Annex D).

5.1 Eastern Russia

The great expanse of Russian land east of the Urals is tilted to the north with most of its south-

ern and eastern parts being mountainous. One highland that stands far to the north, near 70° north latitude, is Gory Putorana (Figure 5). It is not a range but a domed plateau with a radial drainage pattern. Although its highest point is only 1,701m (G. Kaman), Putorana dominates the vast taiga plain for nearly 1,000km around. The next major ranges, Sayan and Stanovoy, are 1,500 km away west and east of Baikal Lake (Figure 4). The highland east of Sayan is so disturbed tectonically that it has led to creation of the graben lake of Baikal, the deepest in the world (1,737m). The surrounding mountains have pine and larch forests. East of the lake, a series of ranges trend north-east towards Stanovoy Khrebet. This Buryat Mongol area is endowed with rich forests and minerals such as gold, iron, tungsten, and molybdenum. A southern spur, Yablonovj, joins the border ranges of Mongolia near Ulanbaatar. In the east, the Stanovoy Range forms the water divide between the south-flowing Amur and north-flowing Lena rivers. As the Amur turns north to join the sea, it is bounded by Sikhote Alin along the east coast. The Bureinskij Range runs parallel to Sikhote Alin west of the Amur.

East of the Stanovoy Range, the headwaters of the Lena approach to within a 100km of the Pacific but are blocked by the Dzhugdzhur Range. It is less than 2,000m in elevation and runs parallel



Figure 5: North-East Asia (A)



Figure 6: North-East Asia (B)

to the north-west orientation of the coast. The extreme north-east corner of Russia beyond the Lena has a series of young mountains, some of which exceed 2,900m. It is a land of intense cold and its vegetation demonstrates a transition from taiga to tundra. Larch, pine, fir, and birch are the major species of taiga. Reindeer herding, timber extraction, fur trapping, and gold mining are important activities. The alignment of ranges is in a southern arcuate towards Magadan. The western section has two parallel ranges aligned north-west/south-east.

These are the Verkhoyanskiy and Cherskogo flanking the north-flowing Yana River. The section east of Magadan also has two parallel volcanic ranges but they are aligned south-west/north-east. The northern one, Kolymskoye, traverses the mainland, which forms its spine, until terminating in the east. The southern range is made up of the Koryakskoye on the mainland and the Sredinnyy on Kamchatka Peninsula. The peaks of the last range, exceeding 4,700m, are the highest in Eastern Russia. However, the climate is much milder here and there is

adequate rain along the east coast. Fishing is a major industry along with seal hunting and lumbering.

5.2 North and East China

Most of the mountains of China are physiographically related to those of Central Asia. Those east of 110° longitude can be considered in two components as extensive ranges north of the Huang-Ho and the maritime hills to the south. Commencing from the north-west are two ranges, the Changbai and the Great Khingan enclosing Manchuria. The former range along the Korean border trends north-east/south-west and averages 1,000 masl with some peaks exceeding 2,700m. The latter straddles along the Russian and Mongolian boundary into Inner Mongolia. The Greater Khingan Range, from 1,100 - 1,400m in average elevation, has a gentle gradient with rounded tops. The eastern slopes have a comparatively moist climate and are covered with forests. These two ranges, with high points of 2,744m and 1,656m respectively, are aligned south-west/north-east. South-west of the Great Khingan across Inner Mongolia is the Taihan Shan. It stretches 400km north-south as a boundary between the Shani Plateau and the plain of north China. The high point on the range, Wutai Shan, has been a sacred site for Buddhist pilgrims from early times. It has a pronounced cold temperate climate becoming increasingly arid towards the west. The main cultural groups are the Korean in Changbai and the Manchu, Mongol, Evenki and Oroqen in Great Khingan, and they are mostly of the Altaic language family. The area has experienced extensive deforestation for agricultural expansion since the 14th century (Rost 1999). However, there has been intensified reforestation in recent decades.

The mountains of China south of the Huang River and east of the Wuhan Basin are basically hill ranges that appear prominent owing to the surrounding lowlands. The most northerly of these is the Tai Shan in Shandong province. It is an east-west aligned outlier rising above the vast delta of the Huang. The main summit, Yuhuang Ding (1,524m), known as the Jade Emperor Peak, has

been revered since ancient times in folk, Taoist, and Buddhist traditions. Another range north of the Yangtze River is the Dabei Shan on the border of Anhwei and Hupeh provinces. The fold axis running north-west/south-east links it structurally to the Qinling Shan to the west. The eastern section of the range is higher (approaching 3,000m) and more complex. The area produces timber and bamboo and also grows high quality tea.

There are numerous small ranges south of the Yangtze, all with south-west/north-east alignments. Those encircling the Kiangsi Plain (with Poyang Lake) clock-wise from the north-east are the Jiuling, Wugong, Nan Ling, Wuyi, and Tianmu. Jiuling Shan has three parallel ranges with extremely rugged topography. Most of the ranges exceed 1,000m in height, the dominant peak being the Wu-mei (1,686m). The area is heavily forested. Wugong Range lies south of the Jiuling Range, traversing the Kiangsi-Hunan border. Its western section averages 1,500m while the lower eastern section has three parallel ranges. The forests are rich in pine and cedar. The Nan Ling, running eastwards from Guanxi to Qiansi, forms the watershed between the Yangtze and Pearl Rivers; and these granite ranges are generally at 1,000m in altitude, approaching 2,000m in some places. Despite being low, the Nan Ling is an effective barrier to northern cold waves, so that the climate south of it is warm and supports crops all year round. The highest point is the Shinkenkong (1,902m) due north of the Guandong Basin. Further east from Huamei Shan (1,673m) the range has two spurs: the Luoxiao northwards and Dayu Ling eastwards.

The south-east maritime hills run parallel to the coastline east of the Qiangsi Plain. The Wuyi Shan runs north-east along the Qiangsi/Fukien border. The range is much eroded and the highest peak, Huangang (2,158m), lies towards the north. Further north, Tianmu Shan also trends north-west demarcating the boundary between Zhejiang and Anhui provinces. The high points on the range are the Shier Shan (1,262m) in the south and the Xitianmu (1,507m) in the north. The range is famous for dense forest and tea plantation. Fi-

nally, there are the coastal ranges of the Daiyun Shan and Donggan Shan which are traversed by the Min River, debouching at Fuzhou. There are about a dozen national minorities in these southern highlands who predominantly speak Sino-Tibetan languages and practise sedentary farming.

In contrast to the hills of coastal mainland China, those across the Formosa Strait in Taiwan are truly mountainous. The backbone of the island is the Chungyang Shanmo that trends north-south. It rises steeply from the Pacific to slope gradually westwards. Two-thirds of the land surface is composed of rugged highlands. The highest peak is the Yue Shan (3,997m) in the central part of the range. Abundant rainfall supports luxuriant vegetation. The tree line lies above 3,600m owing to the island's position astride the Tropic of Cancer. The montane people belong to the tribal *Malay* groups who practise shifting cultivation.

5.3 The Korean Peninsula

The Korean Peninsula (Hankuk) is dominated by highlands that run throughout its length. The

mountains are of ancient Archaen rocks that have been uplifted to the east and down-tilted to the west. The central range, known as Hamgyong in the north and Taebak in the south, runs parallel and close to the east coast. The northern section linked to the Changbai Range on the Chinese border is fairly extensive and includes the highest peak in Korea, the Paektu-san or 'White Top Mountain' (2,744m). The structure is also complex with lava plateaus in the interior and escarpment to the east. Two ranges, the Kangnam and Myohyang, trend to the south-west but elevations do not exceed 2,000m. Another eastern range, the Nangnim, turns south to join Taebak Sanmaek. The latter is not very high but forms the watershed of the peninsula. The slopes along the east coast are steep, while those in the west are gentle. The average height of the highest plateau, Gaema, is only 1,500m. The range continues south-westerly as Soback Sanmaek and its high point, Chii-san (1,915m), virtually approaches the sea coast. The climate of Korea is monsoon humid, midway between the continental and marine types. The highlands were once heavily forested and have been cleared exten-



Author

14. Buddhist Shrine, Korea. A hill near Kyongju provides an ideal retreat for contemplation. Persimmons (*Diospyros geus*) with yellow fruit are indigenous to the area.

sively for agriculture and timber extraction. The people are derived from the nomadic tribes of Mongolia who have fused into a homogeneous group. Although Chinese cultural influence is dominant (Plate 14), their ancient heritage survives in shamanistic rituals generally performed by priestesses.

5.4 The Japanese Archipelago

The Japanese word for landscape, *sansui*, is derived from two characters: *san*, mountain, and *sui*, water. This compound term truly reflects the high relief of the country in that the Japanese mountains rise from one of the world's great oceanic depressions with depths of up to 10,000m. Forming part of a volcanic zone that rims the Pacific, the island chain may be likened to the crest of a submerged mountain. The mountains of Japan are described in three groups as those of Hokkaido, Honshu, and Kyusu.

The northern island of Hokkaido is dominated by volcanic mountains. In the east, some of these

volcanoes are still active. The central core, Ishikari Sanchi, has the high peak, the Daisetsu-zan (2,290m). Two ranges radiate from here: the Kitami to the north and Hidaka to the south. These are of granitic rock formation. West of these are the Teshio Sanchi, parallel to the coast, and the Yubari Sanchi inland, representing a metamorphic belt. Hokkaido is the home of the Ainu, the only aborigines surviving in Japan.

The main island, Honshu, has an arcuate form with mountains as its backbone. These ranges are recognised in three zones: five in the north-east, three in the centre, and three in the south-west. The north-south aligned ranges of Ou, Mikuni, and Kanto form the spine of the north-west zone. The Kitatami and Abukama Ranges run close to the east coast. The central zone is a knotted complex of ranges running at right angles to the main spine of the island. Known as the Japanese Alps, these include the Hida Range in the north, the Kiso Range in the centre, and the Akaishi Range in the south. These constitute the highest mountains in Japan and there are at least seven peaks above



15. Tateyama area, Japan. Mt. Tateyama, with a Shinto shrine on the summit (2,872m), is much revered by the Japanese. This range in the Japanese Alps has numerous cirques (background) and thermal springs dotted with huts (foreground) for visitors.

3,000 m, including Mount Fuji (3,776m) east of Akaishi. Composed of Palaeozoic and Mesozoic rocks intruded by igneous ones, the ranges have very steep slopes. The north-west winds bring heavy snowfall in winter. The windward side has climax montane forest while the south-east leeward side has mostly scrub vegetation (Kikuchi 1981). The south-western zone commences west of Nagoya in the form of a long north-south mountain linking the Ryohak, Suzuka, and Kii Ranges. The extreme western part has the Chugoku Sanchi extending between Kyoto and Hiroshima. It is an up-faulted granitic highland with mature, rounded relief. There are no peaks over 2,000m in the south-west zone. The highest is on Shikoku Island across the southern inland sea : the Ishizuchi-san (1,911m).

The southern island of Kyushu is an area of young folded mountains with some vulcanism to the

south. The Kyushu Sanchi straddles north-south across the centre of the island as a distinct watershed. The high point, Kuju-san (1,787m), is situated on the northern end of the range. The Tsukushi is a minor range in the north-west aligned transverse to the central range.

The Japanese islands receive very heavy precipitation in the form of snow, rain, and typhoons. Despite the rugged topography, the mountains have dense forests. If their provenance is climatic, their preservation owes much to the sedentary orientation of Japanese agriculture without livestock and to settlements in which the main economic activity is coastal fishery. In Japanese culture, mountains are less for profane use and rather associated with spirituality. So mountains, *sangaku*, revered as divine, inspired *shugendo* or the cult of the mountain (Picken 1994) (Plate 15).

(see Figures 5 & 6)

Annex D : Ranges of North-East Asia			
S.N.	Range (subsidiary)	Prominent Peak (metres)	Location
1.	Bureinskij Khrebet		Russia
2.	Chereskogo	(2,640)	Russia
3.	Changbai Shan	Aborigen (2,586)	China/North Korea
4.	Chungyang Shanmo	Paektu-san (2,744)	Taiwan
5.	Dabie Shan	Yue Shan (3,997)	China
6.	Daiyun Shan	Huo S. (1,774)	China
7.	Dznugdzhur	Baiyan S. (1,596)	Russia
8.	Great Khingan Range	Gore Topgo (1,909)	China
9.	Gory Putorana	Fuka S. (1,656)	Russia
10.	Hamgyong-Sanmaek	Gora Kaman (1,701)	North Korea
11.	Hokkaido	Kwanmo-bong (2,540)	Japan
12.	Japan Alps	Daisetsu-zan (2,290)	Japan
13.	Jiuling Shan	Fuji-san (3,776)	China
14.	Kolymskoye Nogor'ye	Wu-mei (1,686)	Russia
15.	Koryakskoye , ,	-	Russia
16.	Kyushu	Gora Led' anaja (2,562)	Japan
17.	Nam Ling	Kuju-san (1,787)	China
18.	Sikhote Alin	Huamei S. (1,673)	Russia
19.	Sredinnyj Khrebet	Gora Tardoki-jan (2,077)	Russia
20.	Stanovoy Khrebet (Yablonovyy Khrebet)	Kl'ucevskaja Sopka (4,750) Gora In'aptuk (2,578)	Russia Russia
21.	Taeback-Sanmaek	Burun Sibertuj (2,519)	South Korea
22.	Taihang Shan	Chii-san (1,915)	China
23.	Tai Shan	Wutai S. (3,058)	China
24.	Tianmu Shan	Yuhuang Ding (1,524)	China
25.	Verkhoyenskiy Khrebet	Xitianmu S. (1,507)	Russia
26.	Wugong Shan	Gora Mus-Chaja (2,959)	China
27.	Wuyi Shan	Wugong (1,585) Huangang (2,158)	China

Chapter 6

South-East Asia

South-East Asia is the least compact among the regions of the Asian continent. Out of its total land surface, estimated at four million sq.km., the mainland mass has a share of only 40 per cent. The rest is accounted for by several thousand islands of the Indonesian and Philippine archipelagoes. Thus, it is composed basically of insular and continental components. Nevertheless the orographic features on both these landforms are interrelated. This is due to the focal location of the region where the two great axes, one of latitudinal Cretaceo-Tertiary folding and the other of the longitudinal circum-Pacific series, converge. This interface has given a distinctive alignment to the major relief of the region as a whole. In brief, the basic geological structures that determine the trend of the mountains are (a) north-south and north-east in the mainland interior, (b) east-west along the Indonesian islands, and (c) north-south across the Philippines. The mountain ranges of the region are described in three geographic divisions: the continental interior, peninsular, and insular (Figure 7 and Annex E).

6.1 The Continental Interior

South-East Asia has an oceanic front in all directions except to the north. Its northerly land boundary commences as a panhandle between South and Central Asia and then on to the southern

extremity of North-East Asia. The contiguous areas constituting the continental interior include the highlands of Myanmar, Thailand, Laos, and northern Vietnam. The relief pattern is that of a longitudinal ridge and furrow in Myanmar and an undulating plateau eastwards. These are related to their structural difference: the former being a zone of tertiary folds and the latter of block-faulted massifs of greater antiquity.

The basin of the Irrawady (Elephant River), forming the heartland of Myanmar, is ringed by mountains on three sides. The western rampart, linking Patkai, Chin, and Arakan, has been dealt with in the South Asian context. The northern ramparts, Kumon, Kachin, and Namkiu of the Tertiary fold, all trend north-south parallel to the Hengduan Range and are the highest in South-East Asia; and this includes Hkakabo Raz (5,881m) in the extreme north. East of the Irrawady lies the Shan Plateau which consists of mostly block-faulted massifs of the Mesozoic age which are rich in minerals. The topography has an undulating surface carved by the tributaries of the Sittang and Salween rivers. The hills are mature and rounded and approach 2,500m only in the extreme north. The population is predominantly Shan and Karen. Southwards, the Pegu Yoma extends 435 km as an outlier range between the Irrawady and Sittang rivers. Its high-



Figure 7: South-East Asia

est peak, Popa Hill (1,519m), is an extinct volcano. The mountains of Myanmar are rich in tropical hardwood forests. Various hill tribes practise shifting cultivation on the uplands (Table 3).

The mountains of northern Thailand adjoining Myanmar and Laos are extensions of the Shan Plateau. They form a horseshoe at the headwaters of the Menam river. Those to the west are old ranges of granitic intrusions and upturned

Table 3: Highlanders of the South-East Asian Interior

Myanmar (Region)	Thailand (Region)	Laos (Region)	Vietnam (Region)
Akha (north-east)	Akha (north)	Akha (north)	Muong (north)
Kachin (north)		Miao (east)	Mias (north)
Karen (east)	Karen (west)	Moi (north)	Hani (north)
Lahu (north-east)	Lahu (north)	Lahu (north)	Yao (north)
Lisu (north)	Lisu (north)	Lolo (west)	
Naga (north-west)	Dai/Tai (north)	Dai/Tai (south)	Dai/Tai (north)
Shan (east)	Shan (north)	Blang (north)	
Wa (north-east)	Hmong (north)	Hmong (north)	Hmong (north)
Palaung (north-east)	Yao (north)		Yi (north)

limestones. Doi Inthanon (2,595m), south of Chiang Mai, is the highest point. Evergreen forests predominate with mixed types below 1,800m and moist types above. Logging is making deep inroads in the area. The inhabitants above 1,000m are mostly Hmong who subsist on maize and poppy. Poppy growing has been controlled since the late 1970s and people have been encouraged to extract pine resin. Although there are several national parks in the Thai highlands, there is very little involvement of the local people as they are regarded as enemies of the forest (Ganjanapan 1998). The northern plateau is composed of ancient granite ridges. The plateau has a series of north-south ridges drained by four tributaries of the Menam River: from the west to east they are the Me Ping, Me Wang, Me Yom, and Me Nan. The climate is humid and precipitation ranges from 1,000-2,000 mm in summer. The winter is dry. Cultivation extends up to 1,200m upland with paddy as an important crop (Roder 1997). Swidden cultivation in secondary forest or shrub vegetation may be for two years, followed by a fallow period for as much as eight years. The eastern rim along the border of Laos is low in elevation. The natural vegetation is of the tropical monsoon rain type. The area has been the domain of more than a dozen ethnically different tribes such as the Akha, Hmong, Lisu, and Yao. They practise various forms of swidden agriculture and opium poppy is a major cash crop. For example, the Lisu cultivating at elevations ranging from 1,000 - 4,000m grow poppy after maize, while the Karen lower down (at 800- 1,200m) combine

maize and upland rice on patches that are abandoned after three to six years of cultivation (Hurni 1982). Indigenous terms, such as *raj* (swidden), *suan* (garden), and *naa* (irrigated field), indicate the diversity of land use. The mountain watersheds of northern Thailand have extremely low runoff efficiency, e.g., the recorded surface runoff is only a fifth of the precipitation received (Alford 1992). Time-series' data showing little change in sediment regimes since the 1950s provide no conclusive evidence that swidden agriculture is a major factor in land degradation.

The northern part of Laos, along the eastern flank of the Mekong River, is mostly rugged highlands of sandstone and limestone. West of Luang Prabang, the relief form is made up of parallel ranges aligned south-west/north-east. Eastwards, the Xiang Khoang Plateau forms a compact block with a radial drainage pattern. Some of the highest peaks in Laos occur in this area—including the Phou Bea (2,820m) near the Plain of Jars. The general elevation of the plateau is 1,200m compared to 2,000m in the northern mountains. Towards the south, the Annamite chain is rugged and densely forested. The local tribes include the Miao in the east, the Moi at higher elevations above 900m, the Lolo in the north-west, and the Thai at lower elevations (below 1,000m). Ray, a local version of shifting cultivation is common in these highlands.

Vietnam's border with Laos and China in the extreme north is marked by a series of ranges.

They are all aligned north-west/south-east, maintaining their trend in Yunnan from where they descend. Most of these are low ranges, approaching 3,000m on the central range between the Red (*Songkoi*) and Black (*Songbo*) rivers. The rock formation is mainly igneous overlain by limestones and sandstones. Fluvial erosion has created varied shapes on heavy limestone formations. With a tropical monsoon climate and an average annual rainfall of 1,500mm, forests are an intermixture of deciduous and evergreen species. Much of these have been reduced to secondary types due to overexploitation through burning and clearing. The montagnards include the Hmong, Muong, Hani, and Yi.

6.2 Peninsular

The mountains of South-East Asia grouped as peninsular fall into two types. The first type, as in Indo-China, is aligned along the coastal area of the peninsula. The second type forms the spine of the peninsula along the Tenasserim-Malaysia stretch. The first type includes the Truong San along the east coast and the Chuor Phnum Kravanh along the south-west coast of Indo-China. The former, 'La Chaîne Annamitique' in French, extends southwards from Tonkin to the Mekong delta as a rugged highland. The chain is less of a continuous range than a series of plateaus. The high point, Ngoc Linh (2,598m), is in the central section. Both its northern and southern extremities exceed 2,400m in elevation. The highland rises precipitously from the east and descends gently towards the Mekong Valley. The composition is mainly of sandstones and limestones with some exposures of ancient crystalline rocks in the north. These highlands receive more than 2,000mm of rain annually and support tropical evergreen forests. In the extreme south, the basalt highlands have some large rubber estates.

Chuor Phnum Kravanh or simply Kravanh was formerly called the Cardamom Mountains. It extends about 160 km along the south coast of Cambodia with a south-east/north-west axis. Its eastern extension, Chuor Phnum Damrei, for-

merly called Elephant Mountains, is aligned north-south. The highest point, Phnum Aoral (2,929m), is located at the convergence of these two ranges in the north-east. Their western slopes receive nearly 5,000 mm of rain annually from the south-west monsoon. In contrast, the eastern slopes receive half of that. The indigenous people speak mainly Mon-Khmer. Commercial crops include cardamom and pepper.

The second type of peninsular range traverses south along the Myanmar-Thailand border all the way to Selangor in Malaysia. It commences with the Dawna Range east of Yangon with the high point, Mawkhi (2,080m), being on the Myanmar side. Further south, the range is called the Bilaktaung Range and it terminates short of the Kra Isthmus. Here also, the highest peak, Myinmoletkat (2,072m), lies west of the border. Despite its low elevation, the range acts as an effective climatic barrier. The western slopes receive nearly 3,000 mm of rain, while it is about 1,500mm on the east side.

The Thai section of the Malay Peninsula has some elevated ranges exceeding 1,000m between the Kra Isthmus and Songkhla area. Southwards, the highlands of Malaysia commence at Bukit Bubus (1,145m) on the country's northern border. Peninsular Malaysia has several north-south trending ranges with granitoid topographic highs flanked by limestone, quartzite, and shale. Of these, the Banjaran Titiwangsa, including the Cameron Highlands, extends south to Selangor. Gunung Tahan (2,187m), the highest peak in Malaysia, lies on an eastern spur of the main range. The ranges are under dense tropical rain forests which are home to small groups of indigenous people (*Orang Asli*) of the Negrito type. These include the Jahai, Jakun, Semai, and Temiar.

6.3 Insular

The insular component of South-East Asia consists of archipelagoes that rim the continent between the Indian and Pacific Oceans. The geographical alignment is determined by major

structural arcs traversing the region. The islands are dominated by rugged mountain backbones, many of which have volcanic cones. Those on the west, such as Sumatra, Borneo, and Java, that rest on the continental shelf have fairly extensive coastal lowlands fringed by shallow seas. Eastwards, the islands rise abruptly from deep seas like the isolated peaks of submerged mountain ranges and, in many cases, have virtually no coastal plain. The description of the mountains of insular South-East Asia is given in three groups: Borneo, The Philippines, and Indonesia.

South-East Asia is a region in which the land divides but the sea unites (Fisher 1964, p 662). This is seen in The Philippines as a country of 7,000 islands and in Indonesia, a country of 3,000 islands, while the singular block of Borneo is shared by Indonesia, Malaysia, and Brunei. Borneo is not only the largest island in the region, it also has the highest peak (Gunung Kinabalu - 4,094m) outside the continental interior (Box 3). Borneo's highland backbone is aligned like a trident pointing to the south-west. It commences in Sabah with Crocker Range in the extreme north. The central range, Pegunungan Iran, is a prominent water divide along the Indonesian-Malaysian border. Around Bukit Batubrok (2,240m) it bifurcates into three ranges. One continues south-west along Muller Range towards Schwaner Range. The western branch, Kapus Hulu, defines the boundary between Indonesia and Malaysia. The eastern branch, the Meratus Range is the lowest of the three. The main relief pattern is determined by the axes of Tertiary folding running in a series of parallel curves. Although parts of the northern heights, including Kinabalu Peak, are granitic, most rock formations are sandstone and limestone. These highlands have dense equatorial rain forests with successions of montane and even alpine types on the highest elevations with over 4,000 plant species. The various indigenous groups include the Dusun, Kadazan and Murut in Sabah; the Iban and Penan in Sarawak; and the Barito and Maloh in Kalimantan.

The islands of The Philippines straddle a zone of Tertiary/Quaternary folding of active vulcanism trending north-south between deep sea basins. Nearly all have rugged interior highlands and in combination resemble the upper portions of submarine mountain ranges. Superior elevations are, however, confined to the larger islands, Luzon and Mindanao respectively, in the extreme north and south. Mount Pulug (2,929m) in Luzon in the north and Mount Apo (2,954m) in Mindanao in the south are in the same elevation range. Luzon includes two parallel ranges with the higher Cordillera Central as the spine and the Sierra Madre along the east coast. The dominant rocks are Tertiary sedimentaries with some exposures of ancient basement complex in mountain cores. Zambales, across the Lingayen Gulf, is a volcanic range that receives a lot of rain and has dense forests. The highlands around Banaue are famous for elaborate field terraces. However, this wet rice culture of the Bontoc and Ifugao is an exception amid a vast area of shifting cultivation (*kaingin*) by other tribes and the still primitive Negrito of the Sierra Madre and Zambales.

The southern island of Mindanao has, as in Luzon, two north-south trending ranges. Here also, the western range forms the core of the island whereas the eastern one is mainly littoral. The former traverses the entire island as a distinct watershed between the Agusan Valley to the east and the Mindanao Basin to the west. A western spur, the Katanglad Mountains, has many peaks above 2,800 m, but the highest one, Mount Apo, on the main range, lies further south. Rainfall on the highlands is about 800m lower than on the east coast but occurs all the year round and supports dense vegetation. The uplands are also used for vegetable production under a fallow system with an average re-cultivation period of four years. The highland tribals are mostly Moro, and they are sandwiched between adherents of Islam in the west and Christianity in the east.

Indonesia consists of numerous large and small islands spread over a vast area. The major structural alignment is east-west, dictated by two par-

Box 3

Climbing Mount Kinabalu



Author

The Kinabalu Park in Sabah is crowned by Mount Kinabalu (4,101m) (Plate 16), the highest peak in South-East Asia. The Park covers an area of 754 sq. km. With probably the richest flora in the world. These include 1,500 species of orchids, 80 of figs, 60 of oak/chestnut, and 26 rhododendron varieties. The Park headquarters at 1,524m is about two hours drive from Kota Kinabalu. The summit lies nine kilometres north of Park headquarters, involving an ascent of 2,577 metres. The climb can be accomplished in two to three days. It is, however, an entirely different matter for those with proven stamina. Passing the welcome gate ('Selamat Mendaki') in October 1994, I came across the following bill-board.

16.Mt. Kinabalu, Malaysia. Mount Kinabalu (4,101m) is the highest peak on the vast stretch between the continental Hengduan Ranges and New Guinea in the Pacific. The granite massifs are shaped by glacial scouring and frost shattering. It is considered sacred – as the resting place of departed Kadazan/Dusun people.

International Climbathon, 1993

Name	Country	Placed	Time Recorded		
			Hour	Minute	Second
Kusang Gurung	Nepal	1st	2	44	36
John Hosson	Britain	2nd	2	52	41
Dil Bahadur Gurung	Nepal	3rd	2	55	23

Those from Nepal were Gurkha soldiers serving in Hong Kong. In the female category, the top three places were taken by local Malays, the first covering in 3 hours, 28 minutes and 16 seconds.

For an average climber, there is no need to rush. It can be a journey to discover the rich variety of flora and fauna. The climb starts beside the Power Station (1829m), which lies above the tropical Dipterocarp vegetarian zone. Then the path ascends under a temperate forest of oak, chestnut, myrtle laurel, and rhododendron.

Around 1,900m begins the cloud forest zone of gnarled tree-trunks festooned with moss, epiphytic ferns, and orchids. Beyond 2,100m, appear Pitcher plants of various species. Higher up, *Schima breviforme* with white flowers and *Vaccinium* with crimson leaves are notable. There are six rest places between the climb entrance (Power Station) and Panar Laban (3,353m). Panar Laban ('Place of Sacrifice') is 1,500 meters higher from the commencement of the trek at the Power Station, and has lodging facilities. Beyond Panar Laban, vegetation becomes stunted and scarce. Instead, bare rock faces of granite loom large. A narrow gully and then a rocky traverse leads to Sayat-Sayat (3,810m), the highest hut on the mountain. Sayat-Sayat is the native name for the *Leptospermum* bush, abundant around here.

The final ascent is across the summit plateau of wide slabs of granite assisted with a rope line. Most begin their climb in the very early morning from Panar Laban or Sayat-Sayat to be in time to see the sunrise from the summit. The highest summit, Low's Peak, provides excellent views all around. The place can be windy with mist swirling around.

Source: Harka Gurung. *ADIPA Newsletter* (Kuala Lumpur), August, 1995, pp. 1,23 & 24.

allel ranges of Tertiary/ Quaternary folding. In the north-east, the axes of the fold turn north towards The Philippines to which they are geologically linked. The inner of the two major east-west folds indeed forms the spine of the long island chain through a series of volcanic cones from Sumatra to Timor. The description of the mountains of Indonesia is given in five sections: (1) Sumatra, (2) Java, (3) Lesser Sundas, (4) Sulawesi, and (5) Moluccas.

Sumatra Island is marked by highlands along its entire length of over 1,700 km. Although it is called Bukit Barisan (The Mountain Range), it consists of two or more parallel ridges separated by structural troughs adjacent to numerous extinct and active volcanoes. In the north, Pulau Samosar is an island within the crater of Toba Lake. The range runs close to the western side of the island and has a precipitous slope facing the Indian Ocean. The main sections are the Aceh Range in the north, the lava and tuff plateau of Batak, the ridge and basin of Padang highlands, and finally the Benkulen Ridge to the south. Some peaks approach 3,000m in elevation, the highest being Kerinci (3,805m) in the Padang highlands. These highlands receive heavy rain from the south-west monsoon. Except for the intermontane Batak Plateau with savanna vegetation, most of the highlands have dense tropical rain forest. The indigenous people are the Batak and Gajo in the north, the Menangkabau in Padang, and the Lamponger in the south. Shifting cultivation, or ladang, is common in these highlands.

The slender island of Java, extending nearly 1,000km east-west, is dominated by a chain of volcanic cones. Of these 17 are still active and 14 exceed 3,000m in elevation, the highest being Gunung Slamet (3,428m). In the west, a clus-

ter of peaks forms the rugged relief of the Priangan Plateau. In central and eastern Java, the peaks are more spaced and are separated with lowlands. The central range is composed mainly of Tertiary basalts and andesites and Quaternary volcanics. As in the case of Sumatra, the southern slope facing the Indian Ocean is steep. Overall, the soils derived from ejected lava and ash combined with abundant rainfall make the base of these highlands fertile, and it is an area where the rural population is extremely dense.

Lesser Sundas is composed of small islands aligned east-west between Bali and Timor. In structure and physiography they are an eastern extension of Java, but on a smaller scale. Most of the island cores are volcanic peaks that rise abruptly from the sea. These high points reach 3,142m in Bali, 3,726m in Lombok, 2,850m in Sumbawa, 2,400m in Flores, and 2,427m in Timor Island. The area has scrub-like vegetation, due to its long dry season. The population is basically Malay who engage in wet-rice cultivation. However, the Balinese stand out as a relict of the Hindu-Javanese culture amidst an Islamic realm (Plate 17).

The spread-eagled island of Sulawesi lies north of Lesser Sundas. Its distinctive layout and relief are related to a number of factors: convergence of several axes of Tertiary folding and extensive uplift, faulting, and subsidence. Therefore, it is distinguished by high relief and wide occurrence of lakes with a maze of rift valleys. The highest point, Rantekombola (3,455m), is located south of the central axis from where ranges diverge to the extremities of the peninsula. Most of the vegetation is tropical rain forest. The highland people, mostly animist Toradja in various tribes, practice shifting cultivation. Those engaged in wet-



Machukar Rana

17. Traditional Bali Dance, Indonesia

rice cultivation are Muslim Buginese and Christian Minahasan.

The Moluccas form a group of small islands on the extreme east of South-East Asia. These include Halmahera in the north, Obi in the centre, and Buru and Seram in the south. They represent a collision of north-south and east-

west aligned structural axes. The uplands in Halmahera in the north are volcanic. The elevation rises towards the south, culminating on Gunung Binaiya (3,119m) in Seram. The highland people are of Melanesoid, Australoid, and Negrito origins, and their occupations range from shifting cultivation to hunting and fishing.

(see Figure 7)

Annex E : Ranges of South-East Asia			
S.N.	Range (Subsidiary)	Prominent Peak (M)	Location
1.	Ailao Shan	Fam Si Pan (3,143)	Vietnam
2.	Bilaktaung Range (Dawna)	Myinmoletkat (2,072) Mawkhi (2,080)	Myanmar Myanmar
3.	Borneo (Crocker, Iran, Kalimantan)	Gunung Kinabal (4,094)	Malaysia
4.	Banjaran Titiwangsa	Gunung Tahan (2,187)	Malayasia
5.	Chuor Phnum Kravanh (, , , , Damrei)	Phnam Aoral (1,771)	Cambodia
6.	Cordillera Central	Mt. Pulog (2,929)	Philippines
7.	Java	G. Slamet (3,428)	Indonesia
8.	Kachin	Hkakabao Raz (5,881)	Myanmar
9.	Lombok	G. Rinjani (3,726)	Indonesia
10.	Mindanao	Mt. Apo (2,954)	Philippines
11.	Moluccas	G. Binaiya (3,019)	Indonesia
12.	Pegu Yoma	Popa Hill (1,519)	Myanmar
13.	Shan Hills	- (2,603)	Myanmar
14.	Sierra Madre	Mingan (1,901)	Philippines
15.	Sulawesi	Bulu Rantekombola (3,455)	Indonesia
16.	Sumatra	G. Kerinci (3,800)	Indonesia
17.	Thailand, North	Doi Inthonon (2,595)	Thailand
18.	Timor	G. Mutis (2,427)	Indonesia
19.	Truong San	Ngoc Linh (2,598)	Vietnam
20.	Xiang Khoang Plateau	Phou Bea (2,820)	Laos
21.	Zambales	High Peak (2,037)	Philippines

Chapter 7

Australasia

Three large islands east of Timor Trough and Aru Basin constitute Asia's farthest region of Australasia. Australia, its main bulk, can be described as the world's largest island and smallest continent. The other two island groups are New Guinea in the north and New Zealand in the south-east. Australia and New Guinea are only separated by the shallow Arafura Sea but present a contrast in geological structure. Australia is mostly founded on Precambrian stable shield related to Gondwana land. New Guinea, on the other hand, has east-west axes of Tertiary folding. New Zealand is similarly built on a folded structure but aligned south-west/north-east (Figure 8 and Annex F).

7.1 New Guinea

The island of New Guinea is comprised of the Indonesian Province of Irian Jaya and the independent country of Papua New Guinea. Their boundary along 142° east longitude bisects the island virtually into two equal halves. However, the Central Cordillera, extending east-west over 2,500 km as the central spine, provides physiographic unity to the island. Indeed, they are the highest mountain ranges between the Himalayas and the Andes with an average tree line of from 3,750 - 3,900m. The Central Cordillera has narrow crested ridges above montane basins enriched by volcanic depositions of laharcic material and ash (Brookfield

and Allen 1988). The prominent peaks are the Puncak Jaya (Mt. Victory at 5,029m) in the west and Mount Wilhelm (4,697m) in the east. The former, originally called Mount Carstenz after a Dutch navigator, is high enough to support some small glaciers. The western section in Indonesia, Pegunungan Maoke, has three other peaks over 4,500m in elevation. The eastern section in Papua New Guinea extends from Thurnwald through the Bismarck to Owen Stanley Ranges in the extreme east. As a general pattern, the highlands have the steepest slopes towards the south. Along the northern coast are a chain of lower ranges that trend parallel to the main range. These are the Van Rees in the west, Torricelli in the middle, and Finisterre in the east. The main highlands are composed of Archaean schists and massive crystallines with lava effusives in the central part. These rock formations are rich in minerals—including gold.

The highland terrain is very rugged. The lower slopes are covered with dense tropical forests while grasslands prevail on the higher ranges above 3,000m. The highlands are inhabited by scattered tribes of the Papuan type, some of whom continue their primitive ways. The earliest settlers were centred around swamplands with taro and pork as basic foods. Subsequently, these 'sedentarised' swamplanders expanded into adjoining dry land for swidden cultivation (Gorecki



Figure 8: Australasia

1986). They were followed by the Melanesian people, mainly along the coast. The economy is based on subsistence horticulture¹ and pig husbandry. The main crop is the sweet potato (*Ipomoea batatas*) which was introduced in the 17th century. Forest land is cleared by fire and used for garden cultivation of various root crops. The upper limit of crop cultivation is about 2,500m with cultivation on slopes ranging from 30 to 40 degrees. These slopes are never terraced or irrigated (Humphreys and Brookfield 1991). Cultivation techniques based on indigenous knowledge seem well-adapted to fertility management (Sillitoe 1998). This has resulted in comparatively dense settlement at elevations between 1,500 - 2,500 m; one of the advantages of the sweet potato being its tolerance to low temperatures and the fact that its yield is two to six times higher than that of the taro (Smith 1985). Currently, timber extraction and mining are the main economic activities.

7.2 Australia

Australia is the lowest and flattest of the continents and has no high mountains despite its vast

extent. Approximately three-quarters of its area is covered by a plateau that rarely rises above 500m. The Great Western Plateau is mostly desert or semi-arid scrub country. The few uplands occurring there are mere pimples on the extensive peneplain. The ancient shield topography is missing only in the east where a chain of low ranges runs parallel to the coastline. The western uplands include the Hamersley Range in the north and the Stirling Range in the extreme south. The Hamersley and its eastern extension, the Ophthalmia Range, are aligned east-west with Mount Bruce (1,235m) being the high point. The rocks are mainly Palaeozoic crystallines. The climate is subtropical with summer rain. The Stirling Range near the south coast is a small lava outcrop capped by Bluff Knoll (1,167m). This area has a temperate climate favoured with winter rainfall.

The central uplands are ringed by deserts in all four directions. These are all low hills with a predominantly north-east strike. The Macdonnell Ranges in the north and Musgrave Ranges in the south enclose the dry lake of Amadeus. Much of these upland areas are designated as Abo-



18. Kangaroo, Australia – Kangaroos in eucalyptus forest near Flinders Range. This marsupial of the family *Macropodidae* is native to Australia and nearby islands.

¹ The use of horticulture here refers to the cultivation of fruit and vegetables on small holdings for subsistence and not to gardening in the decorative sense.

original Reserves and there are seven in all. The only range in South Australia, Flinders' Range, trends north-south along a structural fault fronting Spencer Gulf near Adelaide (Plate 18). The highest point is St. Mary Peak (1,165m). The nearby uplands, known as Barrier Range to the east and Gawler Range to the west, are merely low knolls approaching 500m. These are of much-eroded Palaeozoic rock formations with ridges of hard quartzite.

The Great Dividing Range extends over 3,200 km from Cape York Peninsula in the north to Bass Strait in the south. It is an eroded plateau ranging from 900 to 1,500m. The highest point, Mt. Kosciusko (2,230m), in the extreme south, was named in 1840 after Thaddeus Kosciusko, a Polish revolutionary. The topography is subdued with rolling hills. The island of Tasmania has some small mountains. The main range lies west of the Great Lake and has a number of peaks. The highest peak, Legges Tor (1,573m), is an outlier far to the east. Despite their low elevation, these mountains are considered to be of great interest owing to their luxuriant native flora. Thus, the

small island has four national parks centred around the highlands.

7.3 New Zealand

New Zealand forms part of the 'rim of fire' as a surface impression of the boundary between tectonic plates. The mountains of New Zealand extend throughout the length of the two islands as their spine. In terms of geological origin, those in the North Island are younger than those in the South Island. The northern ones are mostly hilly and dominated by four volcanic cones. Maori legends describe the ranges as a great fish brought to the surface by a magic fish-hook; great swellings arose where it was clubbed by the gods who caught it, and the active volcanoes are the death twitches of the giant (Lowe 1969, p 155). This Fish of Maui is associated with North Island as its tail, Lake Taupo as its heart, and the Wellington area as its head.

The mountains of North Island extend nearly 500km north-east/south-west, commencing from Raukumara overlooking the East Cape to Cook



19. Native vegetation, New Zealand. Protected forest north of Wellington. North Island. The mixed forest of broadleaf in the foreground and conifer along the ridge are both of evergreen species.

Strait. It is connected with Huiaru further south which joins the central plateau with the highest peak, Ruapehu (2,797m). Nearby are two more volcanic peaks, Ngauruhoe (2,291m) and Tongariro (1,968m), which overlook the warm lake of Taupo which is surrounded by ice. Several ranges diverge from the plateau to the north and south. Ruahine Range descends further south to merge with Tararua Range. The climate is marine temperate with rain in all seasons and higher precipitation (over 1,500mm mean annual) in the highlands. The surface configuration is one of steep slopes and vegetation is basically deciduous forest (Plate 19). The indigenous people are Maori of Polynesian origin.

Mountain ranges traverse the entire 800 km length of South Island as its backbone. There are 223 named peaks that exceed 2,300m in elevation. The central and highest section between Arthur's Pass and Haast Pass is referred to as the Southern Alps. Northwards, there are many ranges with average elevations of 2,000m with their highest elevations fronting the east coast. The central section with Mt. Cook (3,764m) has many peaks exceeding 2,500m. It has numerous glaciers,

Tasman Glacier in the Mount Cook National Park being nearly 30 km long. Since the Southern Alps are generally steepest on the western side, the longer glaciers are in the east where there are gentler slopes. In the west, glaciers descend more rapidly approaching the rain forest along the coast. The southern section of the range is more splayed-out and contributes to a broken topography. The prevailing winds that sweep across the Pacific bring abundant rain and snow. The snow-line varies from 100m in winter to 1,800m in summer. Natural vegetation is of broad-leaved deciduous species in the west and is a mixture of broad-leaved and needle-leaved evergreens in the east. Over 90 per cent of alpine plants are endemic. The landscape has undergone two diverse impacts. First, Polynesian migration marked the commencement of the destruction of montane forests by fire. Then followed exploitative pastoralism throughout the tussock grasslands and mountain lands of the interior when European colonisation began in the mid-1850s (O'Connor 1984). South Island was unique in having only wild bird life. Now all types of animals have been introduced and have become pests in this pristine land.

(See Figure 8)

Annex F : Ranges of Australasia			
S.N.	Range (Subsidiary)	Prominent Peak (Metres)	Location
1.	Australian Alps	Mt. Kosciusko (2,230)	Australia
2.	Central Cordillera	Mt. Wilhelm (4,697)	Papua New Guinea
3.	Flinders Range	Mt. Mary Peak (1,165)	Australia
4.	Great Dividing Range	Round Mountain (1,608)	Australia
5.	Hammersley Range	Mt. Bruce (1,235)	Australia
6.	Macdonell Range	Mt. Zail (1,510)	Australia
7.	Musgrove Range	Mt. Woodroffe (1,440)	Australia
8.	Pegunungan Maoke	Puncak Jaya (5,039)	Indonesia
9.	Ruahine Range	Mt. Ruapehu (2,797)	New Zealand
10.	Southern Alps	Mt. Cook (3,764)	New Zealand
11.	Stirling Range	Bluff Knoll (1,110)	Australia
12.	Tasmania	Legges Tor (1,573)	Australia

Chapter 8

Thematic Overview

The preceding chapters describe the physical characteristics and human use of mountain areas of Asia on a regional basis. It would be presumptuous to try to synthesise fully these diverse aspects on a continental scale. Therefore, what has been attempted is only an overview with some thematic perspectives. These pertain to the physical environment, cultural diversity, and mountains as an economic frontier in the development context.

8.1 Physical Environment

The configuration of the Asian mountain system has been determined by tectonic forces, the principal one being the impact of the Gondwana Plate thrusting beneath the Angara Plate. This collision is expressed in the great axes of folding spanning the continent east-west and then sweeping south to north through the island chain along the Pacific Rim. The basement of these Tertiary mountains is of Cenozoic formation, less than 20 million years old. The youthfulness of the mountains is evident from their extreme elevation and high relief. Older Paleozoic and Mesozoic formations in the north-west and eastern Australia also have fold mountains, but these have been long eroded into plateaus and peneplains with some ranges as ancient ribs. As a general pattern, the folded structure of the Cenozoic formations has a rough

surface configuration, while those of the Paleozoic and Mesozoic systems are broken or smooth (Table 4).

Apart from structure and relief, other major components that influence physical environment are climate, soils, and vegetation. The mountains of Asia encompass a wide variety of climatic regions as they span a great latitudinal range. This is evident from three extreme regions. The first is one of high altitude at the core of the continent where the climate varies with elevation, latitude, and exposure, tending mostly towards temperate to alpine. The second extreme relates to the subarctic one in eastern Russia with low precipitation and very long winters. The third one relates to the tropical islands of South-East Asia where all months are warm or hot with diurnal rain. Other climatic variations are the semi-arid to arid of the west, wet and dry tropical of the south, and the temperate marine climate of South Australia and New Zealand (Table 4).

The dominant soils of highland Asia are mostly of a mountainous type that is shallow and that may be grass-covered or barren depending on the climate of the elevation zone. Other prevalent types are the chernozemic of the North-West supporting grasslands, the desertic in the West, and the podzolic of the South and South-East. In

Table 4: Physical Components

Region	Structure & Relief	Climate	Soils	Vegetation
South Asia	N: Cenozoic & rough W: Cenozoic & broken S: Precambrian & smooth	N: Temperate W: Semi-arid S: Wet & dry tropical	N: Mountain soils W: Grumosolic, Desertic S: Latosolic	N: Evergreen & deciduous W: Deciduous shrub S: Broad-leaved deciduous
West Asia	N: Cenozoic & rough S: Precambrian & smooth	N: Semi-arid S: Arid	N: Grumosolic S: Desertic	N: Mixed vegetation/grass S: Xerophytic
Central Asia	N: Paleozoic/Mesozoic & broken S: Cenozoic & rough	N: Semi-arid S: Cold arid	N: Mostly desertic S: Mountain soils	N: Grassland S: Barren
North-West Asia	Mostly: Paleozoic/ Mesozoic & broken Far East: Cenozoic & rough	N: Semi arid E: Humid mid-latitude S: Humid sub-tropical	N: Chernozemic S: Mountain soils	N: Mixed forest & tundra S: Mixed forest
South-East Asia	Continental: Paleozoic/ Mesozoic & broken Insular: Cenozoic & rough	Rainy tropical	Continental: Podzolic Insular: Mountain soils	Tropical rain forest
Australasia	New Guinea: Cenozoic & rough Australia: Precambrian/ Paleozoic/Mesozoic & smooth to broken New Zealand: Cenozoic & rough	New Guinea: Rainy tropical Australia: Hot arid in west & humid in east New Zealand: Temperate marine	New Guinea: Mountain soils Australia: Desertic in west & grumalic in east New Zealand: Mountain soils	New Guinea: Tropical forest Australia: Xerophytic in west and mixed forest in east New Zealand: Mixed forest & grassland



Machhukar, Rana

20. A Varied Topography, Kabhrepalanchowk, Nepal

terms of vegetation type, most of Central and West Asia are xerophytic with patches of grass. Another extensive type is the mixed forest of deciduous and evergreen species along the southern slopes of the Himalayan Range and much of North-East Asia. South-East Asia is the domain of broad-leaved evergreen forests. The extremes are represented by the boreal taiga of the extreme north and savanna grasslands of Australia.

Asian mountains have great environmental diversity (Plate 20), ranging from cold and hot deserts to tropical rain forests. Yet, whatever the bio-climatic regime, superior elevation and steep slopes are their distinctive features. Elevation exposes them to erosive elements and slope facilitates the gravitational flow of materials downhill. Thus, mountain areas are intensely affected by processes of surface erosion, either of water or wind. This has led to the erroneous notion that the mountains are fragile. In fact, mountains represent a high energy area with much mass wasting without which there would be no depositional material for the adjoining plains. Therefore, it seems more realistic to consider mountains as dynamic landforms.

8.2 Cultural Diversity

Mountain areas are generally considered as refuges or havens for minority peoples (Plate 21).

Yet it was from the highlands of Central Asia that nomadic hordes spilled over to the south and west to create vast empires, culminating in the Mongol conquests that reached their zenith in China during the time of Kublai Khan (1215-94) and in India during the time of Akbar (1542-1605). That mountains do not constitute a barrier to human movement is evident from the ethnic pattern in the Himalayas where the Caucasoid-Mongoloid interface is at a tangent to the crest line. In the west, Caucasoid people predominate, including in the trans-Himalaya, while, to the east, Mongoloids descend down to the Brahmaputra Plain. Indeed, some mountain ranges provide passages for migration, as for example the highlands of Yunnan, which constitute another epicentre of Mongoloid dispersal. Although 27 out of China's 55 so-called national minorities still reside there, the area has been the source of migratory waves of people that diverged west along the Himalayan Range and to the South-East impinging on the farthest islands.

The ethnic distribution of Asia's mountain people has a general pattern of mainly Mongoloid in the east and Caucasoid in the west. Both have southern regional variants; Malay in the former and Semitic in the latter. In West Asia, the dominant groups are Iranian, Turki, and Semitic (Table 5). South Asia is predominantly Caucasoid

Table 5 : Indigenous Culture, Asian Mountains

Region	Race/Ethnicity	Language	Religion
South Asia	N: Caucasoid in the west and Mongoloid in the east W: Caucasoid S: Dravid & Negrito	N: Indo-Aryan in the west and Tibeto-Burman in the east W: Indo-Aryan S: Dravidian	N: Islam, Buddhism & Tribal W: Islam S: Hinduism, Buddhism
West Asia	E: Iranian W: Turki S: Semitic	E: Persian W: Turki S: Arabic	E: Islam (Shia) W: Islam (Sunni) S: Islam (Sunni)
Central Asia	N: Tartar S: Mongoloid	N: Tungusic, Mongol S: Tibetan	NW: Islam SE: Buddhism
North-West Asia	N: Tungu S: Mongoloid	N: Manchu, Samoyed E: Japanese S: Chinese	N: Shamanism E: Shinto/Buddhism S: Confucianism/Buddhism
South-East Asia	N: Mongoloid S: Malayan, Negrito	N: Shan, Thai, Mon-Khmer S: Malay	N: Buddhism & animistic S: Islam
Australasia	N: Papuan C: Austro-Dravidian S: Polynesian	N: Austronesian C: Austric S: Maori	N: Animistic C: Animistic S: Animistic

with Mongoloids in the east and Dravid-Negrito in the Peninsula. Central Asia is mostly Tartar with some Mongol, while North-East and South-East Asia are decidedly Mongoloid. The Austro-Dravid, Melanesian, and Polynesian people of Australasia have only a hoary connection with some mainland groups.

Asian cultural diversity is most pronounced in terms of languages and dialects. Their complexity is illustrated by two legends, one from Daghestan and another from Sikkim. According to the former, an angel sent to distribute a bag full of languages over the earth flew too close to a Caucasus crag that ripped the bag. A hundred languages dropped out before the hole could be closed (Townsend 1972, p9). The latter legend is an East Himalayan version of the story of the Tower of Babel. When the Lepcha tribe of Maong were building a tower to seize the heaven, those above asked the helpers for grappling irons. Workers below misheard the message and, assuming that heaven had been reached, pulled away the main support, and the tower collapsed. Those who survived the disaster suddenly noticed that each spoke a different language (Leifer 1962, p7). Languages do tend to diverge into various dia-

lects due to their mountain isolation. Island interiors show a similar propensity for linguistic differentiation – Indonesian Malay has over 30 regional variants. The major language groups of mountainous Asia are Indo-Aryan in the west, Tungusic and Samoyed in the north, Chinese in the east, Tibeto-Burman in the South-East mainland, and Malay in the archipelago (Table 5). Peninsular India and Australia are distant outposts of the Dravidian and Austric languages respectively.

Compared to the ethnic and linguistic complexity, religious realms have a much broader sweep (Table 5). The plateau of Tibet and adjoining Mongolia is Buddhist (Lamaism). Parts of mainland South-East Asia are also Buddhist (Theravad). East Asia is mostly a mixture of Buddhism, Confucianism, and Taoism in China and Korea and Buddhism and Shinto in Japan. West Asia and part of Central Asia are Islamic with Iran as a Shia island amidst the sea of Sunnis. South Asia is predominantly Hindu and the archipelagoes of South-East Asia mostly Islamic, leaving The Philippines as a Christian outpost. But whatever the regional pattern of higher religions, mountain areas demonstrate a persistence



Greta Rana

21. Women of Hunza, Pakistan

of primitive beliefs. Living close to raw nature, the spiritual mould of the people continues to be dominated by the older substratum of anonymous gods and demons, as indicated by their animistic proclivity. Indigenous cultures are, however, being eroded by the dominant cultures intruding from the neighbouring lowlands. These civilisational influences include the Arabic in the west, Indic in the south, Russo and Sinic in the north, Sinic in the east, and Anglo-Saxon in Australasia.

Mountains are generally considered marginal areas for human occupancy due to their harsh environment and poor soil. In Asia also, the highlands have the least density in terms of population, although they are not as sparsely populated as in other continents. In terms of agricultural regions, one significant aspect of the Asian highlands is nomadic herding. This form of economic activity is most extensive in Central and West Asia, around cold and hot deserts respectively. Despite their vast geographical extension, rangelands sustain an economy and material culture based on seasonal mobility and multiple use of animal products (Miller et al. 1997). The second common type is the shifting cultivation which spans the highlands of South Asia and South-East Asia. It is based on adequate precipitation that supports rapid plant regeneration. The third type, rudimentary sedentary farming, is widespread in most areas where rainfall is low. The fourth type, intensive subsistence tillage, is mainly rainfed in humid regions and based on irrigation in the drier west. Plantation agriculture, in which tea, coffee, and other cash crops are cultivated, is confined mostly to the highlands of countries that have a colonial past.

Forests constitute an important resource in the Asian mountains. These include vast stretches of taiga coniferous and mixed forests in the north, sub-tropical forests in the Himalayas and south China, and semi-deciduous monsoon and tropical rainforests in the South-East (Table 4). If inaccessibility preserved them in the past, the same factor acts as a constraint to their commercial exploitation. Yet, extension of roads has opened

many of these areas for timber extraction. These include the north for conifers, east Asia for temperate hardwoods, and the south for tropical hardwoods. Among the various factors that impinge on forest land is that of changing land use and conversion to cropland in tropical areas due to increasing populations (Myint and Hofer 1998).

Asian mountains are also rich in minerals but these occur mainly outside the Alpine fold system on older rock formations. Central Asia and eastern Australia are particularly well-endowed in variety: iron, copper, tin, lead, zinc, gold, and silver. The areas where iron is mined are Peninsular India, Korea, and West Australia. Tin is mined mainly in South-East Asia and copper in Japan, The Philippines, and eastern Australia. Lead and zinc are extracted in North-East Asia and eastern Australia. As with forest resources, the problem with mineral exploitation is transport from the source to the market.

The mountains of Asia are a depository of tremendous hydro resources with immense potential. This inexhaustible resource has been well developed only in Japan, New Zealand, and parts of China. Elsewhere, it has been constrained by the high cost of infrastructure. However, improvements in road access and increasing energy demands have made feasible the execution of many hydropower projects. These have benefitted the mountain economy and also the environment by providing energy from a source other than fuelwood.

Some mountains in Asia have attracted pilgrims since ancient times as spiritual magnets (Birnbaum 1997). Earlier travel for pilgrimage purposes has now been overtaken by secular tourism. Since the turn of the century, high mountains like the Himalayas were centres of exploration and adventure as forerunners of mountain tourism. With rising incomes and more mobility, mountains have become accessible to an increasing number of tourists. For many mountain areas, tourism now constitutes a major source of income. With proper management, the possibilities for expanding tourism are immense, as it is an ever-expanding economic activity.

Mountains are economic as well as political frontiers: the latter expressed as political boundaries make mountains 'hot spots' of armed conflicts. In Asia, such confrontations engulf the Caucasus, Kurdistan, Afghanistan, Kashmir, Myanmar, Mindanao, and West Iran. They will persist with political rivalry among States as well as with mountain people's search for self-assertion and autonomy. In the economic arena, frontier phenomenon need not necessarily be the limit but rather the extension of possibilities. Mountain remoteness has two implications. One is its marginality in terms of the slow pace of innovation. A classic example is the long intervals between the introduction of the potato in different areas of the Himalayas. First introduced into Bhutan in 1774, the potato reached Kumaon in the 1850s, and has had an impact on the economy of Hunza only in recent decades. However slow, technological innovations are penetrating even distant mountain communities. Another aspect of mountain remoteness is the preservation of natural and cultural diversity. These are humanity's most valuable resources. Yet, the path to their conservation is not the current preoccupation with environmental problems, whether in research enquiry or development discourse. Assessments of the mountain environment have ranged from alarmist (Eckholm 1976) to cautionary (Ives and Messerli 1989) scenarios. Much of the crisis scenario is the result of oversimplification and generalisation. As a consequence, development programmes for mountain areas tend to be only *ad hoc* replications of external designs unsuited to the mountain situation (Jodha et al. 1992). Such an approach tends to highlight natural blight and ignore human plight (Gurung 1982). Much of the

sediment flowing from the highlands is generated through natural processes that are beyond man's capacity to manipulate (Bruijnzeel 1989).

Mountain people have continued to survive by contending with natural risks as well as exploitation from the centres of political and economic power. Thus, most Asian countries that fall within the category of the least developed are mountainous and land-locked. Even in relatively better developed countries, mountain areas remain zones of least development as the periphery of the periphery. The relationship between natural environment and economic development is generally considered to be antagonistic. This notion is based on the general observation that the more advanced the economy, the greater the pressure on natural resources. Emanating from the same logic, the relationship between environment and development in the mountains should be considered inverted since some of the environmental stresses there are due to extreme poverty. Here poverty is the basic cause of poor land management, and the consequence of poor management is deepening poverty (Blaikie and Brookfield 1987). Despite their intimate knowledge of the natural world through accumulated experience, it is poverty that compels mountain people to overexploit scarce resources. One needs to appreciate this economic compulsion for survival. The problems of the mountain environment cannot be solved without improving the economy of mountain inhabitants. Therefore, the emphasis should be on economic development in order to transform these frontiers into areas of benign environment sustained by the mountain people themselves.

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* **Editor's note.** Not all references are cited in the text. However, the vastness of the topic and the difficulty of finding good reference material have prompted us to include as many titles as possible. Not all references have complete information, but references that have been cited in the text have been included even if information regarding the place and publisher is lacking.

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Appendix 1

Mountain Glossary

Term	Derivation	Definition
<i>Ab</i>	Dari	river
<i>Akaba</i>	Arabic	pass
<i>Arak</i>	Arabic	cliff
<i>Banjaran</i>	Malay	range
<i>Bassikish</i>	Burushaki	orchard
<i>Bhanjyang</i>	Nepali	pass, saddle
<i>Bhot</i>	Nepali	trans-himalaya
<i>Bulag</i>	Mongol	spring
<i>Balak</i>	Uighur	spring
<i>Bum</i>	Kachin	mountain
<i>Chaka</i>	Tibetan	salt lake
<i>Changbo/Changbu</i>	Tibetan	river
<i>Chu</i>	Tibetan	river, stream
<i>Chuan</i>	Chinese	river
<i>Chuli</i>	Nepali	pinnacle
<i>Daban</i>	Uighur	pass
<i>Dag/Daglari</i>	Turki	mountain
<i>Dake</i>	Japanese	peak
<i>Danda</i>	Nepali	hill, ridge
<i>Dao</i>	Chinese	island
<i>Dara</i>	Tadzhik/Khirghyz	river
<i>Darrah</i>	Pashto	river
<i>Darya</i>	Dari	river
<i>Dhar</i>	Hindi	rest, ridge
<i>Di</i>	Magar	stream, river
<i>Ding</i>	Chinese	mountain, peak

<i>Dolina</i>	Russian	valley
<i>Darrah</i>	Pashto	river
<i>Feng</i>	Chinese	mountain, peak
<i>Gad</i>	Nepali	stream, river
<i>Gang</i>	Tibetan	mountain range
<i>Gar</i>	Afghan	mountain
<i>Gangri</i>	Tibetan	peak
<i>Ghar</i>	Pushto	mountain range
<i>Ghat</i>	Hindi	pass, passage
<i>Ghunsa</i>	Tibetan	lowland, warm soil
<i>Giri</i>	Sanskrit	mountain
<i>Gol</i>	Turki	lake
<i>Gudar</i>	Afghan	pass
<i>Gunung</i>	Malay	mountain
<i>Harkish</i>	Burushaki	cultivated land
<i>Himal</i>	Nepali	snow mountain
<i>Himalaya</i>	Sanskrit	abode of snow
<i>Jabal</i>	Arabic	highland
<i>Jhum</i>	Assamese	shifting cultivation
<i>Kaingin</i>	Tagalog	shifting cultivation
<i>Kang</i>	Tibetan	mountain range
<i>Karej</i>	Baluch	underground channel
<i>Kharga</i>	Nepali	alpine pasture
<i>Khet</i>	Nepali	irrigated land
<i>Khola</i>	Nepali	valley, river, stream
<i>Khusi/Khuwa</i>	Kiranti	stream, river
<i>Klinh</i>	Gurung	snow
<i>Koh</i>	Persian	mountain
<i>Kosi</i>	Kiranti	large river
<i>Kotal</i>	Persian	pass
<i>Krebet</i>	Russian	mountain
<i>Kudak</i>	Uighur	spring, well
<i>Kuh</i>	Dari	mountain range
<i>Kuhha-ye</i>	Persian	mountain
<i>Kul</i>	Khirghyz	lake
<i>Kumri</i>	Marathi	shifting cultivation
<i>Kund</i>	Sanskrit	lake, pond
<i>Kush</i>	Pushto	range
<i>Kyu</i>	Gurung	stream, water
<i>La</i>	Tibetan	pass, saddle
<i>Ladang</i>	Malay	shifting cultivation
<i>Langna</i>	Nepali	pass

<i>Lednik</i>	Russian	glacier
<i>Lekh</i>	Nepali	highland (with winter snow)
<i>Ling</i>	Chinese	peak, mountain
<i>Lung</i>	Tibetan	valley
<i>Muchang</i>	Chinese	pasture
<i>Muztagh</i>	Turki	snow mountain
<i>Naa</i>	Karen	irrigated field
<i>Nadi</i>	Hindi	river, stream
<i>Naqab</i>	Arabic	pass
<i>Neta</i>	Nepali	pass, saddle
<i>Nur</i>	Mongal	lake
<i>Nurru</i>	Mongol	mountain
<i>Ozero</i>	Russian	lake
<i>Pahar</i>	Nepali	hill, (without snow)
<i>Pakho</i>	Nepali	unirrigated land
<i>Parbat</i>	Nepali	mountain
<i>Pegunungan</i>	Malay	range
<i>Pendi</i>	Chinese	basin, depression
<i>Pereval</i>	Russian	pass
<i>Phnum</i>	Khmer	mountain
<i>Pik</i>	Russian	peak
<i>Qanat</i>	Persian	underground channel
<i>Quan</i>	Chinese	spring
<i>Raj</i>	Karen	shifting cultivation
<i>Ray</i>	Thai	shifting cultivation
<i>Ri</i>	Tibetan	mountain range
<i>Rize</i>	Tibetan	peak, mountain
<i>Rong</i>	Tibetan	valley
<i>San</i>	Vietnamese	mountain
<i>Sawah</i>	Javanese	upland farming
<i>Seshant</i>	Sanskrit	frontier
<i>Sanchi</i>	Japanese	range
<i>Sanmaek</i>	Korean	mountain
<i>Say</i>	Khirghyz	river
<i>Shamo</i>	Chinese	desert
<i>Shan</i>	Chinese	mountain
<i>Shankau</i>	Chinese	pass
<i>Shui</i>	Chinese	river
<i>Su</i>	Khirghyz	river
<i>Suan</i>	Karen	garden plot

<i>Tag</i>	Uigher	peak, mountain
<i>Tagab</i>	Dari	river
<i>Takura</i>	Nepali	pinnacle, summit
<i>Taungya</i>	Burman	mountain field
<i>Tau</i>	Kazakh	mountain
<i>Ter</i>	Burushaki	high pasture
<i>Thang</i>	Tibetan	plain
<i>Tog</i>	Burushaki	irrigated meadow
<i>Too</i>	Khirghyz	mountain
<i>Tor</i>	Arabic	mountain
<i>Tso</i>	Tibetan	lake
<i>Uul</i>	Mongol	mountain
<i>Xia</i>	Chinese	gorge
<i>Yanchi</i>	Chinese	salt lake
<i>Yarsa</i>	Tibetan	upland, cold soil
<i>Yoma</i>	Burmese	range
<i>Zangbo</i>	Tibetan	river

Appendix 2

Mountain Areas and Minority Peoples of China

Nationality	Language	Population Family	Mountain Area (1991)	Economy
Achang/Echang	Tibeto-Burman	27,708	Gaoligong Shan (Yunnan)	Rice cultivation
Bai	Tibeto-Burman	1,594,827	Cangshan (Yunnan)	Sedentary agriculture
Blang/Bulang	Austro-Asiatic	82,280	Xishuabana (“)	Rice, tea cultivation
Bao-an/Bonan	Altaic	12,212	Jishi Shan (Gansu)	Farming, herding
Bou-yei	Sino Tibetan	2,545,059	Dalau Shan (Guizhou)	Rice cultivation
Dai/Tai	Sino Tibetan	1,025,128	Gaoligong (Yunnan)	Rice cultivation
Daur	Altaic	121,357	Lang Shan (Inner Mongolia)	Farming/herding
De’ang	Austro-Asiatic	15,462	Lincang (Yunnan)	Tea growing
Dong	Sino-Tibetan	2,514,014	Wugong Shan (Hunan)	Rice cultivation
Dongxiang	Altaic	373,872	Qin Ling (Gansu)	Horticulture
Drung/Dulong	Tibeto-Burman	5,817	Gaoligong (Yunnan)	Swidden farming
Evenki	Altaic	26,315	Great Khingan (Inner Mongolia)	Nomadic herding
Gaoshan	Austronesian	400,000	Dayun Shan (Fujian)	Rice cultivation
Gelao/Gelo	Sino-Tibetan	437,997	Guizhou plateau (Guizhou)	Rice cultivation
Hani	Tibeto-Burman	1,253,952	Southern Hills (Yunnan)	Rice & tea cultivation
Hezhen	Altaic	4,245	Great Khingan (Heilung Kiang)	Hunting, fishing
Hui	Arabic	8,602,978	Qinling (Ningxia)	Trade
Jing	Sino-Tibetan	18,915	Chuang (Guanxi)	Farming, fishing
Jingpo	Tibeto-Burman	119,209	Baoshan (Yunnan)	Cash crop
Jinuo	Tibeto-Burman	18,021	Xishuangbana (Yunnan)	Rice, tea cultivation
Kazakh	Turkic	1,111,718	Tianshan, Alay	Nomadic herding
Korean	Altaic	1,920,597	Yanbian (Liaoning)	Rice cultivation
Kyrgyzh	Turkic	141,549	Tian Shan, Pamir	Nomadic herding

Nationality	Language	Population Family	Mountain Area (1991)	Economy
Lahu	Tibeto-Burman	411,470	Xishuangbana (Yunnan)	Shifting cultivation
Lhoba/Luoba	Tibeto-Burman	2,312	Hengduan (Yunnan)	Shifting cultivation
Li	Sino-Tibetan	110,900	Wuzhi Mtn (Hainan)	Rice cultivation
Lisu	Tibeto-Burman	574,856	Hengduan (Yunnan)	Shifting cultivation
Manchu	Altaic	9,821,180	Changbai (Liaoning)	Sedentary agriculture
Maonan	Sino-Tibetan	71,968	Dalou Shan (Guangxi)	Sedentary agriculture
Miao	Sino-Tibetan	7,398,035	Miuling, Wuling Mtns	Rice cultivation
Moinba/Monpa	Tibeto-Burman	7,475	Tsang-po Gorge (Tibet)	Sedentary agriculture
Mongolian	Altaic	4,806,849	Inner Mongolia	Nomadic herding
Mulam/Mulao	Sino-Tibetan	159,328	Nan Ling (Guangxi)	Rice cultivation
Naxi	Tibeto-Burman	278,009	Haba, Yulong Mts (Yunnan)	Sedentary agriculture
Nu	Tibeto-Burman	27,123	Hengduan (Yunnan)	Shifting cultivation
Oroqen	Altaic	6,965	Greater Khingan	Reindeer herding
Primi/Pumi	Tibeto-Burman	29,657	Laojun (Yunnan)	Shifting cultivation
Qiang	Tibeto-Burman	198,252	Hengduan (Sichuan)	Sedentary agriculture
Russian	Slavonic	13,504	Altay (Xinjiang)	Urbanised
Sala/Salar	Altaic	87,697	Xilian Shan (Qinghai)	Horticulture
She	Sino-Tibetan	630,378	Donggan (Zhejiang)	Rice, tea cultivation
Shui	Sino-Tibetan	345,993	Miuling (Guizhou)	Rice cultivation
Tadzhik	Turkic	33,358	Tien Shan, Pamir	Nomadic herding
Tartar	Turkic	4,127	Tien Shan	Trade
Tibetan	Tibeto-Burman	593,330	Tibetan plateau	Nomadic herding
Tu	Altaic	191,624	Taibai Shan (Qinghai)	Herding
Tujia	Tibeto-Burman	5m704,223	Daba Shan (Hunan)	Sedentary agriculture
Uyghur	Turkic	7,214,431	Tien Shan (Xinjiang)	Horticulture
Uzbek	Turkic	12,453	Tien Shan (Xinjiang)	Herding, Trade
Wa	Austro-Asiatic	351,974	Awa Shan (Yunnan)	Shifting cultivation, hunting
Yao	Sino-Tibetan	2,134,013	Nan Ling, Daiyun Mts.	Sedentary agriculture
Yi	Tibeto-Burman	6,572,173	Sichuan & Yunnan	Sedentary agriculture
Yugur	Altaic	10,569	Qilian Shan (Gansu)	Nomadic herding
Xibe/Xibo	Altaic	83,629	Greater Khingan	Nomadic herding
Zhuang	Sino-Tibetan	15,489,630	Nan Ling, Wu Yi (Kiangsi)	Sedentary agriculture

Source:

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