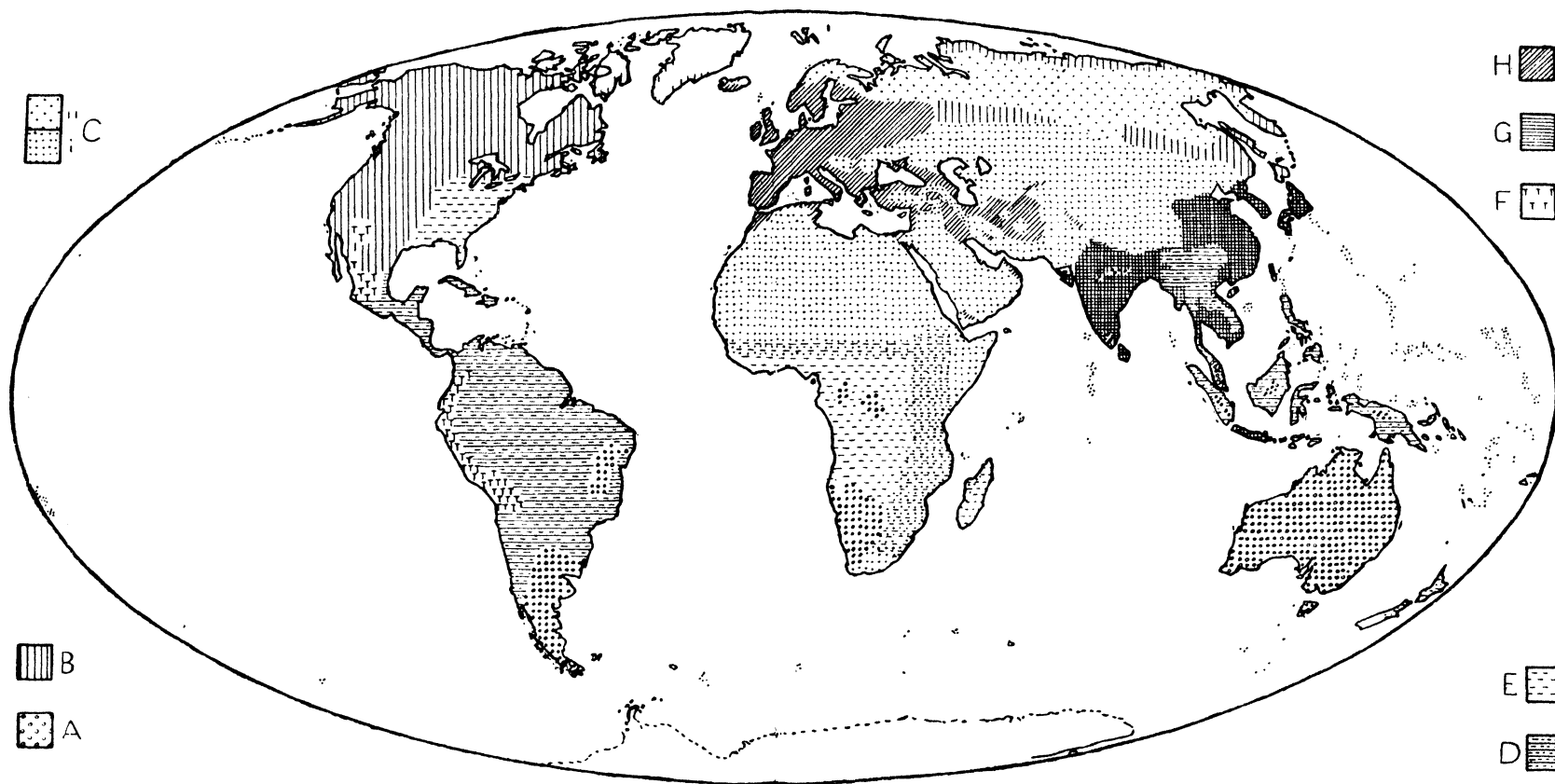


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THE ECONOMIES OF MANKIND AT THE GREAT AGE
OF DISCOVERY

A—most primitive hunters, fishermen and food-gatherers;
B—more specialized hunters and fishermen; C—pastoralists (i) sheep, horse, goat, cattle or camel, (ii) reindeer;
D—simple cultivators; E—more advanced cultivators;
F—sedentary highland cultivators; G—the oriental agrarian civilizations; H—occidental economies.

AN INTRODUCTION TO HUMAN GEOGRAPHY

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GEOGRAPHY

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AN INTRODUCTION TO HUMAN GEOGRAPHY

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CONTENTS

List of Maps	<i>Page</i> vii
Preface	ix
<i>Chapter I</i> Tradition and the Modern Conception of Geography	11
II Climate and Man	41
III Human Migrations and Climate	62
IV Environment and Economy	79
v Population, Resources and the Phenomena of Contact Between Societies	154
Biographical Notes and Bibliography	180
Index	185

LIST OF MAPS

	<i>Page</i>
<i>Front End-Paper.</i> The Economies of Mankind at the Great Age of Discovery	
<i>Back End-Paper.</i> The Economies of Mankind Today	
Figure 1. The Location of Villages in Part of Languedoc	26
Figure 2. The Conjectural Vegetation Zones of the World during the Würm Glacia- tion	56-7
Figure 3. The Correlation between Indices of Climatic Fluctuation and Caravan Traffic in the Near East	77
Figure 4. The Distribution of Malaria	152-3
Figure 5. The Distribution of Sleeping Sickness in Africa	148

PREFACE

GEOGRAPHY as an academic subject tends to breed massive treatises rather than concise expositions. An author attempting to write a short introduction to one of its branches must be severely selective, and cannot hope to include in his exposition all that he would deem essential. He can but make his introduction in such a manner as will, in his belief, enable the reader to derive most benefit from his subsequent studies.

Human geography differs in degree rather than in kind from Regional Geography, the nature of which is admirably discussed in the accompanying volume of this series, *The Spirit and Purpose of Geography*. Both are aspects of a modern geography, the rise of which is traced in the first chapter of this volume; and both seek to interpret and apply the same concept of man's relationship with his earth. In the present author's view, Regional Geography is, in a sense, micro-geography; for it is concerned with analysis and description of parts of the earth. It is on its most distinctive and highest plane when intensively applied to a small area. Human geography, on the other hand, is macro-geography. It seeks to elucidate, rather, the general problem of man's relationship with his environment. It is an oecumenical geography. Accordingly, in the second and subsequent chapters, several cardinal inquiries in this field are discussed. Nevertheless, this distinction is not one that is generally accepted among geographers, and since in this book the author is attempting to interpret and present the thought of leading geographers during the past century, in the first and last chapters (partly for sake of brevity) certain principles are discussed in a regional rather than an oecumenical setting.

It is a pleasure to acknowledge the kindly and critical interest of the author's teachers and the editors of this series, Professors Wooldridge and East, both at the inception of composition and when the first draft had been completed. Their critical readings preserved the work from becoming the

vehicle of mis-statements and erroneous judgments. But for the published version, the author assumes responsibility both for form and exposition.

It had been hoped to include more maps to render the book self-contained. But during production it was decided that only a few maps representative of the larger number desired by the author could be reproduced. The reader is accordingly asked to have at hand, during perusal, a good modern atlas, such as the new Oxford Atlas (1951) or Darby and Goodall's Library Atlas, and, as companion to chapter one, a classical atlas containing maps of Gaul.

To the publishers of the Loeb Classical Library, Messrs. William Heinemann, Ltd. and of the *Regions et Pays de la France*, Les Presses Universitaires de France, grateful acknowledgment is due for permission to reproduce the passages quoted in the first chapter; also to Professor W. M. Macmillan for assenting to the quotation from *Bantu, Boer and Briton* on p. 166.

J.H.G.L.

August, 1952.

CHAPTER I

TRADITION AND THE MODERN CONCEPTION OF GEOGRAPHY

Two millennia ago, the ancient world of the Mediterranean was united under Augustus, and for four centuries afterwards a vast population enjoyed in large measure peace and ordered government. Ease of movement within the Empire, and its commercial and political connections with the people without—the ‘barbarians’—in Europe, Africa and India, enlarged the common stock of geographical knowledge in the talk of the market-place or the baths, stimulating philosophers and writers of the age to consider and discuss geographical problems. Profoundly interested in Greek thought, and particularly applauding the strong link with philosophy which Greek scholars in the Platonic tradition tended to maintain, the Romans were predisposed towards encouraging such a world-study as Strabo sought to expound. This peer of ancient geographers, a Greek born in Asia Minor, was educated according to contemporary practice in schools of grammar and philosophy. He travelled, if not throughout the Empire, at least extensively in the eastern Mediterranean lands. Inclined to scholarly pursuits, he wrote not only an immense work called *Historical Memoirs* (which has not been preserved), but also a *Geography*, written about 7 B.C., which, surviving the Dark Ages, has come down to us as the greatest of ancient treatises on this subject.

Strabo held positive views about the purpose and utility of geography.

“The science of geography . . . is . . . quite as much as any other science, a concern of the philosopher; and the correctness of my view is clear for many reasons. In the first place, those who in earliest times ventured to treat the subject were, in their way, philosophers. . . . In the second place, wide learning, which alone makes it possible to under-

take a work on geography, is possessed solely by the man who has investigated things both human and divine—knowledge of which, they say, constitutes philosophy. And, so, too, the utility of geography—and its utility is manifold, not only as regards the activities of statesmen and commanders but also as regards knowledge both of the heavens and of things on land and sea, animals, plants, fruits and everything else to be seen in various regions. . . .”

In these opening lines, it is asserted that geography is a philosophical study, demanding wide learning, and useful alike to statesman and citizen. Later, amplifying these principles, he emphasizes the importance of

“a clear exposition of the inhabited world”

and

“how many parts there are; and likewise how large the uninhabited part is, what its nature is, and why it is uninhabited.”

In this sentence, he states quite explicitly that the unequal distribution of population is a fundamental geographical problem. Again, he writes,

“the greater part of geography subserves the needs of states; for the scene of the activities of states is sea and land, the dwelling-place of man . . . it is therefore plain that geography as a whole has a direct bearing upon the activities of commanders. . . . For . . . they can manage their various affairs in a more satisfactory manner if they know how large a country is, how it lies, or what are its peculiarities either of sky or soil.”

Later, at the end of the first chapter of the first Book, he extols objectivity:

“the geographer, also, should direct his attention to the useful rather than to what is famous and charming . . . that which is useful and trustworthy should always be given precedence.”

But this was a counsel of perfection, from which he allowed himself frequent licence to digress, as, for instance, upon Homeric myths, or the savage customs of the Irish (Bk. IV, c. 5, sec. 4).

Thus, quite explicitly, Strabo tells us that geography is a

higher branch of learning, worthy to be pursued by those bearing the weightier responsibilities in society; that it endeavours to blend diverse and more specialized studies into a coherent view of 'sea and land, the dwelling-place of man', and that important general questions invite inquiry, such as the irregularities in the distribution of population, or the size and extent of the habitable world (which he discusses at length in his second Book).

At the beginning of the third Book, he tells us that, having provided a general outline of the subject, he will go on to discuss the several parts of the inhabited world. This task occupies him for the remaining fourteen books of his great treatise.

Strabo's views of the scope and importance of geography are as apposite now as when they were first set down in writing. He was not the first geographer; but his predecessors were confined by more rudimentary notions, combined geography with history, or investigated special aspects. With Strabo ancient geography reached its full maturity. But his principles transcended his powers of application. Lack of accurate information and the embryonic state of cognate sciences were his constant handicap, and continued to frustrate his successors until quite recently. His achievement was not equalled until the seventeenth century.

② Ptolemy, about A.D. 150, his most eminent successor in the ancient world, compiled a gazetteer rather than a geography. After the fall of the Roman Empire, the chief centres of learning were situated for many centuries within the Islamic world. In Baghdad and Cordoba, important treatises were written. Not till the great discoveries of the sixteenth century did geography revive. The first description of the world disclosed by Magellan, Columbus and Vasco da Gama, by Apian (1524), followed the Ptolemaic tradition; but Strabo's treatise was printed in Venice at about this time (1516), and his broader conceptions were reflected in Sebastian Münster's Universal Cosmography (1544), which was written in Latin, still the language of the learned. The word 'universal' was thus introduced into geography to indicate that a work purported to describe the whole world, including its relations with the solar system and the fixed stars; and in more recent times the

immense scale of Strabo's labours has been emulated by several geographers.

It would be too sweeping a generalization to assert that all important works on geography since 1500 conform closely to the scope and methods of Strabo. But the tradition that it is a continuing task of scholarship to describe and interpret the contemporary world has never been extinguished, though at times it has been dimmed. Today, it is again vigorous, having been much stimulated by the great human migrations of recent centuries, the alterations to the earth's surface which have resulted therefrom, the revolution in political geography and the intensification of commerce and travel.

But although we may thus discern this central tradition in geography, the progress of human thought has induced considerable modifications in both concepts and exposition. This may be readily appreciated if we compare passages written by Strabo and modern authors.

In his fourth Book, Strabo describes what we nowadays call Mediterranean France, *i.e.*, the French Mediterranean littoral and its immediate hinterland. To summarize these few paragraphs, in part by means of quotations, is to reveal both the achievements and limitations of ancient geography.

"The figure of Narbonitus is approximately a parallelogram, since, on the west, it is traced by the Pyrenees, and, on the north, by the Cemmenus (the Cevennes); as for the remaining sides, the southern is formed by the sea between the Pyrenees and Massilia (Marseilles), the eastern by the Alps, partly, and also by the intervening distance (taken in a straight line with the Alps) between the Alps and those foothills of the Cemmenus that reach down to the Rhodanus (the Rhône) and form a right-angle with the aforesaid straight line from the Alps. . . ."

He also refers to the coastal lands between Massilia and the Varus (Var) river.

"Now from this river, the seaboard extends as far as the temple of the Pyrenean Aphrodite. This temple marks the boundary between the province of Narbonitus and the Iberian country. . . . The distance thence to Narbo (Narbonne) is sixty-three miles, from here to Nemausus (Nîmes)

eighty-eight, from Nemausus through Ugernum (Beaucaire) and Tarusco (Tarascon) to the hot waters that are called 'Sextian' (Aix-en-Provence), which are near Massilia, fifty-three, and thence to Antipolis (Antibes) and the Varus river seventy-three: so that the sum total amounts to two hundred and seventy-seven miles."

Others have recorded this distance as 2,600 stadia:

"For there is disagreement with respect to distances.

Massilia was founded by the Phoeceans, and it is situated on a rocky place. Its harbour lies at the foot of a theatre-like rock which faces south. And not only is the rock itself well fortified, but also the city as a whole, though it is of considerable size. It is on the headland, however, that the Ephesium and also the temple of the Delphinian Apollo are situated." At the former, the Ephesian Artemis is worshipped, the cult having been planted by the first colonists. (Strabo narrates this legend at some length.)

"The government under which the Massiliotes live is aristocratic, and of all aristocracies, theirs is the best ordered. . . ."

Six hundred men are elected for life to an Assembly, from which fifteen form an Executive, and in which three hold chief power.

"They possess a country which, although planted with olive trees and vines, is, on account of its ruggedness, too poor for grain; so that, trusting to the sea rather than the land, they preferred their natural fitness for a seafaring life. Later, however, their valour enabled them to take in some of the surrounding plains. . . ."

Here they founded subsidiary forts; but their hold was precarious, and only their ships and arms enabled them to withstand repeated sieges. But the Romans finally subjugated the barbarians, who turned from war to farming. Massilia, after an early alliance with the Romans, joined Pompey's sedition against Caesar, and was severely punished; but had recovered. Being permitted a degree of autonomy, it had become a notable place for the study of speaking and philosophy.

To the west of Massilia are two gulfs, separated by the Isle of Blascon (Agde). The Rhodanus (Rhône) discharges into the

first and larger gulf; the second is between Narbo and the Pyrenees.

“Narbo is the greatest of the emporia in this country though there is a city near the Rhodanus which is no small emporium, namely, Arelate (Arles).”

On either side of Narbo there flow rivers, which rise in the Pyrenees and the Cemmenus Mountains. Large fishes can be caught with a trident in the muddy Ruscino (the name of this river is now preserved in the district—Roussillon—through which it flows). On the Orbis is Baeterra (Béziers) and on the Arauris (Hérault) is Agathe (Agde), founded by the Massiliotes.

Another marvel of this seaboard is a plain, circular in shape and a hundred stadia from the sea.

“It is called the Stony Plain (now Le Crau), from the fact that it is full of stones as large as you can hold in your hand, although from beneath the stones there is a growth of wild herbage which affords abundant pasturage for cattle. In the middle of the plain stand salt water and salt springs, and also lumps of salt. Now although the whole of the country which lies beyond, as well as this, is exposed to the winds, the Black North, a violent and chilly wind, descends upon this plain with exceptional severity; at any rate, it is said that some of the stones are swept and rolled along, and that by the blasts the people are dashed from their vehicles and stripped of both weapons and clothing.”

Aristotle said that these stones were vomited by earthquakes; Poseidonius that the waves of a lake became petrified; Aeschylus, removing what was difficult to account for into the realm of myth, invoked Zeus, who showered stones from heaven to provide missiles for Heracles in his fight with the Lignes.

Authorities differ with respect to the number of mouths into which the Rhodanus discharges. Marius, however, cut a new channel (about 100 B.C.) for the benefit of the Massiliotes, who levied tolls upon all using it; but entry remains difficult because of silting and the absence of land-marks on the low coast, a difficulty partly overcome by building beacon-towers. Beyond the Rhodanus is ‘Stomalimne’, full of oysters and fish.

“The sea-board which extends from Massilia to the Varus River . . . has not only the following cities of the Massiliotes,

namely Taurentium (near La Ciotat), Olbia (near either Bornes or St. Tropez), Antipolis (Antibes) and Nicaea (Nice), but also that naval station of Caesar Augustus which is called Forum Julium (Fréjus)."

Nicaea lies beyond the Var; but although it is in an Italian province, it is still partly ruled by the Massiliotes; however, Antipolis, though within Narbonitus, has been freed from Massiliote rule.

Close to the coast are five islands, which are cultivated and garrisoned by the Massiliotes.

How, we may ask, would a modern geographer appraise Strabo's description of this region? What are his merits, his weaknesses, his strength, his deficiencies? To what extent does he provide a model or at least a prototype for his successors?

First, it is to be remarked that to Strabo geography was a subject of wider scope than it is today. He does not distinguish it from topography and local history: and after describing the site of Massilia, he relates at length the legendary story of the temple of Artemis on the near-by headland. Again, whilst abstaining from the detailed description of the city, he provides a full account of its government, thus straying once more from what would now be regarded as the proper field of geography into Politics or Government. In later Books, he expatiates upon the customs of uncivilized peoples, digressing into the provinces of Ethnology, Sociology or Social Anthropology.

Second, he obviously found it difficult to describe the shape and extent of terrestrial areas. He had recourse to geometry. Narbonitus was a parallelogram; the Stony Plain was a circle; and the relation of Narbonitus to the Alps was reduced to a geometrical figure. To ascertain dimensions, he summed the distances, stage by stage, along the road traversing the area from west to east. He resorted to ineffective descriptions, because he could not provide maps, and, as atlases had not been invented, he could not presume that his readers could make good the deficiency. Nowhere is he more handicapped than when discussing the Rhône delta. Lacking a good map, he quoted three irreconcilable authorities.

Third, he had extraordinarily little to tell us about what,

today, would be called physical and bio-geography. He knew the names of mountains and rivers, but nothing of their nature. The Black North (wind) and the stony plain were marvels, of which myth and legend offered explanations as credible as Aristotle's. He perhaps implied that the climate of Narbonitus resembles that of Asia Minor; but makes no positive statement. His references to the natural vegetation of two marshes and the herbage of the Stony Plain are incidental; and we are not told whether there were any forests, heaths or park-lands.

Yet, withal, we retain after perusal a clear image of certain geographical essentials. In Strabo's time, Mediterranean France was on the fringe of the civilized world. Greek colonists had established fortified trading posts along the coast, which for several centuries they had held precariously in the face of hostile and war-like barbarians; but to the profit of merchants and cultivators. More recently, the power of Rome had disarmed the natives, who were engaged in more peaceful occupations, about which Strabo could not write in detail; and new cities had been founded, some of which were already populous and prosperous. We are reminded of African colonies half a century ago, when, from the long-held coastal trading forts, military expeditions had annexed the interior; or Ceylon, 150 years ago, when the ports held by the Dutch since 1652, and the coastal fringe, had just entered into the possession of the British, who proceeded to subjugate the Kandyan kingdom. But for all his omissions, digressions and irrelevancies, we can learn from his pages the names of all principal inland towns and naval stations; also, the distances between them; much about the character of the littoral and obtain at least an impression of a mountainous interior and narrow, discontinuous coastal plains. We are also told something—but not much—about the products of the land and some of the cities.

We should not despise his limitations, for his capacity to write geography was hardly surpassed until the nineteenth century, and during the Middle Ages, in Europe, even the learned knew much less than he, although in the Arab world knowledge from ancient times was better preserved. It is true that after the Great Age of Discovery, geographers could write

of new continents and oceans: but the quality and content of their writings advanced little beyond Strabo's standards. Relying upon descriptions of sailors, travellers and merchants, fact was often confused with fable. It was cartography, rather than geography, which advanced between the sixteenth and nineteenth centuries, thanks to the improvements in navigation and therefore of the means to ascertain position. Geographical knowledge certainly increased; but its concepts remained static. Indeed, in the seventeenth century, cartographer and geographer sometimes collaborated, and world atlases thus included lengthy descriptions of each country interleaved with maps. One of the greatest, published in Amsterdam when Dutch geography had no equal, was John Blaeu's "Great Atlas" or "Description of the Earth", which appeared in nine large volumes in 1654.

Later, cartographers and geographers again parted company, although they moved forward along parallel roads. The former, at the instance of the French map-makers of the eighteenth century, mastered the art and practice of large-scale surveying, which from Europe spread slowly to other continents increasingly subjected to European political influence or control. And when it came to revising or compiling atlases, cartographers now refrained from representing features which had not been at least roughly surveyed, and preferred to leave unexplored areas as blank spaces. Geographers, as discoveries multiplied and knowledge increased, compiled newer universal geographies, each larger than its predecessor. Soon after 1800, Malte-Brun wrote a *Summary of Universal Geography* (in French), in eight volumes (1812-29). In the next two decades, Carl Ritter followed, in German, with his *Description of the Earth in Relation to Nature and Human History* (1817-18). He wrote twenty-one volumes, of an enlarged version, before exhausting his powers in writing of Africa and part of Asia (1822-58). Later still came the Frenchman Elisée Reclus, whose *New Universal Geography* (in nineteen volumes, published between 1876 and 1894), was translated into several languages. In the present century, a group of French writers, mostly pupils of Vidal de la Blache, who founded the modern French school of geography, have written yet another *Universal Geography*,

in twenty large volumes, published between 1925 and 1949.

If we turn over the pages of these works, we shall receive superficial, but none the less valid, impressions of progress in geographical knowledge as well as in the means of its exposition. Malte-Brun's and Ritter's volumes are without illustrations. Reclus employed numerous maps and illustrations, engraved and printed from steel plates. In the most recent universal geography there is a wealth of maps in line and colour, many diagrams and hundreds of clearly reproduced photographs. Evidently modern geography has not failed to take advantage of improvements in draughtsmanship and printing.

But there is much more than this, which can be appreciated only by reading and comparing one writer with another. For the rationale of twentieth century geography is an inheritance from the great intellectual movements of the nineteenth. To realize all that this implies, we may compare with Strabo's description a geographical account of the same Mediterranean lands of France, taken not from a modern universal geography but from a book which well exemplifies modern methods of geographical study and exposition, the *Regions and Pays of France*, by Joseph Fèvre and Henri Hauser, published in 1909. These two authors require four times as many pages as Strabo; but nevertheless the classical and modern accounts may be deemed comparable in scale, because Strabo's information about the area outside the towns or away from the coast was so imperfect, and, on the other hand, the region is now more closely settled.

It would be tedious to provide even a precis of Fèvre and Hauser's chapter here. It will suffice to translate a few paragraphs from the original French and to summarize their argument.

"I. General View of the Mediterranean South.

From Montélimar to Port-Vendres towards the south-east, stretch *pays* which are diverse in many respects: very low plains, limestone hills, granite or porphyritic mountains, *pays* both populous and almost deserted. Nevertheless, this assemblage, seemingly heterogeneous if we consult only a map, forms a strongly individualized region, the Mediterranean South.

It derives its unity from its warm, sunny, windy climate,

in which general dryness is interrupted only by sudden and heavy rainstorms. Moreover, a very specialized vegetation, very different from that of the rest of France, is closely related to that of the Maghreb (the Arabic name for the Barbary States or north-west Africa), Greece and Peninsular Italy. Furthermore, the watercourses are short (except for the Rhône), fast-flowing and torrential. Finally, in the countryside and the life of the inhabitants are to be found characteristics quite unmatched in the rest of France. It is a world apart in that varied and harmonious *ensemble* which is the land and nation of the French."

The authors then turn to the "Physical Environment", and treat of the geological evolution, rocks, relief and the mountains of Provence. Coming to the plains of Provence, they state:

"The continuity of the (structural) folds in Provence and Languedoc is masked today by the series of alluvial plains alongside the lower Rhône, below Montélimar. All are ancient gulfs filled up by rivers with materials of very differing age and origin.

To the north are the plains of Comtat and Palus, which are extremely fertile, and have been transformed by irrigation into an immense market garden. Then there is the Crau, the ancient delta of the Durance, which it cast into the sea in former times through the gap of Lamanon, to the east of the Alpilles. Its waters there deposited an immense quantity of pebbles, torn from Alpine slopes, scarcely covered by a thin sward. . . ."

They proceed then to describe Languedoc, the Roussillon, the coasts (giving much attention to the contrast between the rocky shores of Provence and the marshy littoral of Languedoc), before analysing climate and river régimes with the aid of graphs.

Under the heading of "Economic Development", they next write thus of agriculture:

"Agriculture presents, in the Mediterranean region, characteristics which are imposed by the very environment, climate and soil.

The general drought renders irrigation an absolute necessity: without water, the land is a desert of stones and

rocks; water, bearing fine silt, transforms this into a garden of unbelievable fertility, suited above all to irrigated crops and the vine. The plain of Comtat is an immense market garden, and the Roussillon is a kind of 'huerta', similar to those along the Iberian coast. Lower Languedoc is a sea of vines, which descend from the lower hill slopes to the plain and even invade the sands of the littoral. . . .

The land slopes steeply, especially to the east, and the cultivator is compelled to build dry-stone walls to retain the soil, which is menaced by the heavy showers. Thereon trees are generally grown: mulberry in the Roussillon and on the slopes overlooking Languedoc and the Rhône valley; olives everywhere, but principally in Provence, vines also everywhere, lemons and oranges near the Côte d'Azur. But often, especially in eastern Provence, fields of flowers and vegetables interrupt the olive-groves and the vines.

For thirty years past, the Mediterranean South has manifested a clear tendency towards monoculture. One region produces only wine, another only olives, or (silk) cocoons, or vegetables, and all other crops are abandoned. 'Thus cereal cultivation, formerly practised, is now insignificant. . . .'

Continuing, they examine industry, communications and ports, before turning to population and the towns. Concluding this section, they allude briefly to the 'human type', stating that

"the population . . . is distinguished from the mass of the French by peculiar characteristics. The southerner—of Provence or Languedoc—is vivacious and exuberant, ready to venture but equally to despair; his energy is often verbal and prolonged effort seems repugnant to him. He belongs to his own physical type: that of all Mediterranean races . . . small in stature, with black hair and brilliant eyes. Italian affinities are very evident in Provence. . . .

II. The *Pays* of the Mediterranean South.

Although a specialized climate imparts a unity to the Mediterranean region, there are, nevertheless, great differences between different parts. . . . The proximity or remoteness of the sea, the configuration of the littoral,

exposure, variations of soil fertility, create here or there specialized conditions of living. . . .”

Justifying thus their more intensive analysis of small areas within the whole, the authors next consider Provence, *i.e.*, the lands east of the lower Rhône, which they divide into interior and maritime zones. To Marseille, they devote several pages, beginning thus:

“From the dawn of history, close to the great natural routeway which is the Rhône valley, but sheltered from deltaic alluvium, in a deep gulf somewhat exposed to the Mistral, but which is defended by rocky islets, Marseille was founded by Phœnician merchants to whom succeeded, in the 6th century B.C., a Phocæan colony. Around the bay, opening towards the west, which nowadays is the Old Port, a town developed, well situated on the floor of a basin which is dominated by white limestone escarpments. . . .

. . . In the Middle Ages, it was a true merchant’s republic like Genoa or Venice, and their rival in Levantine commerce. . . .

The economic revolution which caused the axis of overseas commerce to pass from the Mediterranean to the Atlantic sensibly checked its prosperity. . . .

But the colonization of north Africa and the piercing of the Suez isthmus have restored great maritime traffic. . . .”

There follows a description of the modern extensions to the harbour, a summary of the volume and character of traffic, local industries and recent improvements in road, rail and canal connections with the Rhône valley.

The plains of the lower Rhône—the Comtat, Crau and Camargue—are next brought under review, and, passing westwards, Lower Languedoc is examined in detail, in virtue of its extent, populousness and productivity. *Inter alia*, the authors comment on the location of villages:

“In marshy areas, villages are established on a natural eminence; in the river valleys, for fear of floods, they keep to the higher terraces, where, nevertheless, they are sometimes invaded by the furious waters of the Hérault, Vidourle or Lez.

But the chief agglomerations are to be found on the first slopes rising above the plain or the sea; springs, so precious

in this droughty *pays*, are more frequent; moreover, the *commune*, which derives profit simultaneously from cultivation on the plain and the pasturage of flocks on the rocky heath (*garrigue*), is thus on the boundary between the two parts of its domain.

These villages of Languedoc are aggregations of houses, closely packed, one next to the other, and divided only by narrow tortuous streets which rarely exceed 15 or 18 feet in width. Thus they occupy only a limited area in proportion to their population. There is never a garden in front of the house, never a courtyard behind. In the centre is the church, generally very ancient, and, commonly, a tower. Many villages retain well-preserved remnants of ancient walls dating from the Romanesque or Gothic periods. . . . One derives the impression of an archaic type, which has been preserved although the content has changed. . . .”

Finally, brief paragraphs are devoted to the *pays* which lie close to the eastern Pyrenees: Lauraguais and Roussillon.

Undoubtedly geography has been greatly altered since Strabo's day, or, it may be added, since Malte-Brun's. Relatively speaking, modern writers do not lack essential facts concerning configuration, population, agriculture, or any other aspect of lands or human activities. At their elbows are the large-scale maps of France, which immediately answer many of their inquiries, and which they rightly include among their sources in their end-of-chapter bibliographies. They can call upon climatological data when they wish to specify the character of a season or the year; upon statistics of trade or production when analysing agriculture, industry or the traffic of a port; upon geology, the geological maps and geological reports in trying to account for the nature of relief or soils. In no place are they at greater advantage, compared with Strabo, than in *La Crau*. To the ancient writer this waste of stones was a mystery, which philosophers could not explain and to which he was inclined to attribute a supernatural origin. MM. Fèvre and Hauser are in no doubt whatever; the *Crau* is simply a Quaternary delta, *i.e.*, was deposited by an enlarged river Durance, which then discharged summer floods from Alpine

glaciers much larger than those of today. With equal facility, they can explain the configuration and location of different hills, plateaux, mountains and plains, by referring to types of rocks, specific earth-movements and processes or agencies which sculpture the earth's surface. Clearly they are indebted to kindred and more specialized sciences, of which geology is perhaps foremost. They use terms which convey to the reader versed in elementary science a precise mental image of the forms of relief: *limestone* hills, *alluvial* plains and *river terraces*. Or, from biology, they employ the term *vegetation*, or from physical anthropology that of *race*. Knowledge can never be isolated. Progress in one sector enables advances to be made elsewhere. Geography has benefited enormously from the expansion and organization of knowledge about the earth, the atmosphere, the plant world and society. Strabo had the vision of such a geography; but lacked the means to make it a reality.

But the gulf between the ancient and modern writers is yet the wider for reasons of a philosophical kind, which are implicit rather than explicit in both ancient and modern treatises. Strabo, while insisting on philosophical qualifications in the geographer and his need for wide learning, nevertheless too often failed to relate his data and was content to record isolated and irrelevant observations. As a rule he does not attempt to explain facts. Very occasionally, he realizes that geographical phenomena can be correlated, *e.g.*, when he writes

“they possess a country which, although planted with olive trees and vines is, on account of its ruggedness, too poor for grain; so that, trusting to the sea rather than the land, they preferred their natural fitness for a seafaring life.”

Here Strabo suggests that both characteristics of agriculture and the long adherence of the Massiliotes to a seafaring life may be attributed to the rugged terrain in which Massilia stood. We cannot regard his recital of facts nor the connection he establishes between them as adequate or comprehensive; but at least he is fumbling uncertainly for a more rational geography.

To MM. Fèvre and Häuser there is a geographical order. The hills, the crops, the population are not isolated, unrelated

facts, but each finds a meaning and an explanation in the others. Marseilles, *from the dawn of history*, stood where it does because of the routeway to the Paris Basin and the Rhine along the Rhône-Saône corridor, and because its rock-girt harbour is secure from silting. (Strabo knew of the Rhône, but did not realize its double significance for Marseilles.) And its modern commerce greatly depends upon such far-distant geographical facts as the Suez Canal. The villages of Bas-Languedoc are not located at random. They are on river terraces to avoid floods, or at the inner margin of the coastal plain at the foot of rising ground, because of water-supply and the advantages to be derived from the juncture of two types of terrain. (Fig. 1.)

It is this perception of a geographical order which gives

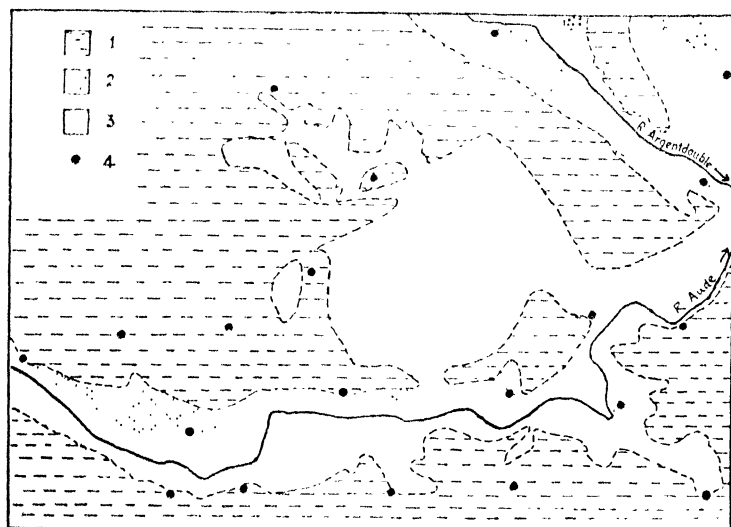


Fig. 1

THE LOCATION OF VILLAGES IN PART OF LANGUEDOC

1. Pre-Quaternary Rocks, *i.e.*, land rising above marshy valley-floors;
2. Gravelly terraces;
3. Alluvium, *i.e.*, silt, sand and gravel naturally liable to flood;
4. Villages.

coherence to the more recent work. Strabo's *Geography* is at its best disjointed and jumbled. Of one place he tells of production, of another, local history, of a third that it is mentioned in mythology; of a city, its form of government; of uncivilized lands, the customs of the people. In other words, he was writing mainly *Topography*. But our modern writers of *Geography*, employ confidently a systematic method of exposition which quite evidently arises from the nature of the subject as now conceived. They proceed from prior conditions to consequences, and from the more generalized to the more localized. Their well-established logical system, applied to France region by region, is first to consider the physical and bio-geographical, *i.e.*, geological structure, climate, relief, rivers, soils and natural vegetation, and then to bring this into relation with human society, its activities, past and present, and its dispersion over the earth's surface. The latter implies analysis of primary production, industries, population, rural settlements, towns, communications, political divisions and trade.

We are thus confronted with the fundamental concepts of modern geography. What conception is it of the earth and of mankind which is so fittingly demonstrated in the manner of exposition adopted by MM. Fèvre and Hauser? The answer, briefly and simply, is that geography was transformed during the nineteenth century. For Ritter, whose works have been already cited, sought to expound a geography which was not confined to description, but established connections or correlations between different orders of facts. He sought not only to describe mountain ranges, but to demonstrate how they influenced human history. To him, a river was not an isolated geographical feature, but was to be related to climate, towns, trade and political geography. Ritter's geography may thus be deemed comparative or correlative. His influence upon geographical method was powerfully reinforced by Darwinism. The doctrine of the evolution of living species from simple to more complex, which was mooted by Erasmus Darwin and Lamarck, became credible when Charles Darwin demonstrated that natural selection might be a causative agency. Between the publication of the *Origin of the Species* (1859)

and the author's death in 1881, the learned world and the intelligent public came to accept his theory. Since then, it has been the grand, unifying principle of the biological sciences, zoology and botany. But its influence spread far more widely than this, and the nascent social sciences were equally transformed. For now an entirely new conception of man's place in nature had to be postulated. Man is not a separate creation, a unique creature arbitrarily placed among other living things to fulfil a divine destiny. He is the latest product of the slow unfolding of life upon this planet during hundreds of millennia. Like other animals—among which he is one of the most specialized—he lives by maintaining a web of relationships with his environment, which comprises both the physical environment—the earth—and the rest of the world of life.

MM. Fèvre and Hauser's method, which exemplifies what is current among geographers today, is designed to reveal the man—environment unity. From the physical environment they proceed to the biological, and then to the reaction of man with this double environment. This logical order is justified by the relative permanence and stability of the physical environment. The hills, valleys and plains change little, while life fluctuates and ebbs. Climate, too, is relatively stable, although it is known to alter slightly during periods varying from a decade to several centuries, with which it is sometimes necessary to reckon in geographical analysis. Climate is influenced by configuration, and in turn may partly determine the character of relief. The hydrosphere—rivers and underground waters—and soils, are the outcome of relief and climate acting together. Plants, so closely adapted to soil, water supply and climate, considered as associations or as vegetation types, come next in logical sequence; and then, taking cognisance of man, his influence upon vegetation, *i.e.*, his replacement, by his agriculture, of a natural vegetation by an artificial, is fundamental, since food is the first human necessity. Domestic animals are not infrequently the intermediaries between man and the plant world, and pastoralism or animal husbandry must be investigated together with agriculture. Rooted in the food-producing economy, but related also to the movements of man and his

products are population distribution, the character and form of settlements, industries, trade and communications.

At the risk perhaps of repetition, it must be emphasized that this integration and interpretation of geographical facts, in order to demonstrate the nature of the man-environment relationship, is quite modern. If we turn over the pages of Malte-Brun's or Ritter's works, we read lengthy descriptions which are topographical rather than geographical (in the modern sense). The earth, or part of it, is there and has to be described; but it does not matter where one begins or ends, and no principle of selection is to be observed in composition, provided that what is written is somehow connected with the place or country named at the head of the chapter. Today, many chapters of these older works seem simply compendia of miscellaneous information. But to attempt to unfold the complexities of a community's relationships with the land it occupies demands a careful sifting, interpretation and selection of the facts which may be relevant. Such an investigation discloses much that is not obvious or apparent, and herein is the justification of placing geography among the higher studies pursued in universities.

It may perhaps be objected at this stage that much of this seems very abstract and remote from geography, that study of maps and places. This is because discussion has been limited thus far to the most fundamental questions, and the particular characteristics of the environment and society have been ignored. The terrestrial surface, with its superficial layer of soil, the varied phenomena occurring at the base of the atmosphere, the oceans and seas, plant life and the animal world, form a complex of extraordinary areal diversity. The land of the globe is fragmented, and is deeply penetrated by the sea. It has been upheaved into mountains and worn down to lowlands. The atmosphere, owing to the rotation of the globe, the inclination of the ecliptic and the unequal distribution of solar radiation, is in constant circulation, engendering a wide-ranging multiplicity of climates. There are glaciers, rivers, torrents, impermanent watercourses, springs, deep-seated underground waters, and basins of inland drainage, forests, grasslands, marshes and deserts. All these aspects or elements

of environment have the property of extension over the earth's surface, or, alternatively, are geographical. The same is true of human societies. Groups of hunters or fisherfolk seek one area and avoid another. More advanced societies practise one type of agriculture here, another there, scatter farmhouses over one tract, and establish villages elsewhere. They are extremely selective in the choice of location for industries and great cities.

The web of relationships in the man-environment unity is thus areally differentiated. The territorial diversity of the earth, and the concomitant extension of human society, remains the very stuff of modern geography. In enunciating this principle, we are not simply restating the traditional scope of the subject in abstract terms. The 'areal differentiation' of the earth and human society is not the same thing as the description of lands and peoples by the older writers and travellers. Whilst not disavowing the implicit assumption of the older topographical method that each place and each human group is unique in its constitution and relationships with the rest of the world, the modern geographer, by inductive methods, is constantly seeking to reveal the patterning, or, to use the term employed in the subject itself, the regional character of areal differentiation. The existence of *regions* is a postulate of all modern research in geography, and is the equivalent of the periods or movements distinguished by historians. Over certain tracts or areas, a homogeneity or similarity of the man-environment complex may be discerned, or of important segments of the complex. A chalk or limestone plateau may be characterized by hydrology, soil, types of settlement and agriculture. A local unity or homogeneity can thus be discerned, distinguished and delimited from equally distinctive neighbouring entities. Alternatively, a repetition or patterning of small regions may exist, as, for example, in the alpine valleys, or the zones of the Weald in south-eastern England.

A region is not necessarily complete in itself. Regions often overlap or are superimposed, because, to use a mathematical term, there is only a partial integration of society with a particular tract of the earth's surface. Thus, in its zonal repetition of rocks, soils, relief, hydrology, vegetation, agriculture and smaller settlements, the Weald of south-eastern

England is a homogeneous and distinctive geographical unit. But, since the growth of London, the settlements and land utilization have been increasingly refashioned, as a mere sector within the metropolitan region. Its villages, towns and agriculture are zoned not only with reference to its geology but also to the structure of a metropolis. It has an external focus of commerce and industry.

But this impressive diversity, and its partial, incomplete regional patterning, is manifested within an order implied in the conception of terrestrial unity, which, in partnership with Darwinism, gives modern geography its rationale. There are, in short, world symmetries in the areal pattern.

This is most easily appreciated if we consider the nature of the atmosphere and of climate. To the varieties of the latter we have just alluded; the circulation producing them is a unity, which, in its elements, is readily apprehended. It may be analysed into latitudinal zones, each manifesting specific air movements and weather. Hence there is a definite pattern of terrestrial climate. In similar locations, with respect to latitude and the land masses, climates tend to be identical. Such a repetition could arise only within a single circulation. Likewise, the oceanic circulation, in its essentials, is comparatively simple, and arises from the distribution of land, the distribution of insolation, the rotation of the earth and the effects of the winds. Thus, because of the fluidity of air and sea-water, the completeness of the gaseous envelope and the inter-communication between the oceans (for three-quarters of the earth's surface is water-covered), terrestrial unity finds especially complete expression in climate and the seas. As all-pervasive is the hydrological unity. Under the influence of gravity and the laws of hydraulics, rivers tend to assume similar 'grades', and to be subject to a common cycle of development. Similar climates are attended by like régimes of river discharge, in widely separated regions. In short, the rivers of New Zealand are subject to the same physical laws as those of Europe.

To the land the notion of terrestrial unity is less completely applicable, though nevertheless a far-reaching tendency. Geological processes have been acting upon the crust for perhaps 1,000 million years. Rain, snow, and frost have eroded

the rocks. Sediments, varying in consistency according to the degree of disturbance in littoral waters, have been deposited. Volcanic rocks of a range of types corresponding to the nature of eruptions have been extruded. Tensional, compressive and shearing stresses have crumpled rocks into defined types of structure, and accompanying heat and pressure have metamorphosed rocks. To the rocks and structure of the crust are applicable the doctrine of uniformitarianism, which, as stated by Lyell, implies both that the geological processes observable today have been operating throughout the history of the earth, and that they have been effective all over the globe. But in other ways, the unity of the lands is less perfect. The triangular shape of land masses, with the apices pointing to the South Pole; the tendency of land to be antipodal to sea: the girdle of vast lowlands surrounding the Arctic basin are symmetries which suggest that the land masses have been shaped by world forces. But the disposition of other major features is asymmetrical. The Pacific Ocean is girdled by volcanic ranges and island arcs; but the Atlantic has for its borders ancient crustal blocks or old folded mountains. The degree of diversity in geology and relief is immense, as must be realized if western Europe is compared with western Australia. Yet even in this diversity of outline and configuration, there is unity in continuity and contiguity, which, as will later be shown, is of great import to life on the earth. Regarding Asia as the heart of the world's land, Africa, Australia and the Americas are appendages, the first-named connected by an isthmus, the other two nearly contiguous across the East Indies and the Behring Straits. During the last Ice Age, the Americas were connected with the Old World, and Australia was all but connected, by a lowering of sea-level. Only Antarctica is isolated from other land areas. Some geologists, following Wegener, would have us believe that the present arrangement of land has resulted from the break-up of a single primal continent (Pangea), and the drifting apart of fragments. The present outline and distribution of the lands may be related to that earlier unity.

Life, in virtue of its relationships with the lithosphere, hydrosphere and atmosphere, reflects their unities. Indeed, the operation of natural selection serves to intensify the regularity

of the terrestrial pattern. Plants, especially sensitive to water-supply, exhibit similar morphological adaptations wherever rainfall is low, *i.e.*, plants of the different deserts resemble one another, although of different species or even classes. In fact, we may recognize vegetation types corresponding with the pattern of terrestrial climates. Responding most to great heat and moisture, it is the equatorial girdle which exhibits the greatest variety and luxuriance of plant life. Animals possess power of movement, and to a greater or less degree evade the direct effects of climate; but we can yet observe that arboreal, polar, mountain and grassland animals, though of different families and species, are nevertheless comparable. Both plants and animals tend to be distributed in a way which reveals the unity of the land. The extremities of the land-area, and islands, especially islands distant from continents, tend to poverty and archaism both of fauna and flora.

Man, and human society, exhibit the same paradoxical subjection to the uniqueness of place and the tendency to unity. Brief though his span on the earth has been, compared with other forms of life, he has been evolved into readily distinguishable racial types, and has invented a range of economies in order to subsist in his varied habitat. We may readily become engrossed with differences between one human group and another. Such over-emphasis upon divergences is a partial geography, lacking in objectivity. Equally with the inspired visionary of old who with fervid faith declared that the Deity had "made of one blood all the nations of the earth", our more prosaic scientific investigations must not ignore this truth. Mankind's unity is manifold. All peoples are equally inter-fertile. Migrations throughout pre-history and history have militated against the tendency to local segregation and differentiation. In virtue of his superior brain, man alone among animals has a universal range upon the earth. His identical fundamental needs, for food, water, clothing (except in the warmest climates), shelter, intercourse and social co-operation impose upon him certain constraints, or, alternatively, impel him to forms of activity which possess fundamental similarities beneath apparent discrepancies. We can perceive universal human tendencies, which are world-wide,

towards the adoption of food-production instead of food-gathering, towards the adoption of settled life instead of nomadic, and hence of conformity to certain laws or geographical controls in the location and lay-out of settlements and the utilization of land. Dependence upon agriculture, industry and trade is increasing, because of the unifying influence and world-wide diffusion of knowledge. Particularly in the last three centuries, the integration of scattered and isolated human groups into a human society has been gradually proceeding, under the influence of ocean transport, the railway, the telegraph and the aeroplane, which, cumulatively, have made the world the effective unit of human intercourse for the first time. In short, the biological unity of man is becoming reinforced by an economic unity. It is no coincidence that the last century has witnessed the burgeoning of Economic Geography as a new and vigorous shoot from the venerable geographical tree. The rationale of this new branch is production and commerce as parts of a world economic system. The decline of wool production in Europe and its transference to the semi-arid regions of the southern continents: the decline of raw silk production in Mediterranean lands and its enormous increase in Japan are the results of a world-wide tendency for production to become located in places where costs are lowest. The influence and uniqueness of place is not thereby diminished, for there is increasing regional specialization, at least in the production of primary commodities, within the world economic system.

Geography, in thus re-formulating its concepts and objectives, has been submissive both to the intellectual and social revolutions wrought by and upon mankind in the past three centuries. Thereby it makes its own valuable yet distinctive contribution to understanding during this revolutionary epoch in human history. It is not an academic discipline pursued simply for the sake of conserving and adding to the sum of human knowledge, but is a requisite to all concerned with the problems of society.

Whilst it would be impossible, in a short work, fully to examine the bearing of these concepts upon more abstruse problems, it may suffice, in a short digression, to indicate the rôle of these geographical principles in the study of human

society. Evolving life, during geological time, appears to have been most stimulated at epochs when, owing to periodical convulsions, the areal or regional diversity of the earth has been at a maximum. During the Mesozoic period, when the lands were of low relief and climate was generally genial, reptiles attained gigantic size, but did not evolve into higher forms. But in the succeeding Tertiary period, when continents were disrupted and new mountain ranges upheaved, mammalian animals became dominant, in addition to new orders of plants. Existing species were thus confronted with a changing environment, and sometimes with heterogeneity where there was previously uniformity. Even greater contrasts of life-conditions were encountered when species were compelled to migrate outside the normal range, *e.g.*, because of marine transgression or a regional change of climate. Social change among mankind appears to have been fostered by the capacity to migrate and the simultaneous multiplication of environmental stimuli in dissimilar regions. That effective isolation of human groups has persisted throughout much of human prehistory is proved by the evolution of distinct racial types. There is little doubt that the independent domestication of animals and plants in the New and Old Worlds, or the adoption of such specialized economies as pastoral nomadism, or that remarkable phase in human culture known as the Neolithic Revolution in the Near East, were due to the challenge of the particular problems of local environments. Some fundamental contributions to human development have thus been achieved by segregated groups. Even after intercourse had intensified, and new discoveries more readily diffused, the rivalry between societies bred in differing habitats, *e.g.*, between pastoralists and cultivators, or sea-faring and continental peoples in the Old World, has been a catalyst, if not an explosive force, in human affairs for from three to five millennia—since the dawn of history.

The first-fruit of world intercourse, after the Great Age of Discovery had caused oceanic unity to become effective for humanity, was the Industrial Revolution in western Europe. It was the combined challenge of a world market and the diminution of wood fuel for iron-making that brought about the fundamental inventions in England. But the application of power

to manufacture and transport, and increasing agricultural knowledge, are now world-wide, and this tendency towards a world-wide diffusion of technical knowledge ensures that no human group will in future be confronted by environmental problems in isolation. The areal diversity of the earth remains, but there is an increasing tendency for societies to use the same technology. Differences in economies are more of degree and less of kind. The local stimulus, in isolation, has ceased to be a force in human affairs. We are now engaged in trying to make effective the world diffusion of knowledge, and in diminishing the gaps between technical knowledge and its application. If this reasoning be correct, how great is the need to cultivate the oecumenical or world-comprehending view! A geography which is aware of the subtler tendencies in the changing relationship between man and his world has a vital rôle in education.

Besides these two fundamental concepts, of evolution, 1, in accordance with natural selection and the areal diversity of the earth, and, 2, terrestrial unity, geography has gained much in the past three centuries from accomplishments in other cognate sciences. In particular, physics, chemistry and geology, founded before Darwin began his work, had much to contribute. Largely as an outcome of recently prosecuted research into the history of science, it is now increasingly understood that the seventeenth century was seminal for physical science. Interestingly enough, we find that the outstanding geographical work of that epoch, by Varenus, which was accepted as authoritative for a century, was clearly influenced by the intense contemporary pre-occupation with natural phenomena. Neglecting man, Varenus described the seas, lands, mountains, climates, rivers and vegetation. This inclination to concentrate upon a part of geography was again stimulated early in the nineteenth century, when geology, with startling suddenness, between the publication of Hutton and Playfair's books and about 1845, revealed the origin and nature of the earth's crust. Humboldt, in his *Kosmos*, sought to demonstrate the earth's place in the universe and its physical nature. Shortly afterwards, Archibald Geikie, one of the giants of early British geology, published his *Physical Geography* (1862),

thus introducing a new term into the English scientific vocabulary. For half a century, the study of the earth apart from man was cultivated. The first efflorescence of the subject in American universities was from its physical branches. In schools, physical geography was appreciated as an unspecialized approach to science, and the older generation of Englishmen doubtless recall their efforts to master Mill's *Realm of Nature*, which, in less exalted fashion, sought to achieve the same purpose as the *Kosmos*. Thus for about a hundred years, the systematic study of the earth's features, its climates, and the physical aspects of the oceans (physical oceanography) has been pursued, and the separate branches of physical geography, *i.e.*, geomorphology (concerning the configuration of the earth), climatology and oceanography have acquired the status of separate sciences. Geography had, in fact, been nearly dismembered when the Darwinian theory was given to the world, and it is no overstatement that apart from the new insight into the place of life upon the earth, the cleavage might have been followed by dissolution.

The acceptance of the new trends in thought as a mean of salvation to geography was a cardinal achievement in the work of Friedrich Ratzel. His range of thinking was wide, and he sought to comprehend a single science of mankind, embracing a philosophy of history, ethnology and geography. Accordingly, he published, in 1882 and 1891, the two volumes of his *Anthropogeographie*, and thus brought the term anthropo- or human geography into the English language (from about 1895). He followed with his *Völkerkunde*, which is one of the classics of ethnology, and which was translated into English as the *History of Mankind*. His trilogy of treatises, any one of which might be deemed a *magnum opus* by a lesser man, was completed by his *Political Geography*. He did not succeed in creating a single science of humanity. His *Völkerkunde* is essentially descriptive, and is a comprehensive survey of the peoples and races of the earth, considered in turn. The systematization of this branch of knowledge was yet to come in modern anthropology with its close comparison and analysis of different human institutions, and the formulation of theories explanatory of their development. It was within geography that he perhaps achieved most,

for he comprehended the distribution of man upon the earth systematically, and realized that a human geography could be created to stand complementary to physical geography. The need to compare facts, and to attain to a world-view of phenomena, are constantly reiterated in his pages. One quotation will suffice to indicate his grasp of fundamental concepts.

"The fluids of the earth are one, just as mankind is one. Water is a separate, thin envelope, partly discontinuous, and woven over the globe. . . .

The fundamental similarity of all the waters of the earth is not a peculiar scientific idea. We see in the flux of the seas around the earth, into which all rivers discharge, as the simple consequence of a connection between water in the seas and the stream-beds, which is even today recognized by primitive peoples. When Livingstone asked the aborigines of Liambai where this stream rose, they said: 'It rises in Leoatlé or the White Man's Sea'. Also, seeing that the sea, with increasing trade, is conducing more to unite peoples than to separate them, the anthropogeographer, viewing the whole earth, is not confronted with something which is entirely new. The flowing element has always transported earth-bound mankind in the fullest sense; if not the sea, then the rivers, its roots, its veins. . . ."

In this passage both the strength and weakness of Ratzel's thought are manifested. He had fully grasped the necessity to systematize and unify the study of man on the earth, if geographers were to remain in conformity with the intellectual current of the times (or *Weltanschauung*, as he would probably have said). How deft is his definition of the hydrosphere! How percipient is his generalization concerning the significance of water to humanity! But withal he was a typical Teuton. He revelled in abstractions and besprinkled his pages with far-fetched allusion and analogy. He converted theory into dogma, and thus gave disproportionate emphasis to a theory of human migrations inspired by his teacher Moritz Wagner. Also, living in Bismarck's age, he formulated only too readily a theory of ethnological and political regions, which, stated baldly, entailed

that to every people or nation there was an appropriate region; and culturally rising peoples tended to expand and extend the space they controlled at the expense of others, so that the regions of one epoch, appropriate to the particular cultural status of peoples, tended to be refashioned in due course to suit the needs of the more rapidly progressing communities. As stated by Ratzel, this doctrine was not, as we should say today, an ideology; but others found in it a justification for Germanic aggression.

The subject was clarified by a Frenchman, Vidal de la Blache, who taught in Paris for forty years, and founded the most influential of modern schools. *La géographie humaine*—human geography—in France, has brought forth a host of publications. If we read at random, we can appreciate that all these authors are seeking to unravel the manifold connections between society and its environment: between peoples and the lands they inhabit. This is true equally of brief articles on the rural economy in a corner of a French *département*; of the greater regional monographs which expatiate, with a profusion of detail, upon the more varied and complex features in a larger area; or the rarer works, like la Blache's own masterpiece, which analyses, with sure touch the characteristics of the regions of France. One or two authors—from whom a quotation will be taken below—have essayed to treat of the whole world and thus expound the principles or foundations of human geography; but in general the French genius has not so readily erected vast yet insecure temples of knowledge like the Germans. It has rather essayed to work, with masterly assurance, upon the small or medium scale.

If we thus seek guidance from the most influential writers and schools of geography in the contemporary age, we are not left in doubt about the nature and purpose of Human Geography. It is rooted in the tradition of Strabo, Münster, Malte-Brun and Réclus, and its purpose is thus to describe the earth and its inhabitants. It is also more restricted in scope and more systematic in its method than the older geography, the better to achieve its objective of disclosing the manifold connections between societies and the lands in which they dwell. It has acquired the title "Human Geography" to distinguish it from

the narrower and more specialized Physical Geography; but it overlaps the latter, and indeed makes large demands upon it, because the nature and rôle of the environment is one of its quests. It would be better to call it Modern Geography, rather than Human Geography; but the latter term has gained wide acceptance.

More than this, the end of exploration opened a new vista for geographical inquiry. The sources of the Nile, the size of the Antarctic continent, or the number and location of Pacific islands ceased to be the subject of quest. There is still much to be done by the geographer who is scientifically trained, in studying lesser-known places. But there are no unknown places and no very large blanks on maps. Ritter and Darwin worked as exploration was ending. Their re-orientation of the human outlook, by compelling geography to become more ecological in character not only revolutionized the rationale of descriptive or, as it is commonly called, regional geography, but also prompted thought on the problems of a general human ecology or human geography. How are we to explain geographical facts of world order, *e.g.*, the character and distribution of races, or the location of more or less populous areas, or the range of cultivated plants, domestic animals, and the economies based thereon? To answer these questions, we require an oecumenical modern geography, and in the succeeding pages, in very selective or even arbitrary fashion, an introduction to this subject will be essayed. For, to quote a living leader of the French school, M. Sorre,

“the first task of human geography is constituted by the study of man, considered as a living organism subject to determinate conditions of existence, and reacting to stimuli received from the natural environment.”

CHAPTER II

CLIMATE AND MAN

THE adaptation by which man is enabled to live in all climates of the world, except the very coldest, is of a dual nature, consisting of both physiological modifications and artificial devices which anthropologists have classified into distinctive cultures. As an animal, man is capable of withstanding considerable variations of temperature and atmospheric pressure. His powers of invention have enabled him yet further to accommodate himself to the wide range of terrestrial climates. Houses and fires keep him warm during the Siberian winter: tents and loose garments protect him from dry air, dust and intense sunshine in the heart of Arabia. It may perhaps be thought that the cultural has accomplished more than the physiological in aiding dispersion over the earth. For his cultural achievements promote his comfort and efficiency in regions which would otherwise be marginal for physiological toleration, and they even somewhat extend the range between the extremes which man can bear. Yet man's inherent powers of adaptation by physiological means are very great.

Of the climatic elements, pressure, radiation, temperature, humidity and wind directly influence the functioning of the human organism. Of these, change of air pressure is least important. Its effects can readily be isolated from the others and studied experimentally. It is insignificant to humanity at large, because changes of barometric pressure near sea level are unaccompanied by any physiological effects. The mercury column rarely falls below 950 millibars and not often does it rise above 1050 millibars. To this range of external pressure amounting to about ten per cent, the human frame is not normally sensitive. Until the barometer was invented, men were unaware of it. On high mountains, however, air pressure is much more considerably diminished. At about 17,500 feet, a barometer reads about 500 millibars, *i.e.*, about half the

normal amount. At 30,000 feet the pressure is between one-third and one-quarter of that at sea-level. The extent of land above 10,000 feet is very small; but, nevertheless, small populations are permanently established, on the high Andes in Peru, and in Tibet, at altitudes of more than 15,000 feet. In tending flocks or herds, and crossing passes, the height of 18,000 feet may be surmounted.

It is well known that an ascent from sea level to about 10,000 feet produces mountain sickness, *i.e.*, shortness of breath, headache, lassitude and faintness. At greater altitudes, prostration and death may follow. For long, ignorance of the cause permitted it to be accepted without dispute that high mountains were inhabited by malevolent demons; but in 1590 a Jesuit father, Acosta, suggested the true explanation. Since then, many experiments have shown that mountain sickness is due to lack of oxygen. It has also been realized that, within certain limits, the human body can adapt itself in a comparatively short time to a fall of atmospheric pressure. The Indians of Mexico and the high Andes are physically vigorous, and perform the most arduous toil in mines or on the land, although not without the assistance of a drug (coca) and perhaps at the expense of longevity.

It was formerly thought that this adaptation to a rarefied atmosphere was partly the result of enlargement of the thorax by the processes of natural selection extending over many generations. Large chests are certainly a normal feature among the Bolivian Quechuas and other mountain populations; but they seem common also among nomads of Central Asia living at low altitudes. And mountain sickness is associated rather with rapid increase of altitude than with permanent sojourning in high mountains. Ascend a few thousand feet, and remain at this height for a few days; ascend again, and go on repeating this procedure of ascent followed by pause to become accommodated to the lowering of air pressure, and you may remain vigorous at least up to 25,000 feet. By this method, climbers have been able to ascend at least within striking distance of the summit of Everest. (But at 30,000 feet, the body cannot become fully accommodated to fall of pressure even by this procedure.) The body has compensated for the lack of oxygen

in the air breathed by increasing the number of red corpuscles, which are the carriers of oxygen in the blood stream. There are no extensive tracts of land above 20,000 feet, but only peaks which are largely composed of cliff, scree, ice and snow, and are unproductive. Accordingly, we may regard the changes of atmospheric pressure which occur within the altitudes available for human habitation as no greater than the adaptive capacity of the human body.

More complicated is the bodily reaction to radiation, *i.e.*, to sunlight. The beneficial influence of light upon humanity has been firmly believed since very early times. To this day, pilgrims ascend Adam's Peak in Ceylon, to greet the rising sun with loud and fervent cries. Death and darkness are synonymous: "Farewell, sweet light!" wailed Iphigenia. To the Eskimos and the crews of arctic expeditions, the polar night brings pallor, insomnia, indolence, dyspepsia and anaemia. The return of daylight renews vitality among the indigenous arctic peoples almost to excess. Among Norwegians, the amount of haemoglobin in the blood is twenty-five per cent greater in summer than during the almost sunless winter.

It is believed that nearer the Equator, intense radiation accelerates many bodily processes. Thus, among females, the onset of puberty occurs between eleven and fourteen; whereas in temperate lands it is from thirteen to sixteen, and in arctic regions from fifteen to eighteen years. (This acceleration of the life cycle may also be partly due to high temperatures.)

Even more direct is the action of light upon the skin. Prolonged, unaccustomed exposure to tropical sunshine causes blistering or even death to a white-skinned person. It is known that this effect is produced by radiation at the blue end of the spectrum, and beyond, in what is known as the ultra-violet range. (The wave-length of this radiation is about $3/10,000$ parts of a millimetre.) But if acclimatization is gradual, the skin becomes progressively darker and a person can spend whole days in strong sunlight without suffering harm. This was clearly proved during the recent war when British troops, serving in India, became accustomed to intense radiation by progressively lengthened daily exposure, thereby becoming dark brown like the indigenous peoples, and finally able

to work or play out of doors clad only in shorts. Evidently, pigmentation in the skin protects the body from the effects of very strong sunlight.

Of a different character is the pigmentation of certain races, such as the dark brown of Dravidian peoples in southern India, the Malays and the Australian aborigines, or the black of Negroes and Melanesians. The colour of the skin is permanent; for the pure-bred Negroes have retained their pigmentation during several centuries in the temperate climates of North America. Among Negroes, the pigment, a substance called melanin, which is found in minute granules at the base of the epidermis, is especially abundant. It even occurs inside the body, *e.g.*, in the grey matter of the brain. But Negro babies are not pigmented, for they are dark reddish-brown like those of other races. Pigment forms soon after birth on certain parts of the body, from which it spreads till the whole skin is uniformly dark. The formation of a permanent pigment in man, after birth, is therefore a complicated matter, and may be connected with the way glands operate in a hot climate. This supposition is strengthened by the bronzing of the skin in Addison's disease, which is a disorder of the supra-renal capsules. It is perhaps no coincidence that the urinary functions are somewhat inhibited in hot, moist climates. We may accordingly believe upon good grounds that a dark skin protects the body from undue penetration by short-wave solar radiation, which tends to be so intense during the day and throughout the year in low latitudes. In less sunny climates pigmented races may be at a disadvantage; for a limited amount of solar radiation must penetrate the skin to permit of the formation of vitamin D, lack of which causes rickets. The frequency of this disease among Negroes in the United States of America is thought by many physicians to be due to the failure of the weaker sunlight of middle latitudes to penetrate strongly pigmented skins. English hospitals have reported the same effect among children of mixed Euro-African parentage. The clothing necessary in a cool climate is a contributory cause.

In order to survive, bodily temperature must be maintained near 98.4° F., in air temperatures which may fall as low as -90° F. in the heart of Siberia, or rise as high as 130° F. in

the Sahara and Arabia. In the coldest climates, clothing is indispensable; though not in some cool climates, as is proved by the savages of Tierra del Feugo, who live naked in the rigours of the Antarctic westerlies in temperatures which vary between 25° F. and 48° F. It has been suggested that the equable character of this climate contributes to the capacity of this people to remain nude; but rather incomplete medical researches indicate that the functioning of the body, notably of the reproductive organs, is gravely disturbed. But the life of the Fuegians perhaps shows that large changes of temperature about a low mean are more dangerous than the low mean itself. Peoples, other than the Fuegians, living in cold latitudes, who employ furry animal skins as a protection against frost do not depend wholly upon their cultural devices in order to survive. The Eskimo, eating the whale, seal and bear, can digest quantities of fat which would be impossible to other races. They consume precisely those foods capable of producing the greatest amount of energy. Moreover, they can accumulate a reserve of fat underneath their skins. For the conductance of the skin, *i.e.*, its power to transmit heat from the deeper layers to the surface, has been experimentally proved to be lower in fat people. With the tendency to adiposity goes massive jaws and teeth, the better to masticate tough food, which is often eaten uncooked. Thus sub-races of man living in very cold climates have become adapted to low temperatures partly by the same means—the development of fatty tissue—as the animals they hunt.

Some students of physical anthropology, notably Buxton, have suggested that the long noses and narrower nasal passages which have appeared among some races living in colder and drier climates serve to warm and humidify respired air before it reaches the throat and lungs. This theory postulates also that this characteristic is of recent development; because the Eskimo nose is as short as the Negro's. Both of these races are thought to be more archaic than the European or the Mongolian.

At high temperatures, the body must dissipate heat, not conserve it. The heat generated in vital processes and muscular activity cannot readily be dispersed. In part, it may be evacuated

by an increased rate of respiration. The everted and enlarged lips and nose of Negro races may thus be adaptive, and may be related to the greater importance of exhalation in transmitting bodily heat to the surrounding air. But darker skins are actually less efficient as a means of transmitting heat to the environment, *i.e.*, heat from the internal organs of a Negro is less readily conducted to the surface, thence to be radiated away, than in a white person. Moreover, pigmented skins are more effective absorbers of the *longer* wave-lengths of solar radiation, of wave-lengths more than 4/10,000 parts of a millimetre, than light skins. Protection against ultra-violet radiation is achieved at the expense of loss of efficiency in other respects.

But there is another cooling agency. The evaporation of liquid heat from the skin is a powerful refrigerant, because considerable energy is required to make water change from its liquid to its gaseous phase, and this is taken from the body. The Negro sweats more readily than a European. He has slightly more sweat pores in each unit area of skin, and these pores are larger. Moreover, the capillaries are more numerous and dilated, bringing blood very freely to the surface of the body. Experiments have shown that for the same amount of work, the Negro exudes sixteen per cent more sweat than a European. It is not surprising that they are great drinkers.

Basal metabolism, *i.e.*, the heat generated in vital processes, such as maintaining the circulation, the heat of the body and in breathing, is reduced in hot climates. Most peoples show a preference for a vegetarian diet and aversion from fats. The digestion is often impaired; indeed, stimulus appears to be required, which Europeans find in alcoholic beverages and Orientals in strong spices, to ensure even a relatively inefficient operation.

Recently elaborate experiments have been conducted in chambers within which temperature, humidity and air movement can be controlled, to ascertain how the human body reacts, clothed and nude, resting and working, to variations in external conditions. In the table below, the results are summarized. A slight air movement is assumed. These temperatures are deduced to be the highest that can be tolerated without rise of body temperature, *i.e.*, incipient heat stroke.

	In Saturated Air R.H.=100 per cent	In Perfectly Dry Air R.H.=0 per cent
Nude Subject resting indoors	92° F.	112° F.
Clothed Subject resting indoors	88	138
Clothed Subject resting in sun- shine	76	111
Clothed Subject walking in shade at 4 m.p.h.	73	123
Clothed Subject walking in bright sunshine at 4 m.p.h.	68	109
Nude Subject engaged in heavy manual work in shade	86	—

The importance of the regulatory function of evaporation from the skin is clearly revealed. In dry air, which permits of rapid evaporation, temperatures much higher than 98° F. can be borne. Clothing increases the powers of resistance, because it partially insulates the skin from the surrounding hot air, and evaporation of sweat from the surface of the garments lowers the temperature of the air actually in contact with the skin, *i.e.*, between the garments and the skin. In his reminiscences, the late Sir Percy Cox used to recall how, in the fearful heat of mid-summer in Oman, he and Lady Cox used to enwrap themselves in wet sheets for the afternoon siesta. When the relative humidity is high, evaporation is less. The body must lose heat by conduction to the air around. Indoors, the body can withstand an air temperature equal to its own if the relative humidity is about sixty-five per cent. Outdoors, the relative humidity must fall to fifteen to twenty per cent, owing to the heat gained from sunlight. A more rapid air movement causes the limit of tolerableness to be increased in dry air; a breeze of 6 m.p.h. raises the limit for the nude subject indoors by 2° to 3° F.

These figures must, however, be received with caution. Observation in the hot climates of the world suggests that the true limit is somewhat higher than is stated in the table, especially out of doors. For in south-eastern Asia, the tempera-

ture in the early afternoon may rise to 90° , the relative humidity being fifty to sixty per cent. According to the tables, this is above the limit of tolerance for outdoor existence in sun or shade. But the native populations perform manual work, if not vigorously, at least fairly steadily. On the other hand, in the hot weather of northern India and Arabia, the thermometer in the afternoon may rise to 125° F., and although the relative humidity is very low, from fifteen to twenty-five per cent, it seems dangerous to go out of doors in the middle of the day, and field work is suspended. It is usual, also, to cease working indoors during the afternoon. Even greater extremes occur in parts of Arabia and north-eastern Africa, when high temperatures, low humidity and a wind co-exist. Then deaths may be caused by heat-stroke due to exhaustion and collapse of the sweat glands. The rapidly moving hot air then causes bodily temperature to rise above the normal. Thus observation, apart from experiment, suggests that only in the hottest deserts of the Old World do temperatures rise sufficiently high for human life to be endangered. In these regions, during summer, clothing, house and tents generally protect during the midday hours. It is only rarely that 'Poison Winds' may blow, which cause fatalities. But outdoor exertion must be avoided during the afternoon. The caravan travels by night and rests by day. The Beduin seeks the shadow of a rock. In towns and villages, workers leave the fields and streets for shady interiors, or even the cellars (*sarradab*) which in Mesopotamia have for thousands of years effectively anticipated the benefits of modern air-conditioning.

We may perhaps account for the discrepancies between observation and experiment in two ways. First, the experiments from which the data in the table on p. 47 were derived ignore the human capacity for acclimatization. A few hours spent in an experimental chamber at temperatures much higher than the normal are hardly comparable with life in a tropical climate. Just as the body's adaptation to reductions of air pressure is slow, so also is the process of accommodation to higher temperatures. Even more important are habits of life. The slow movements of the oriental servant are often mistaken for indolence by the impatient newcomer from temperate

latitudes; but it is evident that economy of muscular activity reduces the amount of heat which must be dissipated. Second, these investigations, largely pursued in America and Germany, are intended to provide data needed by those designing apparatus to control temperature within buildings occupied by white peoples in a variable, temperate climate. Racial differences have not been taken into account. For further enlightenment upon the capacity of man to withstand a wide range of climates, we must accordingly return to observations upon living races, to the evidence of archaeology, physical anthropology and to comparative anatomy.

Biologically, man is closely related to the apes of the Old World. It is generally believed that both monkeys and man diverged from a common ancestral species which, not highly specialized, lived both upon the ground and in trees in the middle of the Tertiary period. Monkeys have become, on the whole, arboreal and vegetarian. By possessing the ability to move rapidly through a forest without coming to the ground, they are secure from capture by more powerful carnivorous land animals, such as the leopard or tiger, and can pluck shoots or fruits anywhere between the ground and the lofty canopy of tropical forests. They are essentially quadrupeds, and most species have prehensile tails. Man has become wholly a biped, through forsaking trees for the land, and has no use for a tail. His feet have become fully adapted for walking or running, and the toes cannot grip a branch, as a monkey's can. The hand, not required either for walking or for grasping branches during leaps from tree to tree, has developed as a very delicately controlled organ, which, having the thumb opposed to the fingers (instead of alongside, as in the monkey's), can use tools in a variety of ways. The adoption of an erect posture has been accompanied by an increase in the size of the brain, and especially of the fore-part, which is the seat of the higher intellectual functions. The eye has become elaborated, and human vision is fully stereoscopic, unlike that of any other animal. A reduction in the dimensions of the jaw and its controlling muscles appears to have accompanied the increasing variety of food which greater intelligence could supply and, in the later stages of evolution, prepare for convenient eating.

Thereby freer and more delicately controlled movements of the jaw, face and tongue were possible, thus giving man the ability to speak. Compared with monkeys, the gestatorial period of the human infant is 280 instead of 240 days, and the child is dependent especially upon the mother but also, indirectly, upon the father, for many years whilst its mental and physical powers slowly develop. Males and females therefore tend to specialize. The former obtain food and ensure the security of the family; the latter tend the young and prepare food. Thus the family finds its origin in the mutual dependence of male, female and the young.

The adoption of a habitat on the ground instead of in trees brought about a change of diet. To fruits, nuts and edible shoots were added animals, as primitive man became a huntsman. At the same time, hair growth was arrested, for modern man, apart from the head and certain other localized parts of the body, grows only sparse, very fine hairs. The skin, too, is thinner and less resistant to abrasion than that of the monkey.

The final stages of evolution as a separate species (*Homo sapiens*) took place mainly during the half million or so years of the Pleistocene period, during which the world's climates underwent great oscillations. Geological research has shown that throughout the Tertiary period, the land areas of the world, particularly in the middle and higher latitudes of the northern hemisphere, were less extensive than today, and the climate was generally milder. Forests of a tropical or subtropical character were more widespread, and it may be inferred that the precursors of both modern monkeys and men ranged widely. But in the Pliocene, great uplifts of land, constituting the final phase of recent world-wide mountain building increased both the extent of land and its mean altitude. Considerable areas became remote from the sea and some were also shielded from rain-bearing winds by high mountains. Forests became parklands or steppes; and herbivorous animals, as well as the greater carnivores, became more numerous. It was in such an environment that man's ape-like ancestors became wholly terrestrial and more carnivorous. The immediate ancestors of modern apes, however, keeping to the

denser equatorial and tropical forests, preserved for the species of living apes the tree-dwelling habit of existence. Reduction of hair-growth in human beings would be improbable in a more severe climate, which would tend to encourage a shaggier growth; and thus until perhaps the most recent stage in human evolution, *i.e.*, the latest phases of Pleistocene, when cultural equipment had become fairly elaborate, hominids, or man-like apes, were confined to warm climates. From the great variety of plant species which have been proliferated in equatorial latitudes, it must be concluded that here dense forests have persisted for long periods, reckoned even geologically. Thus we may infer that as parklands, grasslands and steppes became more extensive towards the close of the Pliocene period, apemen ranged in the outer regions of the tropics and in subtropical latitudes in Asia, Africa and Europe; for fragments of very primitive skulls and other parts of skeletons have been found in China, central and western Europe, as well as in Africa. But their developing intelligence enabled them also to survive near the Equator, for some of the most significant remains have been disinterred in Java. Thus, constitutionally, men became adapted to a fairly wide range within the warmer climates of the world, and towards the outer margins of his habitat must have become accustomed to seasonal changes of temperature.

Before they were able to make fire at will and skin animals—the latter, especially, requiring edged-tools, including scrapers, such as appeared only during the Palaeolithic period—hominids could hardly have survived a season with night temperatures much below 60° F., which, in a fairly equable climate, would be felt in a cool-season mean temperature of 70–75° F. To withstand lower temperatures, as already inferred, at least a seasonal thickening of hair would be a likely adaptation, if apemen had been free to drift slowly into higher latitudes and to remain dwelling in a stabilized cold climate. But the Ice Age prevented such a biological solution, and required of man, as the alternative to imprisonment in tropical jungles (where, we shall observe, only very primitive human societies have ever developed), the invention of an elaborate culture.

Four times the climate oscillated between a degree of

mildness greater than that of today, when permanent snow and ice were uncommon even in arctic regions, and a severity which caused much of Europe, northern and Central Asia to be covered by ice sheets. Arctic and sub-arctic climates, such as today are confined to the regions within the Arctic and Antarctic Circles, prevailed as far south as latitude 40°. The areas over which tropical and sub-tropical climates prevailed were correspondingly reduced. During milder inter-glacial periods, hominids spread more widely, for fragments of very primitive stone tools have been discovered in Europe and northern China, worn by the action of ice and running water. During the first three glacial periods, the ancestors of humanity were compelled to retreat towards the tropics. Thus each glaciation was a crisis not only for evolving hominids, but for all forms of life, and many species of plants and animals which flourished at the end of the Tertiary period failed to survive into the Quaternary. Ape-men, moving to and fro across the Old World, were confronted with new perils, and new economic crises, which increasing intelligence enabled them to overcome. By the third interglacial period, which intervened between the Riss and the Würm glaciations, they were perhaps sufficiently advanced to be able to fashion a variety of crude tools and weapons, although we can only guess at the range of their equipment, because only stone implements have survived, and the use of this material could not have been unique. We can only presume that they could also employ wood, bone and perhaps skins. Certainly by the time of the fourth glaciation (the Würm), which began about 50,000 years ago and ended about 10,000 years ago, men differing very little from ourselves and entitled to the specific name *Homo sapiens* had spread widely in the Old World. They were able to survive as the climate became more rigorous, not by retreat to warmer regions but to caves, where, by the use of fire and skin garments, they continued to live close to the glaciers and ice-sheets. Among the best known of these early races was Neanderthal man, having larger bones and more powerful muscles than modern man, and possessing a more primitive skull, with protruding, massive jaw, a receding forehead and a very prominent bony-ridge above the eyes. Neanderthaloids appear to have evolved

as a separate race north of the Tertiary mountain belt of Europe and Asia. Their remains have been found in northern China as well as in Europe. (Fig. 2.)

Meanwhile other races had appeared, which are ancestral to most living races. Some crossed to Europe from northern Africa during a milder interlude in the last glaciation, by using land-bridges at Gibraltar and at the Sicilian Straits. In what are now the deserts of northern Africa and south-western Asia, the art of fashioning flints with considerable delicacy had been acquired. Some of these could be used for pointing arrows and spears. With these weapons, the larger animals could be hunted, for the lands south and east of the Mediterranean were steppes rather than deserts. In France and Spain, which resembled the tundras of northern Russia, the remarkable cave-drawings, amongst other evidences of the life of the times, have enabled scientists to learn much about this race of early man.

Modern man thus appears to have evolved, on the whole, south of the mountain zone in Eurasia, and to have lived in India, Java, western and southern Asia, and northern Africa before entering Europe, for, especially in south-eastern Asia and Africa, many skull fragments with rather primitive features have been unearthed. It seems that Neanderthaloid and modern races lived together in Europe and south-western Asia during the latter part of the last glaciation, and although the more specialized Neanderthaloids have not survived as a race, some of their physical characteristics have been identified in living Europeans. Some authorities, including Weidenreich, believe that the Neanderthaloids of eastern Asia have contributed more to the Mongoloid peoples.

The dispersion of modern man, which enabled him to appear in Europe was accompanied by migrations in other directions, so that he became scattered throughout the Old World, wherever it was free of ice or snow, especially in Africa, which is very rich in Palaeolithic remains. Since the climates, surface and vegetation differed so greatly from those of today, it is important to know precisely the regions available for human occupation and their characteristics because to them may be related the adaptations exhibited by living races of man, which, we must infer, were beginning to appear as the

Würm ice-sheets were melting. Great expanses of permanent ice and snow could not be occupied at all. These included north-western and central Europe, most of European Russia and the plateaux of north-eastern Siberia. The higher mountains of Europe, especially the Alps, were enveloped in extensive snow-fields or glaciers. The same was true of the Himalayas and Karakorum ranges, the mountains to the east of Tibet, and the high ranges of central Asia, such as the Kuen Lun and the Altai. But in central Asia, as today, distance from the sea reduced precipitation, and the climate of the plateaux at intermediate altitudes was fairly dry, sustaining a natural vegetation resembling a steppe. Westwards, in Asia Minor and in Europe close to the margins of the ice, tundra was prevalent. Rainy mountains in south-western Asia and around the Mediterranean basin were forested, but lower ground was a kind of sub-tropical savannah, where both trees and grasses flourished, including many plants to be found nowadays on the littoral of the Mediterranean Sea. The Arabian and Saharan deserts were smaller and farther to the south than today. Perhaps the only true deserts corresponded with the Libyan Desert and the Rub al Khali (the "Empty Quarter") in Arabia. In central Africa, savannahs and forests covered largely the regions they do today; but in southern Africa, the Kalahari Desert was less extensive and less arid. Little is known of Australia but the climate of its southern parts was probably cooler and more moist, for small glaciers were nourished on the summits of the Australian Alps. The "Dead Heart of Australia" was correspondingly reduced. South-eastern Asia was largely forested.

The withdrawal of an immense volume of water from the oceans to form the continental ice sheets and enlarged glaciers caused the sea-level to fall about 600 feet, connecting Asia with North America by an isthmus where are now the Behring Straits, and reducing the Mediterranean and Black Seas to a series of lakes. Land-bridges also connected Borneo, Java and Sumatra to the mainland of Asia. (But sea still extended through Indonesia along Wallace's Line, maintaining the separation of Australia from Asia, which had begun at least very early in the Tertiary period. For not only were mammals unable to reach Australia before the European settlement, but the precursors of

modern man were also strangers to this continent. No remains of ape-men have been discovered.)

The dispersal of the primitive types of modern man over this immense area and into the most diverse climates when culture was still rudimentary, and massive migrations impossible, allowed the modern types or races of mankind to be evolved, in relative segregation from each other. Keeping speculation within bounds, we may tentatively relate important physical characteristics of the main races to the environments in which they were appearing at the close of the last glaciation.

In east-central Asia the climate was very cold, and, as the Würm ice sheets diminished, increasingly dry. Outblowing winter winds, laden with dust for many thousands of years, have blanketed northern China with loess. Here, strains of Neanderthaloid man, less specialized than in Europe, with which were mingled newer types from the south and perhaps south-west, acquired the thickened, and hence yellowish, skin which is characteristic of Mongoloid peoples, and which may perhaps be deemed protective against cold and drought. The nose and mouth became small, which, as already suggested, may ensure that respired air is more humid and warmer when it reaches the lungs, and freer of dust. Perhaps the slit-like eyes and the epicanthic fold (or curl of the outer upper eyelid over the lower) may serve partly to protect this organ from dust and very cold air. In addition, the lank, straight hair and broad skull appeared, although these features are less readily related with the climate prevailing in the cradle-region of this race.

In south-eastern Asia, India and the East Indies, the early types of modern man conserved primitive features in their skulls. The forehead recedes (among the groups isolated in remote forested hills from more recent immigrations of Mongoloid and White races), the jaw is large and protruding, and the nose broad. The skin has remained dark brown, and the hair generally wavy or curly. Although dispersion within this area was aided, at the height of the Würm glaciation, by the lowered sea-level, it must have been necessary to make rafts to reach New Guinea, where very primitive groups have survived in the still almost inaccessible mountains. The overseas migration continued to Australia and Tasmania, where, practising a

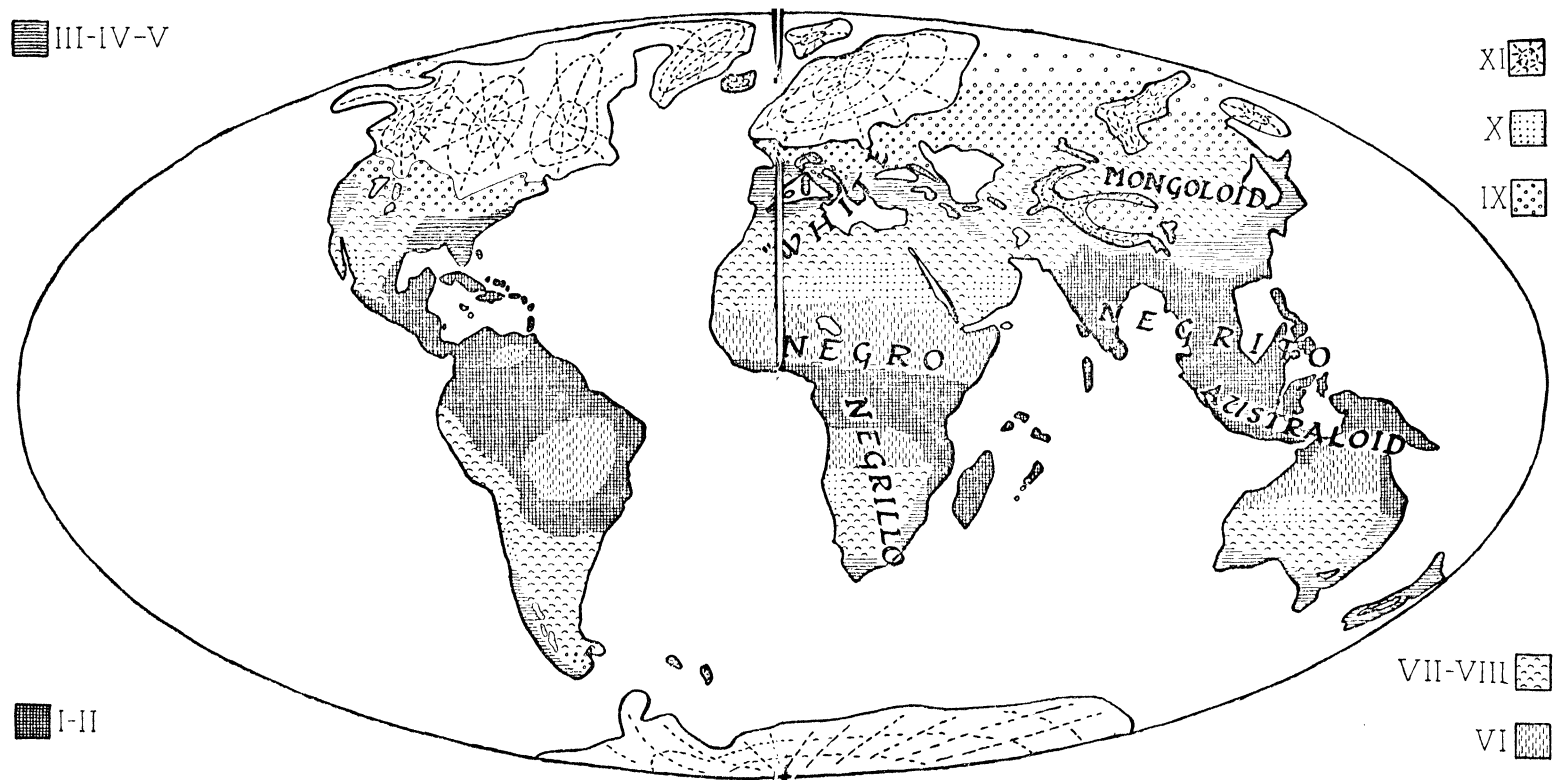


FIG. 2

CONJECTURAL VEGETATION ZONES OF THE WORLD DURING THE WÜRM GLACIATION

The Roman numbers correspond with those of the diagram on p. 80

Palaeolithic culture, the peoples we now know as Australian aborigines remained in isolation from the rest of mankind until very recent times. Other strains, living close to the Equator in the East Indies, became almost black and grew hair in tight curls, which, so some physiologists have argued, both shades the scalp from strong sunlight and yet permits moisture to be evaporated from the sweat-glands.

In south-western Asia, northern Africa and Europe, important strains of modern man had already lost many primitive characteristics by the time they met the Neanderthals. A higher forehead, reduced brow ridge and jaws, smaller nose, lighter complexions and wavy hair have on the whole prevailed. Whilst the Würm glaciation was at its height groups could mingle across northern Africa, which was fairly thickly peopled for the times, if we may judge from the abundance of Stone Age implements. But as the Sahara was desiccated, a barrier was created between men living around the Mediterranean and those in central Africa. In very effective isolation from the rest of mankind, the Negroes conserved and perhaps intensified their skin pigmentation, thick lips, broad noses, tight-curled hair, rather large jaws and receding forehead.

But Africa, south of the Sahara, is large enough to permit more than one race to exist. To the immense extent of the second largest continent must be added the impenetrability of tropical forests. In the depths of the latter, in the Congo basin, the Pygmies became dwarfed. From the same or a similar stock (Negrito), which must have been preserved from intermingling with the Negroes for a very long period by migrations to the extreme south of the continent, sprang the Bushmen, who are not only among the smallest of races but have peppercorn curls and other physical peculiarities. In the Sudan, however, were bred the true Negroes, which have spread southwards along the open savannah lands of eastern Africa almost to the Cape of Good Hope, although a great part of this movement was accomplished within the past thousand years. The black or reddish-black skin of this race is accompanied by the other racial traits just mentioned, and some groups, especially in western Africa, are tall and finely muscular.

Further migrations and racial differentiation have ensued

since the recession of the Würm ice-sheets and glaciers. In Indonesia and the mainlands on either hand the Veddahs of Ceylon, the hill tribes of Chota Nagpur in central India, the Andaman islanders, the Semang of Malaya, the Aëta peoples of the Philippines, the Kubu of Sumatra, the Toala of Celebes, increasingly isolated by the rise of sea-level, have come to exhibit a certain diversity within the range of characteristics known as Negrito; and, except where preserved in remote islands or in jungle-clad mountains, have become mingled with later immigrants representative of other racial stocks who have swarmed into the Monsoon Lands and the East Indies from without. But formerly these Negrito peoples must have been in undisputed occupation of a much greater area of southern India, Indo-China and the East Indies.

In eastern Asia, as the climate ameliorated, Mongolian men began to disperse. Moving southwards towards Indo-China, they became darker and smaller of stature, thus giving rise to the Malays, who have become established along the coasts, in the river basins of south-eastern Asia and upon some of the islands. Mastering the art of ocean navigation, a wide dispersion to the islands of the Pacific (Polynesia) was also achieved by peoples akin to the Malays and Chinese, although before this movement took place, there must have been some intermingling with peoples akin to those of south-western Asia. Moving northwards, Mongoloids dispersed through the forests to the Arctic coast and throughout the grasslands and semi-deserts in the heart of this continent. During historic migrations, some have settled in eastern and northern Europe. Others, crossing to North America, either on ice or before the Behring Straits had been formed, began to live in the New World. The earliest human remains yet discovered in North America are perhaps 10,000 years old, although some authorities believe that they are only half this age. If the earlier date is the true one, then the ancestors of the Amerindian peoples probably passed along a corridor formed when the north American ice sheets began to melt, along the present Mackenzie river valley. That Mongoloid man has occupied the Americas too recently to permit of effective adaptation to climates which are often in the greatest contrast with those of the cradle-lands was affirmed by

the great naturalist Bates, who observed that the pale-skinned natives of Amazonia were less able to bear the humid heat even than Europeans.

In western Asia and Europe, several new types appeared. Around the Mediterranean Sea, the olive-skinned, dark, slight Mediterranean type became fully developed; and migrated thence to the coasts of western Europe, especially during the Bronze Age. Closely related stocks also moved eastwards into India, where their descendants, much mingled with Negrito peoples as well as the Aryan immigrants of historic times, form the principal stock of that sub-continent. As already related, some groups, penetrating even farther eastwards, contributed to the ocean migrations in the Pacific. In Armenia and Anatolia, men became stockier and broad-headed. Migrating westwards to Europe, they are now known as the Alpine sub-race, because, on the whole, they have kept to the mountain districts of central and western Europe, although they have contributed a great deal to the ancestry of the Russian people. In southern Russia, as steppes appeared north of the Black Sea and the Caspian Sea, a tall, fairer, long-headed sub-race appeared, which, later migrating to the shores of the Baltic Sea, acquired the extremely distinctive characteristics of the Nordic race—very fair hair, blue eyes, white skin—which are common today in Sweden, and northern Germany and eastern England.

This sketch of the rise and racial differentiation of modern man permits us to reach tentative conclusions respecting his adaptation to the climates of the globe. Whilst still an ape-man, rather than a man, he was confined largely to tropical and sub-tropical climates, ranging more widely during inter-glacial periods, and retreating towards the Equator during the Gunz, Mindel, and Riss glaciations. During the Würm glaciation, Neanderthaloid types remained in proximity to the ice, and were joined by types of modern man which had evolved in tropical and sub-tropical climates. It seems unlikely that Neanderthaloid stock is well represented among European peoples, although it may have contributed more to the Mongoloids. But the ancestors of modern man, before the closing phase of the Würm glaciation, were denizens of warm climates with a seasonal cycle of temperature changes. Their adoption of

cool temperate or cold habitats is a recent event, depending much upon cultural aids. Its duration is perhaps not much more than 20,000 years, or 600 human generations. But in the course of the dispersal of modern man, and fairly long segregation in habitats which climatically are much contrasted, there have appeared rather superficial differences of physique, mainly in the character of the skin and hair, in stature and the shape of the skull, which are termed racial differences. They are not specific. By every known test, mankind is a single species. Racial differences are more akin to those subsisting between breeds of domestic animals.

CHAPTER III

HUMAN MIGRATIONS AND CLIMATE

THE extent to which physical differences described in Chap. II enable races better to thrive in their cradle regions than elsewhere is a problem of considerable importance to humanity. Substantial migrations have taken place during the past few centuries, and may continue as numbers increase and close settlement of the earth proceeds, especially within the tropics, which alone remain as large potential food-producing regions. If it can be proved that some races are unfitted to migrate to climatically dissimilar regions, how far can cultural devices overcome this disability?

As a result of the migrations since the Great Age of Discovery, communities derived from races long established in temperate regions have settled within the tropics. A more limited reverse movement—of tropically conditioned races to temperate latitudes—has also been witnessed. If we postulate capacity to reproduce and increase as the best test of ability to withstand climatic change, then we must conclude that races which have become transplanted within the past few centuries have recorded both successes and failures.

The Negroes of western Africa have been bred in an equatorial climate, and the extent to which they are physically adapted to such an environment has already been discussed. The fine physique of several west African tribes suggests that here a strain of humanity has been evolved which is better fitted than any other to thrive in a hot, humid climate. During the period of slave-trading, many thousands were shipped to the tropical regions of south America, the Caribbean and the southern United States. In the last-named country, they were henceforth to live in a region where the mean annual temperature is not less than 15° F. below that of their homeland, and where the winter is very changeable, with frequent severe cold spells. There they reproduce themselves, and are physically vigorous, in a way

which is clearly demonstrated by the athletic prowess of their young men. But, as already noted, they seem to be more susceptible to certain diseases which attack man during cold, cloudy weather.

Successful migrations from extra-tropical to inter-tropical regions have been accomplished by the Mediterranean peoples of southern Europe. In Cuba and Porto Rico are white populations descended from the peasants of Spain and Portugal. In Cuba, the importation of Negro slaves ceased in 1841, and was succeeded by active and increasing immigration from Spain. The white population of Cuba has now become much more numerous than the Negro, and has a higher birth-rate. It may, perhaps, be argued that immigration has been so active in the past two generations that the fact of acclimatization has not been proved. But in Porto Rico, where the white population is sixty per cent out of one and a half millions, a greater proportion is descended from seventeenth and eighteenth century settlers, whose existence was precarious until modern hygiene reinforced them in their contest with tropical diseases. In recent decades, the rate of increase among whites has been greater than amongst Negroes, and some assert that the island is now over-populated. Both Cuba and Porto Rico have mean annual temperatures 10–15° F. higher than Spain, and have no true cool season, although December and January are somewhat less hot than July. A smaller white community of similar Latin origin inhabits the tropical uplands of Costa Rica. Its existence is more precarious than those of Cuba and Porto Rico, because Negroes are competing very strongly for the use of the land.

Great as is this climatic change, it is yet inferior to that confronting the northern European races which have settled near the Equator. When persons of Nordic or Alpine stock from England, France or the Netherlands live near the Equator, a rise in mean annual temperature of 30° F. or more must be endured, and a climate having marked seasonal and non-periodic changes exchanged for one which is uniform to the point of monotony. Many are the examples scattered around the world, from the West Indies and Africa to the Philippine Islands and Queensland, which may be examined in order to

arrive at a verdict upon the vexed subject of the capacity of the northern white races to survive in the tropics. Among these are evident successes and obvious failures; but it is not so easy to distinguish the rôle of the climate in either category.

As the Spanish Empire of the New World began to disintegrate in the seventeenth century, England, France, Holland and Denmark seized islands in the Caribbean Sea and "planted" colonics. Barbados and St. Kitts, the two most important English settlements, each had more than 30,000 white persons by about 1640. In the former, the white population has now been reduced to little more than 10,000; in the latter, to only 1,000. All observers agree that the survivors are enfeebled and degenerate. But it would be contrary to sound judgment to attribute the present dismal condition to climate. The original settlers were the dregs of England. Negro slaves were introduced into both islands, bringing low living standards, hookworm, bilharzia and malaria. The wars of the seventeenth and eighteenth centuries were ruinous, and the colonial administration has been very defective. That events rather than climate undermined these communities seems proved by the vigour of smaller groups, which, escaping maladministration and the economic hazards of sugar-planting, and also (lacking strategic importance) the scourge of war, have remained healthy and are increasing in numbers. In the Grand Cayman Islands, 300 miles north-west of Jamaica, in latitude 19° N., and where the annual mean temperature is but little below 80° F., are 2,000 whites, descended from settlers who migrated from Jamaica about 200 years ago. The men are mariners and ship-builders. The women, though not working out of doors, are active in their homes. A strict colour-bar has been observed, and there has been no intermarriage with mulattos or Negroes. The sanctity of marriage is rigorously preserved, although husbands are often absent for long periods at sea or in the ports of the mainland. Only a little inbreeding has taken place, but not to noticeable enfeeblement, and recent investigations have shown that physique and intelligence are good. Social standards have been maintained and improved, as the large, well-painted houses reveal to visitors.

A similar community lives and flourishes on the Bay

Islands, forty miles off the north coast of Honduras. About half of the population of 4,000 is of British stock, which has retained its characteristics for two centuries, notwithstanding that since 1859, when the islands were ceded to the Republic of Honduras, determined attempts have been made to suppress British culture. It speaks well for the vigour of this small British group that success has been won in the dual struggle with a humid tropical climate and an unsympathetic or hostile government. Strict abstention from intermarriage with other racial stocks and a stable livelihood based upon ship-building, trade and growing tropical fruits have laid the foundations for this achievement.

Corroboration is provided from Saba, a mountainous island only five square miles in area, among the Leeward Islands. Originally colonized by the Dutch early in the seventeenth century, it was held by the English for two periods during the Anglo-Dutch Wars, during which the mother-tongue was changed, although Holland has exercised sovereignty continuously since 1682. At about that time, Negro slaves were introduced; but the resultant economy may be described as farming rather than planting, for the holdings were small, and the slaves owned by a white proprietor rarely numbered more than ten. It is thought that masters and slaves worked side by side on the land. Later, many Sabans took to a seafaring life in sailing ships. Till late in the last century, the white settlers in Saba refrained from miscegenation, and remained vigorous. Father Labat, who visited the island in 1701, wrote afterwards in terms of lavish praise for its prosperity and welfare. Raynal, eighty years later, was equally impressed. Fifty European families with 150 slaves then grew garden produce and cotton. He commented that the European stock had remained purer than elsewhere in the Caribbean region, and observed that the women, especially, had remarkably fresh complexions. But in the mid-eighteenth century the slaves were freed and the sailing ship became obsolete. Many men left the island permanently, taking their wives and obtaining economic advancement by becoming ships officers or officials in steamship companies or harbour boards in the U.S.A. or the larger ports of the Caribbean. Thus they proved that their stock had remained vigorous;

but their departure sapped the community remaining in Saba, which is dying out in several villages, and is now somewhat enfeebled in another. At Windwardside and Hellsgate, however, white farmers are still established, and perform almost incredible feats of exertion in tilling and carrying crops on steeply sloping land. Their children are healthy, and respond to education as well as comparable groups in Europe. Adult women seemed somewhat enervated to a recent investigator (Dr. A. Grenfell Price), who attributed this to a sedentary indoor life, which necessitates long hours of lace-making by the light of oil-lamps.

The Grand Cayman Islands, Bay Islands and Saba are all relatively free from tropical diseases, including two which are most prevalent and debilitating: hookworm and malaria. Thus they offer evidence very strongly supporting the view that failures of other tropical settlements by northern Europeans have been caused by disease or social conditions rather than climate. Moreover, in all three, whites and Negroes live side by side; but the former, though employing the latter, have avoided physical and moral degeneration by engaging in vigorous manual work and refraining from intermarrying. How regrettable that these successes should be on so limited a scale! Yet it would be a counsel of perfection to suggest that these lessons from the smaller West Indian islands are applicable to the greater problems of Africa. It should also be observed that climatically all these islands are exceptional. They are swept throughout the year by the Trade Winds, which, blowing steadily, naturally ventilate the houses and cool the sweating skins of outdoor and indoor workers. This is but one of many tropical climates, and these maritime, equable, windy characteristics do not widely prevail in low latitudes.

The American achievement in the Panama Canal Zone is less convincing. It has proved that in a most disease-infested, fully equatorial climate, modern sanitation and hygiene can keep a white population healthy and efficient. More germane to the question before us, many of these whites, engaged in strenuous manual work, including even labour in foundries, continue with unimpaired health for many years. They bring up their families in the Zone, and some men of the second generation are apparently as capable of vigorous work as their parents. But

the American settlement began only in 1905. Forty-five years is too short a period in which to judge the permanence of a settlement. Moreover, the economic base of the American community is extremely artificial. Thanks to the ships which pass through the Canal from all parts of the world, an unusually varied diet can be consumed. Also, vacations are commonly spent in the United States. Americans in Panama do not perform unskilled work out of doors, and coloured servants are usually employed in houses, to the detriment of the American women, who are often under-exercised through lack of muscular work. Thus, at Panama, the community is not well balanced and has a very unusual and artificial economic base; but, nevertheless, it is working, it is healthy and it has every prospect of being permanent.

Queensland is a remarkable and at the same time a much-disputed example of European penetration into the tropics. The coastal districts, which receive moderately heavy rains, chiefly in summer, were settled from several ports (Brisbane, Bundaberg, Rockhampton, Mackay and Cairns) by sugar-planters, after 1860, who introduced labourers from Polynesia and China. The state of society which ruined Barbados was quickly reached. Except for a limited, land-owning class, the white population was undermined and demoralized by the competition of peoples accustomed to lower standards. From about 1885, the 'White Australia' policy was gradually enforced, but it was not until the First World War that the last of the Polynesians ('Kanakas') were finally repatriated. Meanwhile, the sugar industry, strongly supported by bounties and tariffs, continued to flourish, although it had been prophesied that it would disappear through lack of labour. Fresh immigrants from Britain, Australians and a small number of Italians have, aided by a more efficient organization of planting, milling and refining, contrived to maintain production and ensure a reasonable standard of living. A rigorous medical investigation in 1924 revealed that the white population of Queensland was quite normal. Men, women and children were as healthy as their fellow-countrymen of the temperate south. Men were able to perform arduous outdoor work, such as cutting cane or unloading ships, without ill-effects. Women, particularly those who

did housework, were healthy, although it must be admitted that some doctors believe that women in Queensland age more quickly than their southern sisters. This might well be remedied by better town-planning, for at several ports houses are huddled in hollows close to the harbours instead of being situated upon headlands or the open coast and thus better exposed to the Trade Wind. Houses better adapted to the tropics, with netted windows, external kitchens and thermally insulated roofs (instead of corrugated iron) would also be beneficial, by improving the housewife's working conditions.

The sugar-planting districts are, however, marginal to the tropics. Maryborough and Bundaberg are actually south of the Tropic of Capricorn, whilst Rockhampton is situated almost on the Tropic. Only the Burdekin valley, Cairns and Cooktown are fully tropical, having mean monthly temperatures throughout the year above 64° F. Thus, in general, the people of Queensland live in a climate with distinct seasonal contrasts, and only the months of the southern hemisphere summer are truly hot, having mean temperatures above 80° F. In June and July the mean temperatures are nearly 15° F. less. The plateaux of north-central Queensland offer a similar climate, in the hinterland of Cairns and Townsville, where a sparse population is engaged in cattle-rearing. Again, the temperature of the coolest month is below 65° F. Moreover, the summits of the coast ranges rise above 3,000 feet, and provide sites for hill stations close to the principal sugar-producing districts. People of all classes can gain relief from the greatest heat in December and January. The boarding schools attended by children of wealthier parents are also situated at altitudes exceeding 1,500 feet, and where mean temperatures in all months are lower by at least 5° F.

It has also been observed that workers engaged in the heaviest manual labour, especially cane-cutting, tend to leave this occupation, and frequently the province, after an average period of about eight years. And in the extreme north, around the fully tropical Cairns and Cooktown, the requirements of sugar-growing have been satisfied since the last Kanakas left only by immigrant Italians. Beyond dispute, Queensland has been successfully settled by a community mainly of British descent. But it is equally clear that the principal areas of popu-

lation are marginal to the tropics, and are positively sub-tropical for part of the year.

Similar climates prevail over the east African plateaux, which have been colonized by Britons since effective government began about seventy years ago. In Kenya, Nyasaland, Northern and Southern Rhodesia, altitudes of 3,000 feet and upwards in all the principal areas of permanent settlement reduce the tropical heat, although the Equator passes across Kenya. At Nairobi (latitude 2° S., altitude 5,450 feet) the mean annual temperature is 63° F. At Salisbury (latitude 17° S., altitude 4,880 feet), the mean annual temperature is 65° F. The maintenance of health and vigour is no problem in these colonies; but it has only been proved that northern European peoples can live in sub-tropical or warm temperate climates.

The experience of British, French, American and Dutch communities in the Orient remains for discussion. Nowhere have these nations established balanced communities in south-eastern Asia or in the East Indies. Living amongst very numerous agricultural populations, persons of white origin have spent their lives as government officials, managers of estates or factories or as merchants. They have avoided all forms of manual work, including domestic work in their homes, and have generally been sojourners rather than settlers. The Englishman in India, Ceylon or Malaya has looked forward to retirement 'at home' at the close of his working life; and in the last twenty-five years (since steamships quickened the speed of travel between western Europe and the East) has returned to his native country to recuperate every three or four years. It has been his practice to send his children from the age of seven or eight to schools situated at hill stations or in England until the age of eighteen or twenty, partly for fear of the effects of heat during youth upon adult vitality, and partly to preserve from the influence of an alien environment during formative and impressionable years. In these artificial conditions, English families have been established in India and other countries in south-eastern Asia for two or three generations, without loss of vigour, and the East has gained by the work of administrators, engineers, merchants and planters who have been accustomed to the climate and to the indigenous societies from childhood.

It is rarely claimed that this is permanent settlement. The prevailing opinion among English doctors with experience of the tropical East is that English stock permanently established in these hot climates, *i.e.*, without periods of leave at hill stations or in England, and including the years of youth, could not retain its vitality.

A contrary conviction has, however, been affirmed by Dutch investigators, who have abundant data from the long and intensive occupation of Java. Policy and practice have differed from the British in India. Dutchmen going to the East Indies have generally settled there for life, and reared their families in the islands. Until recently, mortality has not been light; but an analysis of statistics to separate the toll of tropical disease from other causes of death lends support to the opinion that climate, alone, has no pathological effects. Within the last thirty years, medical investigations, similar to those undertaken by Australian doctors in Queensland, have revealed that persons of Dutch extraction in Batavia have not in any way been physiologically affected by upbringing and residence close to the Equator. These observers stress, like Dr. Price, the importance of sobriety, good hygiene, modern sanitation and manual work or energetic exercise to ensure good health.

Summing up, it may be said that northern European peoples have successfully colonized sub-tropical lands, and are established within the true tropics, but only on the margins, where distinct seasonal fluctuations of temperature are felt. The capacity of northern European races to colonize *equatorial* lands remains unproved, for the successful instances, in the West Indies and Java are too localized in comparison with the immense extent of lands lying within 10° of the Equator. Europeans from Mediterranean lands appear to be rather better fitted to tropical climates, for in Porto Rico, Cuba, Costa Rica and Brazil are healthy and vigorous communities numbering several millions. But again, all these regions are towards the margins of the tropics, and, especially in Brazil, the heat is tempered by altitude. For the most extensive area of white settlement in Brazil, in the state of Sao Paulo, has an altitude of from 1,000 to 3,000 feet, and in the tropics, an increase of

altitude of 1,000 feet reduces mean temperatures—of the day, month or year—by about $3\frac{1}{2}^{\circ}$ F.

From these well-attested facts of modern migrations we must now turn to the more distant and more obscure past. It has already been shown how the extreme climatic oscillations of the Pleistocene period—the Ice Age—contributed to human evolution, by changing the flora and fauna of whole continents, and providing a control of migration by creating barriers or opening new avenues for movement. But it should not be supposed that the world's climates have remained unchanged since the ice-sheets melted from Europe, Asia and North America. The amelioration of climate after the epoch of maximum severity was interrupted by pauses, and by short periods of increased severity, which have been correlated by archaeologists with events or movements in prehistory. At other times, the general rise of temperature was particularly rapid, and the regional changes of climate most marked. Between 8000 and 6000 B.C. at the very close of the Ice Age, the continental ice-caps of the Old World and North America shrank almost to nothing, and the climates of the northern hemisphere approximated to their present pattern. During the Ice Age itself, anticyclones must have persisted in summer as well as in winter over what is now central Asia and Europe. Probably low-pressure systems were active throughout the year over the Mediterranean and the Near East. The northern Sahara and the lands to the east of the Mediterranean Sea were rainier, and, as already shown, it was upon the steppes or park-lands which were then widely prevalent that an important race of modern man was evolved. But as the ice-sheets dwindled, depressions adopted more northerly tracks, generally crossing Scandinavia, and appeared in the Mediterranean only in winter. Deserts thus expanded in northern Africa and the Near East. Game vanished, and men dispersed widely. Surviving groups of hunters began to congregate along the rivers, *e.g.*, the Nile and the Euphrates, which continued to flow across the desert because their headstreams are fed from the rains or snows of distant mountains. The wild varieties of several cereals, including wheat, barley and oats, have been discovered in the remoter hills of south-western Asia, between Asia Minor and Afghanistan, and, as game

diminished, sustenance may have been increasingly sought from plants. How cereal cultivation actually originated remains a mystery. It has been suggested that gathered wild grain, buried with a corpse to provide food for the soul, grew more abundantly than in the wild state, thanks to the loosening of the soil, the elimination of competitors and a source of fertility. Thus agriculture and the associated ritual may have originated together. Alternatively, and perhaps concomitantly, the notion of sowing wild grain on alluvial land from which flood waters were receding may have saved communities living by the Nile and Euphrates from the dire effects of dearth of game. Thus the elaborate irrigated agriculture of Egypt and Mesopotamia may be traceable to extremely simple beginnings. In Mesopotamia, the most recent archaeological discoveries suggest that the first cultivation of grains took place about 7000 B.C. on the edge of flooded land by nomads, who established themselves temporarily by their crops during the season of sowing, growth and harvesting. Other aspects of what has been termed the Neolithic Revolution may be attributed, directly or indirectly, to the crisis in the economy of peoples living in south-western Asia wrought by the desiccation of their homeland as the present distribution of climates became established. The skins of hunted animals had previously provided clothing and bedding. It is not fortuitous that flax was grown with cereals by the earliest cultivators of the lower Nile, and that weaving is as old as agriculture. The art of making earthenware may have arisen less from dire necessity than from the enforced closer acquaintance-ship between man and the fine silts of the Nile delta or the Mesopotamian Plain. The results of kindling fires for cooking on a silt hut floor, or in a fire-place made of sun-dried blocks (in the absence of stones) may have suggested how clay can be transformed into stone. At an epoch when society was being rapidly changed, new arts were thus suggested. It would be a far-fetched and unprofitable determinism to assert that all the inventions of the Neolithic Revolution were the direct consequence of decreasing rainfall and increasing heat during two millennia. But it is clear that, confronted by an economic crisis, some societies had the wit not only to survive but also to improve their livelihood. There was no inevitability about the

cultural advance. The very same movements of climatic belts caused forests to advance across central and western Europe, replacing the tundras in which upper Palaeolithic peoples had hunted such numerous game that they had leisure to elaborate the remarkable cave-art preserved for our wonderment and admiration along the Dordogne and in Spain. As the forests grew, the larger mammals were replaced by smaller, and hunting became more difficult. For several millennia, rather decadent descendants of the hunter-artists eked out a miserable existence, resorting, indeed, on the shores of the Baltic to gathering shell-fish. The challenge of the oak forest, slowly enveloping a tundra as the climate ameliorated, overcame peoples which, at the beginning of the crisis were culturally more advanced than those of the Near East. It would be tempting to turn aside to examine the rôle of dense forests in human evolution—a fascinating theme, which will receive some attention later. For the present, it is enough to emphasize that the establishment, at the close of the Ice Age, of a climatic distribution approximating to the present was a crisis to the societies both of the Near East and in western Europe. To the former, necessity was the mother of invention: in the latter, society crumbled and could not be effectively rebuilt from within. The new impulses to Europe came from without, after Egypt and Mesopotamia had become the seat of sedentary agricultural communities.

Since about 6000 B.C. no essential change has taken place in the pattern of the world's climates; but many authorities think that further minor changes of the same order have continued, like the lesser shocks which may be felt for days or weeks after a major earthquake. Instrumental observations which have now been recorded for more than two hundred years in western Europe show that during periods varying from ten or fifteen years to upwards of seventy years the character of seasons has slightly altered. Winters during the century and a half beginning in 1700 were more severe in western and northern Europe than nowadays. It has recently been shown that the glaciers of Switzerland and Scandinavia have been much reduced since 1850, and that the northern coniferous forest is encroaching upon the tundra. Navigation in the Arctic Ocean is becoming

less difficult, thanks to the shrinkage of polar ice, and the intensification of sea-borne commerce to Siberian ports may be attributed as much to the lessening rigour of winter as to Soviet initiative and enterprise.

For the period between 6000 B.C. and A.D. 1700 we have no instrumental records of weather. But a good deal of indirect evidence has been collated which suggests that climate is perpetually subject to minor oscillations. Winters become more severe for several centuries, or rainfall decreases for several decades over a large area. Summers may become finer and less unsettled. Perhaps the most reliable indicator of climatic oscillation is provided by plant remains. The flora of a district is sensitive to decrease of rainfall or rise of temperature, and one dominant species may be replaced by another. In the slowly accumulating peat of hollows in the moraines of north Germany and Denmark, pollen from trees and other plants growing on the better-drained slopes around has been preserved since about 5000 B.C., and a microscopic technique has been devised which enables botanists to describe the changes in natural vegetation since the close of the Ice Age. From the succession of vegetation types, the general character of climatic change may be also inferred. It has thus been demonstrated that during the second and third millennia B.C. the climate of north-western Europe was probably more genial than at any time since the onset of the Würm glaciation. Beech forest, which demands a warm, dry summer, attained its maximum extent. It is believed that this climatic amelioration encouraged the migration of Neolithic and Bronze Age folk along the Danube valley from the Near East, and thus helped the transition from hunting and collecting to a sedentary, agricultural mode of life in western Europe. In the Danube basin and central Germany are many small areas of soil resembling the loess of north China, and of similar provenance, having been formed from deposits of dust blown from the Eurasian interior by dry winter winds. On these easily tilled and fertile soils, undergrowth was reduced and readily cleared by fire. Trees, as in Moldavia today, tend to be sparse on the higher, well-drained land between river valleys and on river terraces, where the sub-soil is gravelly, causing the soil water to become deficient in

late summer. It was to these favourable sites, rendered the more attractive by the increased summer warmth, that Bronze Age peasants were drawn. About 1000 B.C., the climate became cooler and wetter. Intercourse across the alpine passes diminished, and the Swiss lake-dwellings (which had been also established during the preceding warm, dry period), were flooded and abandoned.

Much more dubious evidence of climatic oscillation, about which controversy has been active for nearly fifty years, has been derived from the ruined cities and villages of Asia, north Africa and North America, from prehistoric and historical records of migrations, agriculture and weather. The sequoia trees of California, the longest-lived organisms on this planet, have been called upon for testimony, because, in their growth-rings, fluctuations of annual rainfall are indicated, and their cyclical character deduced. Ellsworth Huntington, of Yale University, who travelled widely in Asia between 1900 and 1910, was greatly impressed by the ruins of villages and towns in the heart of that continent, which were once inhabited by numerous populations depending upon an irrigated agriculture. Later, he visited and described the depopulated districts in the south of Palestine, in Cyrenaica and Tripolitania. Palmyra, at the northern margin of the Syrian Desert and a centre of caravan traffic from the first to the third century A.D., was destroyed by the Romans in A.D. 272. But its rainfall, and hence its underground water supplies, may already have been diminishing, and it was never rebuilt. Huntington concluded that a general decrease of rainfall throughout south-western and central Asia had caused streams to disappear, springs to fail and wells to become dry. In places, salt lakes into which streams had discharged in the past have evaporated and new routes for caravans have been adopted across their beds, to replace older, more circuitous ways around the former shores. In all these regions, the settled, agricultural mode of living appears to have prospered most during two or three centuries ending about A.D. 200. It was then, also, that Graeco-Roman civilization reached its zenith on the shores of the Mediterranean Sea. Since that time, the climate has been as favourable only for very brief periods, at about A.D. 1000 and A.D. 1400, which apparently were not of

sufficiently long duration to permit agricultural life to be resumed on the former scale.

But cultivators of oases are not the only inhabitants of these lands. It was in these steppes and semi-deserts that the horse, sheep and camel were first domesticated, and from before the dawn of history, nomadic folk have driven their flocks and herds from one pasture to another, sheltering in tents and carrying their few domestic and personal possessions with them. If rainfall decreases for a period, pastures disappear, animals die and the pastoralist starves, unless he moves to more humid lands beyond his accustomed range of wanderings. Life in dry lands is hard, breeding endurance and resourcefulness. History abounds with conquests of peaceable agricultural peoples by nomad warriors from drier lands. Beginning with the Aryan movements into Europe and India in the second millennium B.C., which were contemporaneous with Libyan pressure upon Egypt and Armenian incursions into Syria, they were resumed about 700 B.C. when Cimmerians and Scythians burst into Anatolia, and Arabs were pouring north-eastwards. About 200 B.C. the Hiong-nu were trying to invade China, and Sarmatians were intruding into the European steppes west of the river Don. In the fourth and fifth centuries A.D., especially widespread migrations occurred throughout Europe and Asia. The Juan Juan were invading northern China, the Huns were spreading across Iran and into Europe, whilst the Arabs were again crossing the Euphrates. In the seventh century A.D. the greatest of all Arabian migrations, under Mohammed, began its course. Again, in the eleventh century, the Seljuks were invading Iran, contemporaneously with nomad incursions into north-western Africa and the steppes north of the Black Sea. The sequoia trees reveal that since 200 B.C. growth has proceeded irregularly, and at intervals has been retarded for periods varying in length from a decade to a century and a half. Assuming that slow growth in California is to be correlated with smaller annual rainfall in the dry lands of the Old World (and physical science offers some support to this hypothesis), then most of the migrations may have had an origin in the oscillatory tendency of climate, to which humanity is most sensitive where the growth of vegetation is already fitful and precarious.

We must, however, clearly distinguish between the fact of climatic oscillations and correlation with historic events. Climatic fluctuation is proven. Our most recent instrumental observations have revealed its precise extent during the past two centuries, and records of changes in rivers, lakes and springs, when collated with the many references to unusual weather in old chronicles, convincingly demonstrate that slight change has always been in progress in the past. But there are puzzling and disturbing anomalies if we try to correlate climatic pulsations with history. One of the greatest nomadic outbursts from Asia was witnessed during the thirteenth century, when the Mongols swept over half of the Old World. But at this time the sequoias

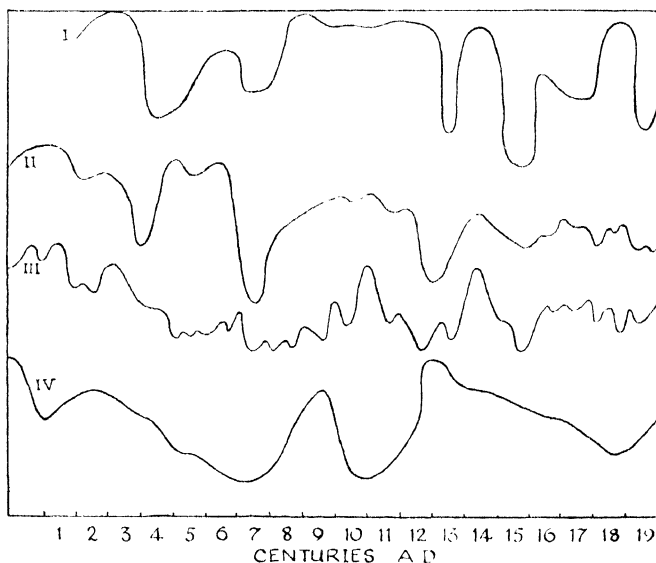


Fig. 3

THE CORRELATION BETWEEN INDICES OF
CLIMATIC FLUCTUATION AND CARAVAN
TRAFFIC IN THE NEAR EAST (AFTER HUN-
TINGTON AND GRANT)

- I. Caravan travel in Syria;
- II. Lakes and ruins in Asia;
- III. Growth of sequoia trees in California;
- IV. Climate and civilization in Ireland.

were growing more rapidly than usual, and in Europe the weather was unusually wet and stormy. These phenomena, if caused by a strengthening of the westerly winds in middle latitudes, would have been accompanied by heavier rainfall in the heart of Asia, thus providing a disincentive to nomadic migration. Some authorities have refused to be seduced by this theory that climatic changes have controlled migrations of peoples in the Old World. Sir Aurel Stein believed that the extension of agricultural settlement in central Asia before the third century A.D. was rendered possible by the power of the Chinese emperors, who ruled ably and had the means to conquer, administer and exploit the resources of the western approaches. Dr. C. P. Grant, who studied the history of caravan traffic across the Syrian Desert, drew a curve showing its fluctuations during the past 2000 years. Her own explanation of the rise and fall of trade between Mesopotamia and the Levant was purely historical. She believed that stable government in the Near East allowed caravan traffic to prosper, and *vice versa*, until the Great Age of Discovery and the shifting of routes from the land to the oceans. But Ellsworth Huntington boldly took her curve, set it against the sequoia curves and claimed that caravan traffic was controlled by climate. (Fig. 3.)

CHAPTER IV

ENVIRONMENT AND ECONOMY

A MORE comprehensive view of the human environment must now be taken. Until now, only the terms of its chief constituents have been given: configuration, climate, hydrography, soils, natural vegetation and animal life. For more systematic study, the aspects of the environmental complex may be divided into two main classes: first, configuration (including the outline and relief of the land) and, second, the hydrosphere, natural vegetation, soils and the fauna. The former is the result mainly of geological processes; the latter strongly reflect the pattern of terrestrial climates. (It must be remembered that complete sundering of the environmental complex cannot be achieved, *e.g.*, the courses of rivers are geologically controlled, whilst their volumes and régimes are an effect of climate. Moreover, climate is primarily the cause of minor features of relief. Nevertheless, the relative independence of crustal processes from atmospheric justifies this notion that, relatively, the environment is dualistic.)

To appreciate fully the nature of the land, it is best to scan a globe. If a globe is unavailable, a map showing the land and water hemispheres may be consulted, which is usually included in reference atlases. From such an inspection, it may be realized that, with the exception of Antarctica and certain scattered, small islands, the land areas of the world are contiguous. At the heart is the Old World. The New World is a long, curving appendage of the Old, only recently severed at the shallow Behring Straits. Australia is a second, smaller appendage, the intervening sea being dotted with the islands, large and small, of the East Indies and the Philippines. It is possible to cross the Behring Straits on the ice in the winter. During the Ice Age, as already related, when the sea-level was lower, early man could pass dry-shod from Asia to North America. During this period, also, Indo-China was joined by land to the nearer East

Indian islands, and New Guinea was united to Australia, although salt-water continued to flow around Celebes. The contiguity of the main land areas, then, has been relative rather than absolute; and has varied to a certain extent during the dispersion of mankind and the development of the human economy. The connection, or near-connection, of Asia and North America, ensured that man originally entered the latter continent from the north-west, and that the west of the Old World was isolated from the New World until recent times. Other features of configuration of first order are, first, the mountains and high plateaux in the interior of Asia, which attain their climax of height and ruggedness north and north-east of India, second, the massive plateau which is Africa, everywhere scarped within a hundred miles of the sea and almost without coastal articulation, third, the exceptional degree to which land and sea are interlocked in Europe, and, fourth, the profusion of islands in the western Pacific, including the island festoons of Japan, Micronesia and Melanesia, as well as the smaller and more scattered island-groups of Polynesia. The north, east and south of the Pacific are void of land.

Superimposed upon the land are the chief vegetation zones, reflecting the pattern of terrestrial climates. The tendency in the plant world is towards the evolution of associations in which trees are dominant, if the moisture available for the transpiration of such large organisms is available and there is a sufficiently long growing season. Drought, during the whole or part of the year, or a very long season which discourages growth, preclude

*Perpetual
Frost*

XI Permanent Ice and Snow

IX Tundra and

Alpine Flora

V Northern Coniferous
Forests

IV Temperate

Deciduous

Forests

III Sub-Tropical
Sclerophyllous
Forests

II Sub-Tropical
mainly Evergreen Forests

I Equatorial

Rain Forests

*High Temperature and
Heavy Rainfall*

*Perpetual
Drought*

X Desert

VIII Semi-Deserts
and Steppes

VII Temperate
Grasslands

VI Tropical
'Grasslands'

trees from becoming established, and grasslands, tundras, steppes or semi-deserts appear. The range of natural vegetation types, and their relationship to climate, may be demonstrated diagrammatically, as in the table above. The distribution of these types is shown in the vegetation maps of modern atlases, and the characteristics of each will now be briefly described.

I. *Equatorial Rain Forests*. The abundant moisture and high temperatures throughout the year enable tall trees, often attaining a height of 150 feet, to co-exist with a welter of climbing plants, especially lianas, epiphytes and in south-eastern Asia, bamboos. The dense canopy of foliage is perpetually renewing itself; the appearance of the forest is an unchanging evergreen; the interior is gloomy and impenetrable. But the profusion, variety and beauty of individual plants or trees, combined with the abundance of animal and insect life, which includes, especially, many surpassingly fascinating birds and butterflies, have captivated many naturalists, travellers and residents in countries close to the Equator. In India, Burma and Indo-China, the annual rainfall, though heavy, is seasonal, and occurs mainly between May and October. A dense forest, resembling that nearer the Equator, is in full foliage during these rainy months; but many trees and plants shed their leaves during the drier weather. This deciduous variant of the equatorial forest is as close-growing as the truly evergreen; but it can be penetrated more readily in dry weather, especially along the beds of the waterless rivers.

II. *Sub-tropical Rain Forests*. In latitudes close to the tropics, and in regions receiving an abundant rainfall, generally greater in summer than in winter, are forests closely resembling the equatorial, but somewhat less profuse and rapid of growth.

III. *Sub-tropical Evergreen Sclerophyllous Forests*. Especially in the lands surrounding the Mediterranean Sea, rainfall occurs during the winter half-year and the summer is dry. In midwinter, temperatures are low enough to check growth, and in midsummer the soil is very dry. Thus spring and autumn are

the two seasons favourable to growth: and in these rather peculiar conditions trees remain evergreen, but display many adaptations to enable them to withstand the heat and drought of summer, *e.g.*, small and hairy or wax-coated leaves. Around the Mediterranean, the olive tree, maritime pine and evergreen oak exhibit these characteristics, and are accompanied by many evergreen shrubs, by grasses and herbaceous or bulbous plants which accomplish the vegetative and flowering cycle during the autumn or spring. Similar forests occur in restricted areas in other continents where this somewhat uncommon type of climate recurs.

IV. *Temperate Deciduous Forests.* Where rainfall is adequate throughout the year, but growth is restricted by low temperatures in winter for from five to seven months, trees put forth new foliage and flowers each spring, shedding their canopies in the autumn. In their trunks and branches, annual growth rings are conspicuous, and the slow cycle of change during the year is a glory of temperate lands in which this type of forest flourishes. There are fewer species than in sub-tropical and tropical forests, undergrowth is more spare or even absent; and often single species, *e.g.*, the oak or beech, predominate to the exclusion of others.

V. *Northern Coniferous Forests.* Where the soil is moist throughout the year, but summer is very brief, the season of growth is too short to permit trees to renew their foliage annually. But the needle-like leaves of the evergreen conifers such as pines, firs and spruces can withstand frost. The number of species is even smaller than in temperate deciduous forests, growth is slow and trees are small. (For the sake of simplicity, certain coniferous forests which extend into regions where the growing season is longer, *e.g.*, in British Columbia and the north-west of the U.S.A., have been included in this type. Here the trees are larger and the growth denser.) The extensive stands of conifers in the northern continents are the world's chief source of "soft" timber.

VI. *Tropical 'Grasslands'.* This type is transitional between the forests of low latitudes and the grasslands of

middle latitudes. Though the temperature is high enough for growth throughout the year, there is only a short season when rainfall is adequate. Grasses, which renew their foliage at the onset of the rains, are associated with scattered trees in a kind of parkland. The trees are often deciduous and thorny, and if evergreen, are adapted to withstand drought, like those of Mediterranean lands.

VII. *Temperate Grasslands.* In temperate lands with light rainfall, growth is possible only in spring and early summer, when melted snow and rain combine to saturate the soil. In late summer and autumn the soil is dry, and in winter the temperature is too low to admit of growth. Grasses are supreme, and grow rapidly during the short, favourable season, but wither and die from June onwards. With them flourish many herbaceous plants and a few small bushes. The Russian steppe or Canadian Prairie is a bright and verdant sward in spring, a tawny waste of dried foliage in August and is snow-covered in winter.

VIII. *Semi-Deserts and Steppes.* Where rainfall is erratic and slight, yet temperature is adequate for growth for much or the whole of the year, vegetation is subjected to the harsh tyranny of drought. Plants are scattered and isolated; trees, bushes and shrubs are stunted and have restricted foliage, or possess strange water-storage adaptations like the cactus. There may be scattered, tufted grasses and ephemerals which grow rapidly, flower and seed after occasional rain.

IX. *Tundra, Sub-Alpine and Alpine Flora.* On high mountains, the shores of the Arctic Ocean and on certain islands close to Antarctica, the soil is frozen for most of the year, and only thaws to the depth of a few inches or a few feet during a very short warm season. Then, moisture is abundant, and indeed, where the land is low lying or gently sloping, the soil may be water-logged. Trees are absent, for their roots cannot penetrate deeply enough to enable them to withstand high winds. In many places, only mosses and lichens will grow; elsewhere, herbaceous plants bloom quickly in the short summer, and there may be a low growth of woody shrubs, like

the bilberry, and an abundance of grasses. On high mountains, between the upper limit of trees and the beginnings of permanent snow-fields, a very short growing season and high winds debar the growth of trees; apart from certain species which have adopted a creeping habit and thus keep their foliage close to the ground. Small shrubs, herbaceous plants and grasses abound, rather than mosses and lichens, and when these zones are free of snow, grazing animals are attracted thereto.

The constitution and fertility of the soil is closely related to climate and vegetation. Modern research has clearly shown that the agencies producing soil are a function of climate, and that in any region, if these processes are permitted to operate long enough, the general characteristic of the soil, *i.e.*, texture, chemical composition, nature of stratification (or the profile) will tend to uniformity whatever the nature of the rocks (or the parent material). In other words, physico-chemical and biological processes producing a soil vary according to the annual cycle of temperature and rainfall fluctuation. Broadly speaking, if temperature and rainfall are high, both soil-forming processes are accelerated. Rock material is more rapidly decomposed, and the soil ultimately contains much clay. Plant remains are rapidly reduced to inorganic substances by micro-organisms, whose activities are stimulated by heat and moisture. The soils of humid tropical and sub-tropical regions are accordingly deep and clayey, and do not contain much humus, *i.e.*, partly decomposed plant remains. Abundant soil water is constantly percolating downwards, and this leaches the soluble, inorganic substances which result from the final decomposition of plant remains, and which are essential for the growth of new plants. This is not serious whilst the natural vegetation is unaltered, because a perpetually growing forest makes a steady demand upon soil fertility, and can absorb the food being constantly liberated in the soil before it is leached away. But if man clears the original vegetation and plants a crop the situation alters. Disturbing the soil accelerates the work of micro-organisms, and the rainfall removes the final products quicker than ever. Both humus, and the soluble inorganic plant foods decrease. But the crop will probably require considerable

reserves of food, and may make heavy demands at a particular season. Reserves, however, do not accumulate in the soil. A tropical soil, cleared and cultivated, is a spendthrift without the reserves necessary to meet unexpected demands. For this reason, until soil-forming processes were better understood, European planters in tropical lands were often disappointed by the poor crops obtained on lands originally enveloped in rioting jungle. It accounts also for the poor returns to most native agriculture in tropical lands, and the frequency with which land has to be abandoned for a new clearing. Only by highly artificial means can fertility be increased to the extent required by heavily yielding crops, and suitable techniques have been devised and applied only in certain oriental societies and in small areas where Europeans have employed scientific methods to solve agricultural problems. For chemical reasons which need not be described here, the soils of humid tropical regions are commonly red in colour, and are usually known as *Tropical Red Soils*. Though capable of supporting rapidly growing, dense forests, they are not amenable to a simple and unspecialized permanent agriculture.

In many parts of the tropical 'grasslands', and in temperate grasslands, the activity of micro-organisms is restricted to a part of the year, when the soil is both moist and warm. Because of the much lower rainfall, leaching is much reduced, and thus both humus and soluble inorganic plant food remain in the soil. Indeed, in many soils of this class, there is an identifiable zone, from 1 to 6 feet below the surface marking the downward limit of percolation. The humus is all the more abundant by reason of the annual decay of dead grass, and is generally present to the extent of from three to fifteen per cent in the surface layers. This gives the soil a black or dark-brown colour, and has caused this important group of soils to be called the *Black Earths*, which include many sub-types in both the tropics and temperate latitudes. There is a large capital in the soil, equal to the demand by a crop at its season of most rapid growth. Comparatively simple agricultural techniques have been successful in providing large yields for long periods from these soils.

In the coniferous and deciduous forests of temperate

latitudes the more humid conditions lead to persistent leaching which is, however, less intense than in the humid tropics. The limited growth of coniferous forests, and the nature of the leaf-fall, leads to the formation of a thin, peaty layer near the surface, beneath which the soil is nearly devoid of plant food and is slightly acid. These pale soils are called *Podsols*. In temperate deciduous forests, the annual leaf-fall provides more humus, and the soils are generally brown. Neither type of soil is fertile when cultivated and sown with crops common in temperate lands; but the less intense leaching and the slower rate at which micro-organisms work enable the unfavourable characteristics to be remedied and a higher fertility to be maintained artificially by simple means.

The characteristics of certain major soil types in humid and sub-humid regions have been summarized here primarily to allow their agricultural potentialities to be appreciated. Other soils, *e.g.*, those of the tundra or of semi-arid and arid lands, from which agriculture is precluded by cold or aridity, have, for the sake of brevity, been ignored. We must now relate human economies to the terrestrial patterns of configuration, climate, vegetation and soils.

Hunting and Food Collecting Economies.

In a certain sense, the basic human need, for food, was satisfied from more diverse sources as man evolved from apes and spread across the earth. For he became omnivorous instead of vegetarian. He preyed upon the animal kingdom and plucked experimentally from every phylum among plants. The Australian aborigines afford a striking illustration of this intensive, intelligent quest throughout the living environment for sustenance and subsidiary human needs. It is remarkable what is edible in the "Dead Heart of Australia". The eggs of emus, crocodiles and tortoises; chrysalises and worms; caterpillars, grasshoppers, crickets, slugs and moths are all collected and consumed. Over 300 plants have been enumerated as sources of food, from their seeds, roots, bulbs, flowers, shoots, buds, leaves or fruits. Kangaroos, opossums, tortoises, frogs, rodents, snakes and many birds are killed and eaten. Fresh-water snails are gathered for sustenance. Tribes living

near the coast hunt certain species of whales, as well as sharks and other large fish. They also collect *mollusca*. The economy of the Guayakis, a primitive people living in South America, in the forests between the rivers Parana and Paraguay, is equally diversified. They hunt numerous birds and beasts with bow and arrow. Also, they gather the larvae of beetles which are parasitic to certain palms, with the pulp and flowers of another palm. They have also learned to pick sour oranges from the gardens of abandoned Jesuit colonies, and search for the aphrodisiacal honey of a wasp.

This diversity, whilst perhaps assuring a well-balanced diet, does not guarantee regular meals. Among such peoples, living mainly in warm climates, to whom food storage is impossible, lean and good times alternate. To days or weeks of abstinence succeed orgies and gluttony after good hunting. But this dietetic catholicity exists only where lack of knowledge (or lack of resources, as in the arid regions of Australia) prohibit a regular food supply. If a few species of game or fish abound, men become especially skilled in trapping, hunting or fishing, and invent specialized weapons. Thus the Eskimo of Greenland and northern Canada depend both for food and fuel in winter upon seals, which they kill at their breathing holes in the ice. In summer, herds of caribou are hunted by spear, bow and arrow. Salmon trout are also included in the summer fare, and berries are collected from the bushes of the tundra. The Plains Indians, living on the Prairies of North America before their dispossession by whites, collaborated in shepherding and slaughtering the bison. In northern Asia, some Mongoloid peoples chase the reindeer at one season, fish for salmon in the estuaries at another, hunt seals and walrus at a third, and during the rest of the year catch marine fish.

Among peoples now vanished from the earth, but whose mode of life has been revealed by archaeology, were the cave-dwellers of western Europe during the Aurignacian and Magdalenian periods of the upper Palaeolithic Age. Using bow, arrow and spear, these peoples obtained their food supplies by hunting the numerous beasts whose bones have been identified in the rubbish accumulated upon cave-floors, such as the mammoth, reindeer, bison, musk ox and wild horse. They

appear also to have fished for salmon in the enlarged rivers of that era. Several of these animals are fierce, large and aggressive. It may be inferred that the ability to kill such formidable quarry was rewarded by an alleviation in the incessant search for food which is the lot of primitive peoples dependent upon smaller animals and gathered vegetable produce. The frosty winter probably ensured a measure of natural cold storage, relieving the men from incessant hunting. It was perhaps during winter leisure, thus gained, that the remarkable cave-wall drawings were executed. The sedentary or semi-sedentary existence which was thus devised; the great range of implements which were fashioned from bone; the ritual and art which were practised all warn us, to use Dr. Gordon Childe's phrase "not to underrate the possibilities of food-gathering as a livelihood". All these peoples may be deemed Food Collectors, in contradistinction to those producing their food supplies. Most anthropologists regard peoples which hunt smaller animals and collect vegetable produce as socially less advanced than those depending upon a few species of animal and fish requiring specialized weapons and skill. The terms Lower Hunters and Higher Hunters have been introduced to emphasize this distinction; hunting being deemed to include gathering edible produce from the plant world.

No food-collecting people is free to wander at will. Men and women may travel widely in search of useful plants, and trudge great distances when hunting. But boundaries are always set to their movements. Each social group—generally a small number of parents and children—is confined to a precisely defined tract. To invade the territory of neighbours is an act which may lead to hostilities. The extent to which habitations may be fixed in location varies. Food-gathering peoples in tropical jungles may be constantly moving, having hardly any need for shelter. At times of heavy rain, they may spend a few minutes constructing a temporary shelter of small branches and large leaves or palm fronds. Alternatively, caves may be utilized during rainy seasons. Among the Veddahs of Ceylon, low lands near rivers, liable to flood during the rainy season, are then avoided, and the available territory is divided so that each group can resort to uplands where movement in the forest is

not restricted in wet weather. Peoples living in colder climates tend to live in one place during the winter, and huts may be occupied for several years. During the summer, a more migratory existence may be adopted, light tents being carried to provide shelter. Alternatively, a form of tent such as the *tipi* of the now vanished Plains Indians may be used throughout the year, and pitched in one place for several months during mid-winter. The large permanent Indian villages of the British Columbian coast, or the apparently permanent cave-dwellings of the Aurignacians, are exceptional.

It can hardly be said that a network of communications exists among food-collectors. Defined, well-beaten tracks can appear only when the population is numerous and sedentary. The search for food causes men and women to wander. They cannot keep to a trodden path. Locally, in hilly country, or where fords are few and far apart, the hunter may frequent the easiest way when returning from the kill. This may be deemed exceptional. The absence of paths or tracks in terrain occupied by primitive peoples—so often the subject of surprised comment by travellers—is no more than a consequence of the economy. Secondly, it is due to the sparsity of the population. The numbers of primitive peoples are very difficult to estimate, and no systematic study of population density in simple economies has ever been made. It has been stated that the hunters living in Britain during the upper Palaeolithic period could not have numbered more than a few hundreds. There are fewer than 100,000 Eskimo along the lengthy Arctic coast of Greenland, Canada and the Canadian archipelago. One person requires many square miles for his support.

Pastoralism.

Dependence upon a few species of animals foreshadows domestication. It is significant that in northern Europe and Asia are both hunters and herders of reindeer. Where exactly is the line of demarcation to be drawn? Many herbivorous animals are gregarious and show no fear of man, but rather, curiosity. In the past, groups of hunters may have followed herds of bison, or reindeer, or wild cattle, killing stragglers as meat was required. Separation of the more docile might follow, especially

of females with young, and the closest association of human beings and animals might result, for primitive man has no aversion from living with beasts. In ethnological writings, we may read of children being suckled by beasts. The story of Romulus being suckled by a she-wolf is thus not altogether incredible, and has significance for anthropology and human geography as well as for folk-lore and history. According to Peake, the aurochs, a species of wild ox widely distributed in eastern Europe during the period immediately after the Ice Age, gives birth to calves which are helpless at birth and cannot walk for some weeks. During this period the herd must remain stationary, and the young, it is thought, were concealed in thickets, which occur where the deciduous forest merges into the grasslands. Perhaps some hunters realized that, as an alternative to exterminating herds at these times when cows could not flee with their young, separation of female cattle with their calves might be achieved.

It is noteworthy that the number of fully domesticated animals has not been increased since prehistoric times, and that almost all are Old World species. We may keep other animals in captivity and even tame them, but often they do not reproduce, or do so fitfully. The tame elephants of India and Ceylon do not breed, and the supply must be maintained by capturing wild beasts from the jungle. But in Burma, at least some elephants in captivity can be conjured to reproduce themselves. Only primitive man, living with the beasts upon whom he came to depend, taught the ox, horse and sheep to do his bidding. It has been asserted that the power to domesticate now seems to be lost. Galton argued, not without cogency, that all the species capable of domestication had in fact been brought under human control. He believed that primitive man had experimented widely, and had achieved all that was possible in this field. In ancient Egypt, the gazelle and antelope were kept captive and were much admired. May we infer that some inherent quality prevented their domestication? On the other hand, we must remember that the caribou of north America is very closely related to the reindeer of Europe and Asia. One has been domesticated; the other has not. Why should not some of the antelopes of the African grassland be domesticated as

readily as the horse or goat? A greater variety of domestic animals would certainly enhance the productivity of the tropics. It can at least be argued that man has been somewhat selective in his choice for domestication, and that the present range of domesticated animals arises from a particular conjunction of circumstances among the societies of Europe and Asia at the close of the Ice Age. The rearing in captivity of fur-bearing animals such as the mink, chinchilla and silver fox is perhaps a renewal of domestication.

Agriculture.

It is equally difficult precisely to define the beginnings of agriculture. The Paiute Indians, living in the Great Basin of the U.S.A., gather, amongst many other products, bulbs and the seeds of grasses which grow close to stream beds. They do not cultivate or sow; but they build dams and divert water in simple channels to places where these plants grow abundantly, in order to increase the yield. Rice cultivation may have a similar origin. The two wild species from which cultivated varieties are derived grow in the hills north-east of India, especially in marshy valley bottoms. Scattering a few ears after gathering to ensure a fresh crop may have been the beginning of the oriental rice civilizations. The grasses of which the temperate cereals are members tend to grow closely in a suitable habitat and to scatter their ripe seeds in the autumn to perpetuate the species. Nature suggests to the children of Nature the notion of sowing. Thus, in the habits of wild species of animals, before domestication, and the manner of growth of certain *Graminae* we can visualize, archetypically, characteristics of herding and cropping as well as powerful influences upon human economies. For both before and after domestication, men became increasingly dependent upon a few species in order to gain an assured food supply, and a livelihood less arduous and uncertain than hunting, fishing and gathering wild plants.

But there is a long history between the beginnings of domestication and the wide dispersion and status of cultivated plants and reared animals. Cultivated rice or wheat, the dog, horse or pig exhibit morphological differences when compared

with their wild progenitors. Indeed, we do not know the species from which maize has been derived; and this ignorance is not unique. Biologists have pointed out that the wild equivalents of domesticated plants and animals reveal considerable variability. Wild wheats still remain a controversial subject in botany. But most authorities agree that cultivated varieties have originated from four or five species. Dogs and allied wild species have been diverging since the Eocene period. The genus *Canis* is one of thirteen or fourteen which are closely related, including the wolf, jackal and domesticated dog, each differentiated into several varieties. This polymorphism has contributed to success in domestication and dispersion, by promoting hybridization. It is certain that selection and breeding, by empirical methods, has been practised since man became a cultivator and herder. In western countries, in modern times, genetics has achieved astonishing feats in the spheres of both animal and plant breeding, and has greatly extended the natural range of, especially, plants. (Domesticated animals can, by their very nature, withstand a considerable climatic range.) Apart from the potentialities in breeding new varieties, man has over-leaped natural obstacles to dispersion. The pattern of terrestrial climates ensures that the same conjunction of temperature and rainfall régimes occur at widely separate points on the earth's surface. A tree of the equatorial forest, such as *Hevea brasiliensis* (the source of natural rubber) was confined to South America until the utility of its coagulated latex became apparent. Apart from human intervention, it could not extend its range into the regions climatically similar in central Africa and south-east Asia. It is common knowledge that for economic reasons the rubber tree is now mainly cultivated almost at the antipodes of its natural home. Food-collecting economies are accordingly limited by the natural range of useful species. The Plains Indians could only chase the bison where the bison naturally ranged. Control of the species was limited to the final stages of a collective hunt, when beasts were lured and frightened to a precipice. But the domestication of animals and plants has enabled man to widen the original distribution of selected species and frequently to replace a natural flora and fauna by one which is largely artificial.

The apparent limitation of man's power over the animal world contrasts with his continuing experiments in the cultivation of wild plants. The number of domesticated animals relatively, is fixed and the extension of their usefulness to man is confined to the creation of new breeds. These potentialities are considerable, as the history of stock-farming in western countries during the past two centuries bears witness. Great benefits may accrue by combining, for instance, the milk and meat yielding powers of European cattle with the disease-resistance of Indian or African breeds. Cultivated plants may not only be improved by selection and hybridization, but may be increased in number. Of this, the most remarkable modern example—the rubber tree—has already been cited; but the reports of tropical agricultural stations tell of many experiments with wild grasses and leguminous plants having as their objective the introduction of good artificial pastures and better crop rotations in hot, humid countries.

The number of domesticated species is extremely few, when compared with the profusion of the plant and animal kingdoms. There are several million animal species, including insects, but fewer than fifty are domesticated. There are more than 350,000 species of plants, of which more than 100,000 are algae, lichens and fungi, and of these, perhaps 3,500 are utilized in their wild state by primitive peoples, and, according to Vavilov, not more than 600 are cultivated. And of these relatively few species, perhaps twenty are of outstanding importance and have an extension throughout the continents, subject to the limitations of environmental requirements. Among cereals, there are wheat, barley, oats, rye, maize, rice and millet—the sevenfold staff of humanity—among roots, potato and manioc; among fibre-producing plants, cotton, flax, hemp and jute; among trees and bushes, the vine, olive, certain citrus fruits, the apple, tea, coffee, banana, bread-fruit, the coconut-palm, rubber and mulberry. Of animals, the dog, ox, horse, camel, sheep, goat and pig, with the domestic fowl, have accompanied the wanderings of mankind to the remotest parts of the world.

The domestication of animals does not necessarily lead to a settled mode of life. The majority of purely pastoral peoples are as nomadic as hunters, and, similarly, share their territories

between tribes and clans. Of such are the Beduin in Arabia or Syria, and the reindeer-herders of northern Europe and Asia. In many mountainous districts in the Old World, higher pastures are utilizable only in summer. Shepherds then drive their flocks to the summits, returning only when the winter snows have begun to fall. In the valleys, semi-permanent camps or even villages may be built. This seasonal migration was probably a habit of life of the sheep and goat before domestication. Among such peoples, we may also find the beginnings of a route system, for, especially in rugged terrain, cattle, horses and sheep are best driven along ways affording pasture, water and safety from predatory beasts, avoiding the steepest and most broken land. Thus originated the drove roads which have survived amid the works of more advanced economies where seasonal movements of flocks still persist, *e.g.*, in southern Europe and Central Asia. True urban settlements are as absent as true villages, but some pastoralists are grouped into tribes, which may assemble periodically in places sanctioned by custom.

It is not surprising that the majority of domesticated species, both plants and animals, were brought to their present subjection to man in the Old World, the first home of man and of civilization. In this, as in many other respects, the pattern and character of economies is still influenced by the conditions in which mankind evolved as a species. Botanists calculate that about twenty per cent of cultivated plants originated in the New World, and of domesticated animals only the alpaca, llama, the turkey and a species of dog.

If plants and animals were originally domesticated in isolation, they soon became associated. The most remarkable feature of the Neolithic Revolution was the appearance of numerous crops and domestic animals, together with houses, pottery, improved implements and other useful arts. Thus human societies and associated domesticated species have interacted. The migration of men has often resulted in the spread of a society with its useful animals and plants. At the same time, the original range of plants and animals from which the livelihood was derived has been enriched by exotics from afar, often potently modifying the older man—crop—animal

association. The introduction of maize, potato and the silkworm (with its source of nourishment, the mulberry tree) into Europe revolutionized the economies of whole regions.

The most important and complex association of cultivated plants and domesticated animals was created in the Levant. Here mountain, plain and plateaux; rainy, sub-humid and dry climates; cold and heat; forest, parkland and mountain pasture, steppe and desert are intermingled. The early civilized communities of Egypt, Mesopotamia, Asia Minor and the Aegean were based upon a series of domesticated animals and plants which were almost uniform throughout the region. Pigs, sheep, goats, two species of oxen, the dog and the ass were living with men in Neolithic times in Egypt. Two-row barley, flax and millet were grown. Later, after the history of Egypt had begun, cotton (from the south), wheat, radishes, lentils and peas were added, the last from Mesopotamia. From the eastern Mediterranean spread the vine, olive, fig and pomegranate; from Mesopotamia, the date-palm; from Arabia, the dromedary; from Persia, the camel; from Turan, the horse. Among smaller domestic animals and birds were the cat, duck, fowl, and pigeon. In Crete, during Minoan times, bees were kept.

It is remarkable how little was added to this assemblage of utilized species as first Neolithic and then Bronze Age cultures spread westwards into Europe. The remains of plants and domestic animals found in the Swiss lake-dwellings (c. 2700 B.C.) correspond closely with those of the much earlier settlements by the Nile and Euphrates. Some warmth-loving species, like the olive and almond could not leave the Mediterranean shores; but the temperate cereals and the domestic animals of Egypt and Mesopotamia were evidently introduced into Central Europe by movements of people and culture. Europe and the Levant form effectively a single unit, on the basis of the most important crops and domestic animals. There, are doubtless a few European additions to the original complex, *e.g.*, the parsnip and cabbage, with, possibly, rye; but these are small in significance by comparison with the great staples.

In the opposite direction, the Levantine complex of plants and animals spread across Central Asia, the cultivated plants being confined to the scattered oases where streams debouch

from the mountains and water limited tracts before being lost in arid wastes. Pastoralism is much more extensive, although the scanty pasture over many plateaux and enclosed basins compel men to wander widely. Before 3500 B.C. the cereals of the Levant were being grown in north-western India, and before 2000 B.C. in northern China.

But on the whole, in the Monsoon Lands, a quite distinct complex of crops and domestic animals is to be found. It is more apparent than in the Near East that there were separate foci of domestication, from which useful species spread under the direct agency of man until, by merging, the present association was attained. In northern China, in the basins of the Hoang-ho and the Yangtse-kiang, perhaps as early as the third millennium B.C., local wild plants began to be cultivated. Three species of millet, several of barley, two of buckwheat; the soya bean; certain species of bamboo; more numerous roots, tubers and vegetables, *e.g.*, aubergines, radishes, garlic and the Chinese cabbage; an oil-seed; the Chinese cinnamon and the sago-palm all seem to have been cultivated first in this region. From southern rather than northern China originated numerous citrus fruits and tea. But few domestic animals were kept. To the earliest stages of sedentary life in the Far East belong only the dog, duck and pig. It will be realized that this initial emphasis upon cultivation rather than animal husbandry has tended to persist in China and Japan.

In northern India, the wild rice of the jungle began to be cultivated in the alluvial plains (flooded as the monsoon rains swelled the rivers) with the aid of the buffalo ox. The principal species of wild dog is, according to some zoologists, native to India. The elephant has been semi-domesticated since the dawn of history: captured and trained to both martial and peaceful arts, but refusing to breed in captivity. Plants associated in cultivation with the dominant rice from the beginnings of settled life in India include the sugar-cane, the cucumber, a sorghum, several beans, citrus fruits, cotton, indigo, cassia, several varieties of pepper, and the black mulberry (with the silk-worm).

By the migration of rice into China soon after the beginnings of agriculture there, the two chief foci of domestication in the

Monsoon Lands were given a common basis. Rice also is the single staple in the alluvial valleys of the intermediate lands, commonly called Indo-China, and is widespread in the East Indies. From the shores of this island world, it seems likely that the coconut spread to the littoral of the mainland. In addition there are more than 500 wild species which can provide nutriment to men, including bamboos, citrus fruits and even cereals. None, properly, is cultivated; but it is often difficult to determine when a plant is wild and when domesticated, in a climate which causes plant life to proliferate, so that the fruit-bearing trees around their huts, upon which the natives depend, are often self-sown.

In America, as in the Far East, plants rather than animals were domesticated. The original area within which wild plants were cultivated was Mexico, central America and the western cordillera of South America as far as about latitude 40° S. Here, in the pre-Columbian age, and quite independently of the Old World, was cultivated a variety of plants quite equal in importance to those known to Neolithic peoples in the Levant so much earlier. Two basic food plants must first be recognized: maize and the potato. A wild species of the former has not been discovered, and the present cultivated varieties are thought to have arisen by hybridization in central America. By the Great Age of Discovery maize was cultivated from the Great Lakes to La Plata. The potato, however, originally a plant of the high Andes, was until the sixteenth century confined to the cool mountain zones of Peru, Ecuador and southern Colombia. Tobacco, most probably native to the dense tropical forests of eastern Peru and Bolivia, and doubtless originally cultivated there, had spread almost as widely as maize by the time Europeans set foot upon the shores of the Caribbean. The cacao (cocoa) tree was known both to the Aztecs and Mayas. The quinoa was grown in Peru for its seeds. The sweet potato, arrowroot and the manioc, all natives of South America, were important sources of food to the aborigines of the Andean region and the Antilles. Among the many fruit-bearing plants two—tomato and pineapple—were to acquire greatly increased significance. And the toiling masses under the Inca despotism forgot their hardships with the aid

of coca leaves, from a plant which grows wild on the eastern slopes of the Peruvian Andes. Jerusalem artichokes, vanilla, sea-island cotton, cayenne or Guinea pepper were also first cultivated by the peoples of the New World before Columbus crossed the Atlantic Ocean. The two domesticated mammals of South America—the llama and the alpaca—have already been mentioned. In addition, the peoples living between Mexico and Chile had domesticated a bird (*Meleagris gallapavo*) which, very confusingly, is known to us as the turkey.

Commonly, but not invariably, an agricultural economy is sedentary. The exceptions are all in warm climates, and may be related to the limited resources of plant food in most tropical soils. Some, but not all, non-sedentary cultivators have no domestic animals. Thus, the Boro, of the south-western Amazon basin, clear the equatorial forest, chiefly by burning in drier weather, to make room for large communal houses and to grow manioc, yams, sweet potatoes, pumpkins, beans, pine-apples, cocoa and tobacco. Meat is obtained chiefly by hunting, because no domestic animals are kept. But despite the effort required to make a clearing and settlement, occupation never lasts longer than a few years, when the soil is exhausted and the location may be known to hostile groups. Practising a similar economy are wild tribes in the mountains between Burma, Cambodia and south-west China. Unirrigated rice-growing is their husbandry, and they live in leaf or matting huts close to their temporary clearings, to protect their crop from wild animals when ripening. But they must move elsewhere after a few seasons. This shifting, nomadic agriculture reappears in Ceylon, under the name of *chena* cultivation, although very few communities depend entirely upon this precarious form of production. Generally the plantains and unirrigated rice are intended to supplement a meagre return from small patches of paddy (*i.e.*, irrigated rice).

Where settlement and the location of cultivation are impermanent, no system of communications can exist. Temporary tracks may be worn in the forest from the village to the nearest spring or watering place on a stream; but the rank growth of vegetation soon obliterates all traces when the group moves elsewhere. Equally with pure collectors, shifting culti-

vators are never numerous in relation to the territories they occupy. The Boro of the south-western Amazon basin number ten thousand, and live in about fifty settlements scattered in an area of five thousand square miles. The density of population is thus two per square mile.

Somewhat more elaborate is the traditional economy of the Bantu in southern Africa. Until the white penetration was far advanced, Bantu tribes used their land principally as common pasture for their large herds of hump-backed cattle. In addition, land was allocated in temporary private ownership for settlement and cultivation, whereon huts were erected, *kraals* constructed to protect cattle from nocturnal attack by wild beasts, and grains, chiefly millet and maize, were cultivated. But as soil became exhausted and the surroundings unhygienic, permission was sought of the chief to build huts anew and grow crops elsewhere. The area originally occupied thereupon relapsed into the common rough grazing. Here, again, neither settlement nor communications can be permanent, and population density is low.

But the majority of the world's agricultural peoples are sedentary and keep domestic animals. The earliest cultivators by the Nile lived in clusters of huts, built of reeds or sun-dried bricks. In many places the accumulation of rubbish and the rebuilding (after devastating wars) on old sites has dotted the alluvial plains with low, man-made eminences. Within these archæologists can identify, in sections, a series of strata from which objects representative of a long succession of cultures may be recovered. It has been proved that villages in southern Italy and Sicily have been continuously inhabited since the Bronze Age, though doubtless rebuilt many times. In England, many of our village names, which are corrupted Anglo-Saxon, tell us that farming has been practised without interruption for not less than fifteen hundred years. In southern France, near Toulouse, it has been proved that many communes (or parishes) coincide with Roman estates, and the villages therein perpetuate the clustering serfs' huts which stood close to *villae*. The same is true of the countless villages of India and China. They have been the dwelling-places of patient peasants from birth till death for from fifty to one hundred human generations.

TYPE	EXAMPLES	ECONOMY AND USE OF NATURAL RESOURCES
A. Most Primitive Hunters, Fishermen and Food-Gatherers.	Andamans, Fucigians, Semang, Sakai, Papuans, Bushmen, Pygmies, Australians, Lower Californian Indians.	Usually a wide range of fruits, nuts, eggs, insects, edible roots, shoots and shell-fish is collected. Smaller birds, mammals and reptiles may be hunted. No modification of natural vegetation or fauna. Pottery, weaving and use of metal often unknown. No trade. Sometimes 'silent barter' with neighbouring sedentary communities.
B. More Specialized Hunters and Fishermen.	Mostly in northern Canada, British Columbia and Alaska. Also include certain hill and jungle peoples in India and Indo-China. Fisher-folk of Malaya and E. Indies.	Food supply commonly from a few abundant species. Weapons, clothing, utensils and housing more elaborate than in Type A. Vegetation and fauna usually unaltered. In north America economies much modified in recent times by contact with Type H; and many groups live by commercial hunting and trapping, enabling skins to be exchanged for the necessities of life. Rare and especially sought-after animals reduced in numbers.
C. Pastoralists (Old World) (i) Sheep, Horse, Goat, Cattle or Camel Herders. (ii) Reindeer Herders	Tunguz, Kazacks, Kirghiz, Kalmuck, Mongols, Beduin, Kurds, Masai, Fulani.	Movements of herders dictated by the need of their animals for fresh pastures. Seasonal movements between summer and winter pastures common in Asia, <i>e.g.</i> , of reindeer herders between tundra (summer) and forest (winter), or of Kurds between mountain pastures (summer) and valleys (winter). Shelter generally provided by tents of skins, felt or wool. Household goods strictly limited and crafts few. Sometimes considerable exchange between pastoralists and neighbouring sedentary communities, <i>e.g.</i> , Beduins sell camels to buy grain, coffee, cloth and weapons. In semi-arid regions, vegetation may be altered and erosion accelerated. Forests may be burned to increase pasture. Goats are very effective in preventing regeneration.
D. Simple Cultivators.	Boro and other peoples of Amazonia; hill tribes in India and Indo-China.	Living mainly in warm forested regions, these peoples obtain much of their food by tilling temporary clearances with hoes or digging sticks. Cultivation usually combined with food-gathering and hunting smaller beasts. Domestic animals rare; textiles and pottery rudimentary; housing generally simple. Sometimes a little barter; but regular trade uncommon. After clearance and cultivation, soil is infertile and often erodes. The forest which supervenes takes a very long time to develop to full maturity, and may be cleared a second time before attaining this stage. Thus secondary forest is often widespread.

SOCIAL AND POLITICAL ORGANIZATION	CHARACTERISTICS OF LAND DIVISION AND SETTLEMENT	COMMUNICATIONS
Basic unit consists usually of a few families; and real government often virtually absent. In Australia a semblance of tribal organization existed.	Nomadism common because of the wide search to obtain food. Temporary shelters may be constructed of brushwood or leaves. Caves may be occupied in inclement weather. Limits to hunting and gathering grounds of group generally recognized. Population density very low; perhaps one person for 5-25 sq. miles.	Even tracks are usually lacking; and rivers are usually barriers rather than means of communication.
Groups living together may be as large as fifty families; but usually smaller. Tribes exist among some groups.	There may, rarely, be permanent villages (British Columbia); or permanent sites for winter camps (Eskimo). Seasonal migrations common. Limits to hunting and fishing grounds usually recognized. Population density not appreciably greater than for A.	Waterways—sea, river or lake — more important than land routes in North America. Sledge and snow shoes used in winter in both Eurasia and North America.
Social unit usually clan or group of several families; but associated with others in a tribe. Patriarchal rule and chieftainship common; but leaders defer to tribal opinion. Larger federations have existed, <i>e.g.</i>, among Mongols and Turks.	Limits to pastures of clans and tribes are generally known. Settlements among pure pastoralists are uncommon; the group moves on after a few days. In the Near East (Balkans, Anatolia, Kurdistan) some pastoralists have winter villages.	Tracks usually absent, since animals and their herders must range widely. Rivers are obstacles or watering places. In mountains sometimes definite tracks leading from winter to summer pastures.
Unit generally from five to twenty families. Tribal organization weak.	Both settlements and cultivated areas are impermanent; but there are usually recognized limits to movements of a group, to the land which it may cultivate, or over which it may hunt or collect.	Temporary tracks may be established near settlements; but no permanent system.

TYPE	EXAMPLES	ECONOMY AND USE OF NATURAL RESOURCES
E. More Advanced Cultivators.	Many African peoples (south of the Sahara). Also islanders of Pacific.	Hand tillage; but greater dependence upon crops. Domestic animals often important. After cultivation for a few seasons, land must be rested for many years. Forests generally destroyed near settlements, to be replaced by scrub, cultivated patches and rough grazing. In hilly regions, soil erosion often severe.
F. Sedentary Highland Cultivators of New World.	Most advanced peoples in New World at Great Age of Discovery: Aztecs, Incas, Chibchas, Quechuas.	Economy based upon maize, potato, quinoa and subsidiary crops. Only llama domesticated. Hill land terraced and dry lands irrigated. Much altered by European conquest, and the western cereals and domesticated animals have spread widely. Cultivated land permanently cleared of natural vegetation, <i>i.e.</i> , of forest, grassland or alpine flora. Much soil erosion, since occupied area is largely mountainous.
G. The Oriental Agrarian Civilizations.	India, Burma, Java, Siam, Cambodia, China, Japan.	The greater part of the population is supported by irrigated rice cultivation. In drier and cooler areas millet and western cereals important. Many other fruits, fibre-producing plants, oil seeds, leguminous plants, spices are grown. Plough cultivation universal; but domestic animals not numerous. Elaborate arts and crafts. Local and inter-regional trade. Important contribution to world trade. Industrialism developing. Original forests largely destroyed and replaced by cultivated land, rough grazing and scrub. Rice lands levelled, embanked, irrigated and cultivated so that fertility maintained or enhanced. But often severe soil erosion on rough grazing and scrub lands.
H. Occidental Economies.	Europe; Canada; U.S.A.; Brazil; Argentina; South Africa; Australia and smaller areas settled by European emigrants.	Basis in largely non-irrigated cultivation by plough, cultivation of 'western' cereals and rearing of domestic animals. Use of mechanical power in agriculture and industry widespread. Forests and grasslands largely replaced by cultivation. In sloping humid, and in semi-arid lands, plough cultivation and over-grazing has engendered severe soil erosion. In arid regions some very large-scale irrigation works have been established. In tropics, the plantation economy has been introduced. Mining, quarrying and exploitation of oil reserves has been increasingly intensive. Destructive inroads into northern coniferous forests for timber and pulp.

SOCIAL AND POLITICAL ORGANIZATION	CHARACTERISTICS OF LAND DIVISION AND SETTLEMENT	COMMUNICATIONS
Tribal government often well-developed.	Settlements either semi-permanent or permanent. Private property in land uncommon; but usufructory rights usually exist. Density of population may attain fifty per sq. mile; but generally five to fifteen per sq. mile. Some villages very large, and population numbers hundreds or even thousands.	Permanent tracks connect villages and lead to cultivated lands. Canoes and similar craft used on rivers and on the sea (Pacific).
Well-organized states had come into existence at the time of the European conquest.	Settlements permanent. Towns existed as well as villages. Village communities regulated details of agrarian life. Many now incorporated in large estates created by Spanish government. Population density ten to fifteen to the sq. mile.	A permanent system of tracks; and roads built along important routes.
Especially in India and China, this economy has sustained well-organized states for millennia.	In rice-growing areas, the rural population attains a density of 500 to 1500 to the sq. mile. Elsewhere the density is somewhat less. The village is the unit of settlement. Private ownership of land is general; sometimes by peasants; more commonly in large estates, <i>i.e.</i> , there is usually a land-owning class. Many towns and cities with large numbers of craftsmen and merchants. In great modern ports, industrialism has become rooted.	A permanent network of footpaths, bridle paths and made roads. Also railway system in India and Japan. Rivers (and in China, canals) are important; many cities are river ports. Coastwise shipping significant, especially in Far East.
Many well-organized states; and several powers with world interests, having hegemony over peoples in stages A to E.	Rural population generally less dense than in Type G. May be very sparse in purely pastoral areas; but cultivated lands generally support a population of from twenty-five to 100 to the sq. mile. Populations of many millions in industrial conurbations. Extremely complex patterns of settlement, both rural and urban. Private ownership of land usual, except in Russia.	A close network of made roads and railways almost universal. Inland waterways are subsidiary. Transoceanic commerce is an integral part of the economy.

No classification of economies can be wholly consistent, because the variety of human societies is such that some tribes or peoples may fail to conform exactly with the definition of any one type. The classification just formulated, of which the first five categories have already been described in the foregoing pages, is intended to demonstrate the several orders of relationship between societies and their environment. Types F-H will now be considered later. The distribution of each type at the Great Age of Discovery and today is depicted upon the end-papers.

Old World Economies.

Ex oriente lux—to Europeans civilization came from the East—from the Levant. Egypt and Mesopotamia gave birth to the first settled agricultural societies, the first towns, writing, the beginnings of science and the earliest systems of government. For perhaps a thousand years, these communities stood in lonely grandeur at the heart of the barbarian world; but in the third millennium B.C. men began to build cities in the Indus valley, and again, after a further millennial lapse, in the Hoang-ho basin of northern China. From these three original foci, the spread and development of Occidental, Indian and Chinese civilizations has resulted in a shift in the location of what is now the principal seat of each. Occidental civilization, from Graeco-Roman times, blossomed more abundantly along the shores of the Mediterranean Sea; and after the Middle Ages, in Western Europe. In India, after about 1000 B.C., the centres of population and culture moved to the middle Ganges basin; in China, somewhat later, to the immense and fertile basin of the Yangtse-kiang.

The greater mobility of the chief seat of occidental civilization has been matched by its wide diffusion not only in Europe and south-western Asia but also, since the Great Age of Discovery, in the New World and Australia. The Indian and Chinese civilizations have been geographically more static. The heart of each has remained in a fixed location for upwards of two thousand years, and the geographical range of each to Asia: the Indian to its own sub-continent, the Chinese to the Far East. None has been wholly independent of the others, for diffusion and inter-

change of ideas, techniques and products have been in progress from the beginning.

But it is first desirable to inquire whether the configuration and climate in this zone of ancient Old World civilizations offers the human race advantages and stimuli which are absent elsewhere. A map of the Old World discloses that a complex belt of high relief traverses the whole width of the land mass from Spain to Japan and Java, broadening eastwards, and attaining its greatest heights between India and China. Within this belt are to be found high mountain ranges (in places enclosing plateaux or plains), as well as confused mountainous *massifs* like the Balkans, Armenia or southern China. At either end, the land is frayed and fretted. The south China coast is a labyrinth of bays, inlets, straits and islets. At no great distance are the island festoons of Japan and the Philippines. Off the coasts of Indo-China are the half-submerged mountain ranges and crustal blocks of the East Indies. What is conventionally known as Europe lies at the western end of this medial highland zone across the Old World. Here the crust becomes highly articulated. Large 'continental' seas such as the Baltic, Mediterranean and Black Seas communicate with each other, and with the ocean, by narrow straits. These enclosed seas, especially the Mediterranean and the Baltic, contain many islands, and close to the Atlantic coast lies the British archipelago. In eastern Europe, the land surface is somewhat more expansive, though still embayed by the White Sea, the Gulf of Finland and the Sea of Azov.

For several reasons, there are emphatic, often harsh, climatic contrasts within this zone. In middle latitudes, the poleward decline of mean temperature is most rapid, a decrease which is due mainly to the severity of winter inland and northwards from the Mediterranean Sea, the Indian Ocean and the China Sea. This is partly a function of latitude and partly a consequence of the immense size of Asia. At this season, especially, it is not far from the mild Mediterranean coasts to the snowy plains of Hungary, or from the sub-tropical Shikoku to the frosts of Peking. The chilly winters of Madrid and Ankara are the outcome partly of altitude, and at the latter the harsh temperature differences between the Anatolian interior

and the southern coast is accentuated by a near-aridity induced by environing mountains. Not all the lands of early civilization have true winters. North China is the coldest; whereas Mesopotamia and northern India have a short cool season. But all have seasonal contrast, combined with considerable variability of wind and weather during the winter half year. India and China share the moderate to heavy summer rainfall of the Asiatic monsoon. Europe, likewise, is moistened by Atlantic rains. The Levant and Central Asia are, especially at low and middle altitudes, rather dry. But on the mountains rain and snow fall heavily, maintaining the flow of many great rivers which drain to the sea, inland lakes or marshy, salt-encrusted depressions.

In short, it may fairly be asserted that within this medial zone of the Old World local environmental contrasts are maximized. Configuration and climate, together cause land and sea, mountain, plateau and plain to mingle, and bring mild and severe seasons, heat and cold, drought and humidity in juxtaposition. Moreover, especially in south-western Asia, the lack of forests on the lowlands and plateaux rendered human intercourse the easier in early times. All the original foci of civilization were located in lowlands within this zone.

To the north and south, local environmental contrasts diminish. From the Ural mountains to the Sea of Okhotsk extends a tremendous lowland, blanketed by coniferous forests and drained northwards by sluggish rivers to a frozen sea. Throughout, the winter is long and severe. There is only difference of degree—none of kind. The farther north we go, the shorter and cooler is the summer.

Africa's nature is different. A massive plateau, extending widely on either side of the Equator, it exhibits a range of climates from the humid heat of low latitudes to the torrid deserts of the Sahara and the Kalahari. But local contrast is lacking, just as its massive build eliminates coastal irregularity. The Sahara, moreover, is not only hot throughout the year (except along its northern margin), but is of much more uniform relief than south-western Asia. Having no great mountain ranges to serve as catchment areas of rainfall, it is void of permanently flowing streams. And generally, in the

more humid and fully tropical parts of the continent, each type of natural vegetation extends unrelieved over great areas, before merging gradually into the next. Climatically everywhere hot, and having only regional variations in seasonal rainfall, Africa lacks the local environmental contrasts of the lands to the north-east.

In the medial zone of the Old World, there must have been a considerable range of economies before the dawn of civilization. The hunters and food-gatherers of Mediterranean coastlands fared differently from those of central Europe. The forests of central China offered a greater variety both of plants and animals than the open plains of northern China. But the potentialities for exchange remain largely latent when society is nomadic. Trade demands settled populations and fixed bases. But after animals had been domesticated, and the first agricultural communities established, regular intercourse increased. Movement is easier over unforested than in forested country. There are many passes in the mountains of Anatolia and Iran. It is notable that the first large states, *i.e.*, the first to bring extensive territories under a single authority, in Persia, Anatolia (the Hittite) and Assyria, were created in these largely open regions. It is unnecessary to emphasize that without regular communications, a state cannot exist. There is no marked tendency to trade between nomadic pastoralists—more than between nomadic hunters—but there is between pastoralists and settled agriculturists. What is important in the geography of south-western Asia is not the character and location of the lands which were the first seats of civilization, in Egypt and Mesopotamia, but that the requirements of settled agriculture, based upon irrigation, exist at many places at the foot of the mountain ranges. The piedmont oasis, watered by rivers descending from high mountains, is a dominant feature in the geography. Thus not only could exchange develop between settled and nomadic peoples, but trade could be promoted between very distant places, thanks to the revictualling possible *en route*. It is significant that Islam—the religion of the dry lands—enjoins pilgrimage as a primary obligation of the Faithful.

A permanent cropping has always been conjoined with an

animal husbandry in the Levant and south-western Asia. The produce of animals has not only been consumed to supplement the yield from crops; but animals have been employed to lighten human toil. The earliest pictorial representations of Egyptian agriculture reveal the ox-drawn plough performing the heaviest tasks of cultivation; and it was already a tradition in Old Testament times that "the ox treadeth out the corn".

The advances in polity accompanying the rise of irrigated agriculture in Egypt and Mesopotamia were doubtless fostered by the need for a determinate authority to construct and maintain irrigation works. The lay-out of ditches and the construction of embankments—essentially works of civil engineering—necessitate calculation, for the successful irrigator must know how large a ditch is needed to irrigate a specified area of land. Where land is permanently cultivated, inheritance, judicial process and taxation demand survey and mensuration. Mechanics, mathematics and government based upon written law and procedure accordingly had their origins in the riverine civilizations of the Near East, and astronomy in the need for an accurate calendar to regulate the annual cycle of agricultural operations when it was realized that greater efficiency could be assured by correctly anticipating the annual flood. The ease with which stars, planets, the sun and moon can be observed in almost cloudless regions—perhaps combined with the fact that in Mesopotamia it is pleasanter to spend the night out of doors than indoors in summer—contributed to the birth of astronomy. With the need for the civil functions of government were also combined the military; for the crops of sedentary peoples are readily raided by marauding pastoralists or hunters. Internecine warfare between the separate villages of cultivators in Egypt and Mesopotamia preceded a unification in the former from within, and imposed upon the latter from without. We do not know—and can only suspect—that dissensions regarding the use of water and land may have fomented internal hostilities. Alternatively, the vision of a more populous, united Egypt or Sumeria, through the exercise of a single control over land and water—may have fired the ambitions of the first kings over these lands.

Thus we can visualize the origin of agriculture in the

stimulus provided by the desiccation of south-western Asia (c. 3); but its early association with animal husbandry, and its spread to India and China were facilitated by the ease of movement along the foot of mountain ranges, conveniently provided with piedmont oases. The advances in the arts, including the discovery and applications of metal-working, again reflect the advantages of geological and climatic variety, in enhancing both crustal and biological resources.

The later evolution of the Old World civilizations by mutual exchange and better utilization of natural resources can only be sketched. At the outset, in the Indus valley and northern China the 'western cereals'—wheat and barley, especially—were dominant. But the adoption, from tropical forests, of an entirely novel range of cultivated plants enabled a distinctive economy to be elaborated, based to a great extent upon irrigated rice cultivation. But the evolution of this economy was complete two thousand years ago; and it has since been static (until the impact of the Industrial Revolution within the last century). A slow colonization has augmented population so that half the world's population is now aggregated in India, the Far East and south-eastern Asia. In its capacity to sustain mere numbers, the cultivation of rice in warm or hot climates upon irrigated alluvial plains, is without an equal. Its success has circumscribed the outlook and policies of the rulers of India and China. They have not needed to look over the oceans for new lands and new sources of trade; until recently, they had ample room within their borders, and a variety of produce which others sought, but which they had no desire to augment. In Japan, however, extreme pressure of population upon resources was, after 1890, a motive for a career of maritime expansion.

The Occidental Economy.

Compared with India and China, the occidental civilization, whilst still confined to the Old World, exhibited greater diversity of economy—due to the intensive utilization of more varied regions—more vigorous and persistent internal evolution and a tendency to territorial expansion which, in the past three centuries has changed the geography of the world. But in western and central Europe, civilization was slow to take root.

In its latest and most characteristic phase, it has established itself in environments, such as the cool temperate deciduous forest and the temperate grasslands, which previously had not proved adequate for populous, complex communities. Until the end of the Middle Ages, the thin population of these regions north of the Alps was backward compared with the ancient riverine communities of the Near East and the Mediterranean coastlands. The older and most fundamental elements of the western economy were introduced to Europe from the Levant. Not till the Neolithic Revolution had been completed, and the cultivation of temperate cereals, the rearing of the ox, sheep and goat, the manufacture of pottery, weaving and building were well established in Egypt and Mesopotamia did small villages of settlers begin to appear on the shores of the Mediterranean and sporadically along the middle Danube, in France and Britain, superseding the long-practised Mesolithic hunting and collecting. Later, when bronze and other metals were being worked, and the villages by the Euphrates and Nile grew into cities, conditions of living changed but slowly in the West. Till society became much more developed in Mediterranean lands, and later in many parts of central and western Europe, cropping was limited, domestic animals were of equal importance, and hunting remained a necessary source of sustenance. When population was extremely small and sparse, cattle and sheep could browse widely for suitable herbage in the forested terrain, finding grass in glades and where, on heathy land, trees grew less readily. Cultivation, for long, was in temporary clearings where undergrowth was destroyed by burning and trees killed by ringing. But the removal of close-growing oak trees was for long unachievable. Thus the elements of sedentary life, although known from intercourse with the Near East (especially by reason of the search for bronze, tin and gold which was widely prosecuted after the utility of these metals had been demonstrated), could not be effectively applied in the West, and productivity was lower. Mesopotamia and Egypt were advantaged by the conjunction of alluvial plains with an annual summer flood. The latter renewed fertility and enabled irrigation to be practised without the aid of elaborate mechanical devices or large works of civil engineering. Thus the effort to

clear reeds and, perhaps, some timber, was justified, because the land was not only extremely productive; but it retained its fertility by a non-human agency. In the forested lands to the west, not only was the land more difficult to clear, but cultivation brought a smaller return and could not be permanent. In short, knowledge of cereal cultivation, alone, could not enable the peoples of Europe to equal in production those of the Levant. Means to conquer the forest, to enhance and maintain the fertility of the soil were also needed. These requirements were not satisfied till much later.

The use of iron, probably first discovered by the Hittites in Asia Minor about 1500 B.C. soon spread widely in the Levant. This metal, and the domestication of the horse, caused turmoil throughout the Levant and the grasslands of eastern Europe. By 1000 B.C. Aryan-speaking peoples were over-running the forested lands of Europe, and were infiltrating into Italy and Greece. By 900 B.C. extensive iron-working was going on in the Alps at Hallstadt. The scale of the operations reveals clearly that weapons and tools were more readily available than in the Bronze Age, for iron is a commoner ore than copper or tin, and, when properly treated, is more durable. Tools to fell trees and grub roots were now readily obtained. Thus it was towards the end of the first millennium B.C., during the spread of the La Tène or Iron Age B culture in western and central Europe that considerable inroads were made into the dense oak forest, to provide cultivated lands around fairly large villages, which were often surrounded by an earthen bank and stockade.

Meanwhile, important developments had been going on in Mediterranean lands. The keeled ship, known in Mesopotamia about 3000 B.C., was introduced to the Inland Sea, where, at first plied by oars and fitted with a small square sail, it served the purposes of maritime trade between Crete, Hissarlik (or Troy, on the Dardanelles), Egypt and Syria. About 2400 B.C., as the search for bronze intensified, sea-going ships sailed regularly not only in the western Mediterranean, but also along the Atlantic shores of Spain and France, to link Britain to the Continent. Thus for more than 4000 years, maritime trade has been the warp in the fabric of the western economy. Now water

transport is the most economical way to carry persons and goods. It may not be the speediest; but it costs less per ton-mile. This relative cheapness has been maintained since the Industrial Revolution, for the steamship is cheaper than the train. (This fact is the secret of sea-power, in the military sense. It enables armies to be sustained at distances far greater from a base than is possible when communications run across lands.)

The Nile was the highway of Egypt; the Tigris and Euphrates of Mesopotamia. The great cities of India were built on or near the banks of the navigable Ganges, and in China, as the basin of the Yangtse-kiang was cleared and settled, and the value of this great system of inland waterways appreciated, towns began to cluster at every confluence and significant bend. To extend the benefits of water transport, the Chinese emperors built the Grand Canal across the Great Plain. But river and canal navigation is very different from sailing the seas. Although ships did set sail from India, it remains true that maritime commerce with that great country has largely been developed from without. The Chinese ventured farther, and junks sailed freely to Japan, Korea and the East Indies; but the amplitude of internal resources rendered it unnecessary to devote great effort to the sea. But in Europe, from the beginning, there were cities and even states which were entirely dependent upon sea-borne intercourse. They redoubled the advantages already existing in the intense environmental contrasts. The Phœnician cities of Tyre and Sidon, built upon rocky islands or peninsulas, and Crete in Minoan times (though this island is large enough to have provided food for the small population of those days), may be regarded as the earliest examples. Later, the cities of the Greek homeland, notably Athens, intensifying trade with the colonies scattered along the littorals of the Mediterranean and Black Seas, discovered that the amount of food which could be produced from the very restricted cultivable land on that mountainous peninsula was insufficient for their population. A mercantile relationship, similar to that subsisting between Britain and her overseas empire since about 1850, was accordingly developed. Athens imported grain from the Black Sea colonies and North Africa, dispatching in return 'manufactured' goods, such as cloth and fine metal work, produced by

numerous slaves huddled in the city's workshops. Rome, when the imperial system reached its zenith, unified the Mediterranean lands. The main shipping routes were as arterial in their function as the roads. Rome imported grain from Egypt, North Africa, France and Spain to feed its swarming population. No counter-balancing return flow of goods was provided, for Rome supplied 'invisible exports' in the form of government and defence.

Equally important were the advances in agricultural economy during the classical civilization. The early Greeks were pastoralists rather than cultivators (to judge from the allusions in the epic poems of Homer), and the small-scale farming of Latium was but a prototype of later systems. In the Mediterranean lands, extensive ground is rare, and much hilly ground must be tilled. The soil is rarely fertile, so that the problems both of erosion and the maintenance of fertility are pressing. As population increased, any form of shifting cultivation became impracticable. The solution was discovered in the combination of trees and shrubs with field crops; in terracing slopes; in the use of leguminous crops, and in fallowing. Thus the Mediterranean economy was perfected. The knowledge and methods of organization thus established have remained in the European tradition. Among the most useful trees native to the evergreen sclerophyllous forest is the olive, which bears a dark-green fruit rich in edible oil. It flourishes on rocky slopes (for its roots abhor stagnant water) and is such a valuable source of food that there are few places from which it is absent. Where, on sloping land well-mantled with soil, it is accompanied by other crops, stone retaining walls are commonly built to prevent erosion and to allow the land to be levelled for cultivation. Then the vine may be trained over the dry-stone walls, and grain sown on the terraces between the olive trees, whose sparse shade does not inhibit growth beneath. In viticulture, and in the cultivation of the almond and other fruits, pruning, fertilizing and selection as the basis of improved varieties was understood. Thus horticulture was wedded to agriculture. To preserve soil fertility when cropping was continuous, leguminous crops, such as beans, clover or lucerne, were alternated with wheat or barley. Or again, the land might be

fallowed for a year, and used for pasture, where sheep could find nourishment during the colder season, before ascending the mountains to their summer grazing lands. Their droppings, and humus derived from the decay of grasses and other annuals when the land was again ploughed, renewed fertility, and grain could again be sown successfully. New agrarian institutions accompanied these technical advances, enabling agricultural production to satisfy the needs of the Roman economy. In southern Italy, the peasantry was displaced, and large estates created by amalgamating farms, which were operated as units by a slave-labour force, chiefly for grain production. This institution, modified in the course of centuries, has persisted until today. South of Rome, the land is still largely held in great estates called *latifundia*. In southern France, Roman legionaries were granted land to clear and cultivate by the labour of servile Gauls. It is known that many parishes in Gascony correspond with Roman estates, and the villages to the *villae* of labourers' hutments. Here, at the French Revolution, the large estates were broken up, and the agricultural unit again became the peasant holding. In the Mediterranean lands in classical times, then, a monoculture in large units of land holding became firmly established, to provide bulk supplies of a uniform product which was handled by a large-scale commercial organization. It co-existed with the smaller holding, where a greater variety of crops was grown, large for subsistence, but also to provide small saleable surpluses of olive oil, wine, grain and animal products. Such smaller holdings have in the course of time evolved into the *métayage* tenure, which is common today in Italy and is slowly disappearing from the *Midi* of France. This, in its simplest form, is a co-partnership between 'owner', who provides land, fixed and moveable capital and seed, and 'farmer' who provides labour and stock in return for a share of the produce. From Roman times till today, the Mediterranean husbandry has persisted, essentially unchanged. It is a combination of grain growing, horticulture and silviculture, symbolized by the three principal economic plants—wheat, the vine and the olive. Stock rearing is subordinate, for the fierce heat and drought of summer parch all pastures. Cattle are not numerous. Goats and sheep are more common, for they

can walk far for fodder without suffering. The former, under the control of a goatherd, browse in the scrub which has replaced the original forest, and, in collaboration with the fire-wood cutter and the charcoal-burner, prevent regeneration of the original vegetation. Sheep, in large flocks, alternate between high mountain pastures in summer and fallow land or coastal marshes in winter. The large estate, operated at first by slaves, later by serfs and nowadays by paid but landless labourers, has widely persisted as the unit of agrarian production; but smaller units, often accompanied by share-cropping, are common. Commerce and political organization have long sustained a rich urban life. To the Greeks and Romans, civilization was synonymous with life in cities.

Whilst this economy was reaching its maturity, during the most halcyon days of Rome, the forests of central and western Europe were little changed. The Gauls, the Teutonic tribes of Germany, the Britons, the Slavonic tribes farther east were scattered in small communities, each isolated from its neighbour by uncleared woodland. Only their tribal, fortified capitals approached in size the status of towns. In the general scattering of population through forested country, these peoples resembled many African tribes before the European penetration of that continent in the nineteenth century. It should not be supposed that the woodland was untouched, although it was largely uncleared. Iron had been known for nearly a thousand years, and timber could thus be used for building huts, making stockades and implements. But these peoples were pastoralists and hunters. Grain they grew only in patches, in partial clearings. Where Roman colonists had established *villae*, in France and southern Britain, more effective clearance was undertaken, and regular cropping, based upon the use of leguminous crops, manure and fallowing, was practised, together with an animal husbandry. But in the turmoil and migrations of peoples from Germany which followed the breakdown of the Empire, the *villae* were destroyed. In France, some survived, to continue the tradition of a rational husbandry; but the forests regained their hold upon many Roman clearings. The renewal of felling, and the final conquest of the forest, was the achievement of the Teutonic peoples who settled in northern

France, Britain and western Germany. Before the Imperial defences were breached along the Rhine, the Teutonic tribes had become very numerous, and had been admitted as settlers in eastern France. The cattle-rearing and hunting economy was failing; and more attention had to be given to grain growing, in a region where soils are frequently wet and heavy, and of only moderate fertility. Realizing that adequate cultivation is the key to a good crop, the Germanic peoples used a larger and more robust plough, which, however, required a team of oxen—usually four—to draw it through the soil. The oxen required guiding—and doubtless goading—and the clumsy plough needed one or two men to keep it in its path. Ploughing thus became a co-operative effort. Four men, each contributing an ox, commonly worked together in England in Anglo-Saxon times. Permanent villages became established, and the land around was divided into the open fields and strips which have so often been described by writers on mediaeval history. As population increased, the fields were extended, and the forest gradually cleared. But not till the end of the Middle Ages was the conquest completed. On the open fields, a two- or three-course rotation was practised, comprising a winter crop (grain), a spring crop (grain or a leguminous crop) and fallow. The fallow period, during which cattle and sheep were pastured on the arable land, enabled fertility to be restored. In eastern France and western Germany, the distribution of land in strips around the village has persisted until today, although co-operative ploughing has ceased, since the adoption of horse traction and more efficient types of ploughs, harrows and drills. In England, surviving open fields were abolished during the Agrarian Revolution, and enclosed fields, grouped in farms, were substituted. But compact villages remain in the Midlands to remind of the now-vanished open fields communities of which they were the nuclei. The enclosure movement in England was not the only changing element in the older agrarian economy, for there is great diversity in rural settlements, the manner of holding land and the products now being raised from the land. Fundamentally, however, the farming of western and central Europe combines animal husbandry (the rearing of cattle, sheep and pigs) with cultivation of the land, to produce crops of the

western bread grains (wheat, barley, oats and rye), augmented more recently by new leguminous fodder crops, maize and root crops, especially the potato and sugar-beet.

The clearance of the temperate deciduous forest and the substitution of an agrarian economy in place of hunting, simple pastoralism and shifting agriculture was accomplished by a small but slowly growing population. Notwithstanding the technical improvements which promoted forest clearance, the yield of grain, in a cool, temperate climate, was small and uncertain; of animal products likewise. Famine was not infrequent, and social customs, including the celibacy of religious orders and late marriages ensured that natural increase would be very slow. War and pestilence, *e.g.*, the Black Death of 1348, not once, but several times left villages empty and fields untilled. Labour was accordingly scarce, and the introduction of serfdom appears to have had its origin partly in the determination of the ruling classes to use the population to the best advantage. But there was an incentive to economize labour and animals, which found expression in the renewal of invention. The water-mill was beginning to be used in Mediterranean lands about the time the Roman Empire began to totter, although it is not known where this device originated. But during the early Middle Ages, the water-mill was introduced throughout western and central Europe. It was, in fact, an integral part of the Feudal System, since mills were generally owned by the lord of the manor, who received a proportion of the flour as a part of his dues. The dam, race and mill-wheel—first extensively applied to the rivers and streams of Europe—enabled the first step to be taken in utilizing the forces and resources of nature to provide motive power. Previously—apart from the propulsion of ships by wind—power for locomotion, for the potter's wheel, for the implements and processes of all crafts, had to be provided by men or animals.

But in the plains and marshes of western Europe, stream gradients were insufficient to enable water-wheels to operate. New invention was again promoted. Windmills began to appear in Germany and Holland during the thirteenth century, whence they were introduced into England and France. The windmill is to be associated with a unique enterprise begun by European peoples towards the end of the Dark Ages. The art of embanking

low-lying lands, in order to control the application of water to crops, had been known throughout the Roman Empire, the source of the knowledge being the Levant. Small areas of the Fens, in eastern England, are known to have been embanked and drained by the Romans. For in these cooler latitudes, the removal of excess water is desirable: not the application of water to remedy deficiency in the soil due to irregular rainfall or the shortness of the flood-season. Early in the Middle Ages, riverine lands were widely drained in western Europe, mainly to provide meadow, which could be mown to provide for the nourishment of cattle in winter. In Holland, where the littoral is below high-water level, and the flood level of rivers, highly fertile land can be used both for meadow and cropping if embanked and ditched, provided that rainfall and seepage can be pumped away. The windmill and the pump can achieve this, and the technique was perfected in Holland towards the close of the Middle Ages. Other inventions paved the way for the expansion of European peoples and the later technological advances. In the fourteenth century, Roger Bacon invented gunpowder, enabling the cannon, and later the musket, to transform warfare. Printing caused ideas to ferment. The mariner's compass and improvements in ship design, first introduced by the Portuguese, at length brought the western European peoples to the beginnings of their trans-oceanic expansion.

The Portuguese, Spanish, English, French and Dutch mariners who crossed the Atlantic and circumnavigated the Cape of Good Hope from 1492 onwards were not the first ocean navigators. The Viking ships had been sailed and rowed to Iceland, Greenland and 'Vinland' five centuries earlier. The Malays had crossed the Indian Ocean and the large canoes of Polynesian peoples had been extending the bounds of human settlement in the island-world of the Pacific. The western European maritime nations differed from their predecessors—who used the oceans as a means of migration—in their intention and power to establish and maintain commercial and political connections between metropolitan countries and those which were newly discovered or newly attainable by sailing across the oceans. After the example of Rome and Venice,

which had bound scattered dependencies to the seat of authority by sea routes, Portugal sought to create an Empire on the shores of the Indian Ocean, and Spain on the western shores of the Atlantic. The rivalry of other western European peoples caused these exclusive schemes to break down, and the New World, Africa, Australia and parts of south-eastern Asia are now largely divided between dependencies of western European countries, and countries which were dependent for a time before severing their connections with the original European metropolitan power. The decadence of the older world powers—inspired by the example of Rome—has been succeeded by the birth of the British Commonwealth, in which independent nations are freely associated, and which perhaps owes more in inspiration to Greece than to Rome.

Western European powers, in rivalry with each other, were nevertheless engaged in similar objectives. They were realizing the potential value of their situation at the centre of the land hemisphere, where products from all the continents could be assembled. Transshipment across the isthmus of Panama began in the early years of Spanish rule. Later, railways and the Panama Canal have rendered more effective the commercial ties between the eastern Pacific coastlands and western Europe. The Suez Canal performs the same function for the Indian Ocean. A reciprocal relationship has been elaborated between Europe and trans-oceanic territories. From Europe, colonists have implanted both the material and non-material elements of western culture in the Americas, Africa and Australia. Europe itself has received new products, and its own economy has been transformed by the introduction of new plants and the demand for manufactured goods by oversea traders and colonists.

To attain a correct perspective in viewing this matter, it is desirable to consider the reception of new plants into Europe both before and after the Great Age of Discovery, and to compare the effect of these introductions in Europe with the less potent results of comparable innovations in the Monsoon lands. Before the sixteenth century, European agriculture was still fundamentally based upon the plants and animals first domesticated in the Near East in prehistoric times. It had

received, however, certain additions, none of which profoundly altered the general characteristics of the European economy, through the mediumship of regular trade between the ancient West and East. Reciprocally, it contributed to the range of products obtainable in the East, without revolutionizing the economy in the Monsoon lands. Tradition associates with the name of an ambassador who journeyed from China to the Levant in the second century B.C. the introduction into China of beans, lucerne, saffron, sesame, walnut, peas, spinach, and water-melon. None of these plants, however, revolutionized the agrarian economy of the Far East. Since before the dawn of history, wheat, millet and soya bean have remained the staple of northern China, as rice, tea, cotton and the mulberry are of the centre and south. The same is true for the greater part of India, where the character of agriculture has not changed around its countless villages from time immemorial. This agrarian stability has been maintained even since the Great Age of Discovery and the penetration of both countries from their sea coasts. It is consonant with the social and cultural conservatism of India and China, where the laws of Manu and the ethics of Confucius are as adequate a guide to conduct as when first given forth. The merchants, soldiers and administrators from the West have wrought in the Monsoon lands, but they have not changed the association of crops and animals forming the rural economy. Two or three new crops, displacing rice or millet over large areas, or an enlargement of animal husbandry, might change the East. In the vast expanse of traditional agriculture, the tea and coffee plantations of India, or, it may be added, modern industrialism, are inconspicuous.

In Europe, and at many places in other continents (except Asia), the appearance of new domestic animals and cultivated plants has profoundly altered the economy and has contributed to social change. In the Mediterranean lands of Europe, rice, citrus fruits, the mulberry and sugar-cane, all introduced from the Monsoon lands in classical times, were important additions to the older cultivated plants. Tobacco has arrived more recently. North of the Alps, since A.D. 1500, maize and the potato have spread widely. Contributing more substantially to basic foodstuffs than the plants earlier brought to the Mediter-

anean, these two prolific sources of carbohydrates have, concomitantly, profoundly modified the agrarian life of many countries in western and central Europe. Maize is now grown from north-western Spain to the mouth of the Danube. In the fertile plains of the Garonne, northern Italy, the middle Danube and Wallachia it is as important as wheat. In the valleys and mountain-girt basins of the Balkans it is the basic cereal.

Professor Deffontaines has shown how, in the lowlands between Bordeaux and Toulouse, the adoption of maize revolutionized the rural economy.

“Maize took the place of corn in the diet of the peasant. It is difficult to ascertain when it was introduced . . . but it only acquired importance from the beginning of the 18th century. The success of maize was entirely due to the small man. Considered as a fodder, it was not subject to the *dîme*, nor did it enter into *métayage* leases; it was acceptable to all. . . . Its yield in grain was greater than that of corn—more than three times greater: in all, thanks to rapid ripening after the growing period lasting only 70–80 days, it did not occupy the land so long. . . . Moreover, it became the cleaning crop *par excellence*; the ‘strong lands’, which were difficult to crop because the fertility encouraged weeds, were completely conquered. On the flood plain of the Garonne, where spring floods imperilled the yield from corn, maize, sown in May, triumphed completely.”

He continues by emphasizing the value of maize as a source of food for man, cattle and poultry.

The plains of northern Italy offer a remarkable example of the progressive elaboration of an economy. The Roman husbandry, described by Virgil in his *Georgics*, sought to rear cattle, sheep and pigs, and to grow the western cereals and fruits, such as wheat, barley, the vine and the apple. The introduction of the mulberry, the silkworm and rice from the Orient did not bring great changes immediately, because of the disturbed state of society during the Dark Ages; but during the Italian Renaissance the variety and abundance of products from the land helped to foster the luxury which was so admired by

the rest of Europe. The finest manufactured goods were wrought from silk, wool and leather. Rice stimulated the Italians to drain extensive marshlands and to control their turbulent rivers, which were prone to overflow after heavy rainfall on the environing mountains, and when winter snows melted in spring. It is no coincidence that the Italians largely created the branches of applied mathematics dealing with fluids. Recently, they have begun to generate electrical power from their mountain waterfalls and lakes. Italian engineers have won distinction in this enterprise, and are acknowledged as masters in this department of technology. This competence in drainage and irrigation in turn encouraged further improvements in husbandry. Away from the coast and main rivers, soils are more porous and do not permit the flooding necessary for successful rice cultivation. But meadows can be irrigated, and maize, which would yield uncertainly if dependent solely upon the rainfall, is much more prolific when watered regularly from rivers and canals. The introduction of a succession of new cultivated plants has provided stimuli, and has provided the means by which one of the most complex and intensive agricultural economies of the world has been elaborated. A social and economic dynamism has gained impetus by the acceptance of cultivated plants from the Levant, the Orient and the New World.

In north-western Europe, the potato has proved an equally potent influence in the social economy since it became known towards the end of the sixteenth century. More productive of carbohydrates in bulk than any other crop grown in cool temperate latitudes, it has enabled many regions to sustain denser populations. Thus, Ireland, a pastoral country till modern times, was conquered and 'planted' by English and Scots in the sixteenth and seventeenth centuries, who dispossessed the native Irish of their lands. The latter either settled upon boggy land, unsuitable for arable farming, or in the hills at altitudes where the climate and thin soils rendered the land of small value to the ascendant class. Others remained on the lands which were once their ancestors' as tenants at will, giving labour in return for the right to build a cabin of turf or stones and to till a small plot. On the bogs, the hills and as

tenants, the native Irish were sustained by the potato. The policy of Cromwell's troopers, harrying, cattle-killing and crop-burning, could not destroy tubers beneath the soil. Thus the oppressed realized the value of the potato compared with cattle and grain. It was discovered that on small plots of an acre or so called *conacres* when let by a Protestant farmer to his Irish dependants) enough potatoes could be grown to feed a family for a year. Where the Protestant immigrants did not actually displace the Irish, as in the poorer lands of the west, farms became much sub-divided, when several sons inherited a father's holding; and again, it was potato growing which enabled an increasing population to live on extremely small holdings. Sustained by the produce of their minute patches, the native Irish continued to multiply till by 1840 they had increased to more than eight millions. Then, in 1845, the blight destroyed the crop, and a people starved. The old system could not survive this shock; and, as emigrants streamed to America, both the economy and institutions of Ireland were modified.

The rise to a great power of Germany in the nineteenth century was, in part, based upon agricultural intensification, which increased, many-fold, the amount of food produced, especially from the light, sandy lands of the North German Plain. Here, aided by copious nitrogenous and phosphatic fertilizers (partly produced from the mines at Stassfurt), the potato flourished, and enabled farmers not only to rear more animals—notably pigs—but permitted the German nation to become much more numerous. As in northern Italy, a new crop diversified the economy, increased the population and raised living standards.

During the migrations of European peoples since the close of the Middle Ages, crops and animals of mother-lands have been established in other continents, as a reciprocal process to that described in the foregoing paragraphs. Thus, in Canada, Australia and New Zealand, wheat, oats, cattle, sheep, pigs, and temperate fruit, especially the apple, have flourished where British or French settlers have sought to reproduce the rural economy of their native lands.

The peculiar climate of southern Europe, characterized by summer drought and winter rains, is nowhere else as extensive

as on the shores of the Mediterranean Sea; but where it recurs in other continents, European colonists have been quick to recognize the similarity and have begun to grow plants, which, indigenous or exotic, have long flourished in Spain, Italy and Greece. Thus, in the vale of central Chile, Spaniards divided the land into estates, and by means of the labour of subjugated native people, successfully grew the wheat, vine and olive brought from Iberia. In California, Cape Colony and southern Australia, British, French and Dutch farmers have introduced the vine and citrus fruits. From these regions, wine, raisins and citrus fruits are widely exported.

Elsewhere, the basic crops and cultivated plants of Europe have been combined with those of the New World to constitute new economies. In the warmer, moister, longer summers of the middle west and the 'South' of the U.S.A. maize yields abundantly, to supplement wheaten flour in human dietary. It is also used as a fodder crop, for both pigs and young cattle. The 'Corn Belt' is one of the greatest sources of meat in the world, which, from the immense packing plants in its cities, distributes to the rest of North America and to Europe. Truly remarkable productivity has ensued by associating maize—of New World provenance—with the domestic animals of the Old World. Farther south, the still hotter and moister summers promote fungoid diseases in the temperate cereals, and wheat disappears. But maize remains, and joins with cotton as the chief products of an economy which, in the association of plants and domestic animals (cattle and pigs), the use of the plough and the cultivation of flat, sloping and even hilly land in fields is fundamentally derived from the European tradition. How different would be the 'Deep South' if it had been colonized by Chinese or Tamils, instead of by Europeans and Negroes taught to employ European methods of cultivation! The broad flood plain of the Mississippi would be an expanse of rice, in small, embanked plots separated by irrigation channels; and elsewhere ribbons of rice would follow the course of every stream. Settlements would accompany this concentration of effort along the valley bottoms, and the slopes would provide land for subsidiary crops, or would be used as a source of fuel and compost. Thus the economy of Europe, based upon the cereals and animals first

employed in the Near East, retains its characteristics in the New World, even when adapted to the production of new crops.

But the stimulus to the western economy in modern times was not confined to agriculture. The cotton goods of India, the porcelain and silk of China suggested new manufactures in countries which were striving to supply goods to exchange for those desired from overseas. It was in England, foremost in trans-oceanic commerce during the eighteenth century, that a series of inventions widened the use of metals and revolutionized all branches of manufacture by the introduction of power-driven machinery. The growth of modern industry and the conurbation from beginnings in England, and afterwards in continental Europe and North America, is familiar. Fundamentally, it depends upon mechanical power, for manufacture, transport and in lesser degree agriculture. The volume of useful products has been greatly increased; but the demands upon the natural environment have correspondingly intensified. Thereby new relationships between society and environment have been established. But often these are far from stable. In many regions of both the Occident and the Orient, the agrarian economy is perpetual because soil fertility is permanently maintained. The Chinese and French peasants are alike in achieving this, by very different methods. But the introduction of European methods of cultivation and European domestic animals into North America, Australia and South Africa have caused losses not only of fertility, but of the soil itself. Restorative methods are being applied but slowly, and the loss of potential productivity is serious when human beings are increasing as rapidly as at present. But the soil is not the only sufferer. The coniferous forests of Canada and northern Europe are being rapidly depleted for constructional timber and pulp manufacture. Some coalfields, *e.g.*, in Lanarkshire, are being worked out. The Occident has accepted the opportunity to build an economy linked by oceanic transport and based upon mechanical power, not only to create new problems, of which the conservation of natural resources is but one.

Ocean commerce has also created a new category of city: the ocean port. The Greek cities around the Mediterranean and the Hanseatic towns were prototypes. The greatest city of North

America—New York—is the principal terminus of transatlantic shipping; and owes its continuing pre-eminence to the exchange of goods between the most productive region of the continent—its hinterland—and the rest of the world. On the eastern coast of South America, the three capitals of Rio de Janeiro, Montevideo and Buenos Aires are all ports. Nearly all the other important towns of Brazil, *e.g.*, Bahia and Pernambuco (Sao Paulo being the chief exception) are also ports. The best location for towns from which political and economic control can be exercised over the most developed regions of this continent is coastal, because the exchange of goods between these countries and the rest of the western world is more important than internal movements of goods. But the law of city location in these countries is operative also elsewhere, for there are only coastal towns in the Guianas, and also, mainly, in Chile, where the capital, Santiago, is situated only a few miles inland in a longitudinal valley. Caracas and Lima—the latter the seat of Spanish government before the colonists seceded—are both close to the sea, and essential to each are the respective ports of La Guayra and Callao. Maps showing the towns, railways and population of South America reveal clearly how the penetration of the western economy has proceeded inland from numerous points of original settlement along the coasts, and in only a few places, *e.g.*, the Pampas of Argentina and in the Brazilian states of Sao Paulo and Minas Geraes has colonization extended far inland. The interior is in fact still the domain of primitive peoples and is not more populous than in 1500. The high plateaux of Peru and Bolivia are the only exception; but the greater density of population, and many of the towns, *e.g.*, Cuzco, already existed during the Inca period, before the advent of the Conquistadores.

Australia, even more than South America, has been settled around the periphery, especially along the eastern and southern coasts. Aridity debarb even pastoralism in the interior, which was aptly called the "Dead Heart of Australia" by Gregory. All the state capitals are ports, or, like Perth, have an adjacent outport. In Queensland, as in Brazil, most other towns are also on the littoral. The sites most valuable to the Commonwealth are harbours so situated as to command routeways

leading inland, to hinterlands suitable for agriculture or pastoralism.

It may perhaps be thought that location of cities in Australia is but a reflection of the inhospitable nature of the interior. But this is not true, and may be appreciated if Australia is compared with India. The latter, since its main alluvial plains became occupied by rice-growing cultivators—a process which began in the north before 2000 B.C. and was not completed in the south till after A.D. 1000—is also most densely peopled in coastal regions, apart from the Ganges basin, where continuous, close settlement extends from Allahabad to the delta. The Deccan, where rainfall is light and uncertain, and irrigation difficult, is only moderately peopled, by Indian standards. Now the spread of settlement in India was the reverse of that more recently prevailing in Australia. Rice growing began inland in the north, and was gradually extended to the rest of the sub-continent by internal colonization. Until the last two or three centuries, India has been largely self-sufficient; and, moreover, trade with the outer world was largely by caravan passing to and fro through the north-western passes. In these circumstances, the great cities were all situated inland, notably along the Ganges and its tributaries. The small, sea-borne traffic, largely in Arab ships before the appearance of the Portuguese, passed through numerous quite small ports, chiefly along the west coast. The opening of the Cape route to Europe, and later of the Suez Canal, intensified commercial intercourse between India and the West. As the Industrial Revolution proceeded in western Europe, Indian crafts were undermined by cheap, factory-made products, which were paid for by the export of primary products. External commerce became for the first time a significant element in the Indian economy. As ships grew in size, expensive port works were concentrated at a few points along the coasts where natural harbours exist or where artificial harbours, *e.g.*, at Madras or Karachi, could command the most populous hinterlands. Thus the three greatest ports of India are now her largest cities. Moreover, modern industries, at length becoming rooted, have selected Bombay and Calcutta as their chief locations. In short, the era of oceanic commerce 'turned India inside out' in more senses than one. Her ancient

cities have retained old functions, but have not acquired new. Activity is concentrated especially in her ocean ports.

But the conquest of the deciduous forests and the oceans, and wresting from Nature the secret of mechanical power does not end the story of the evolution and geographical expansion of the western economy. In Poland and central Russia the deciduous forest stretches eastwards, narrowing in the Volga basin till it disappears near Kazan, unable to withstand the increasingly rigorous climate. Here in the Middle Ages, forest clearance and agricultural settlement were proceeding as in the west. The solid nucleus of the future Russia came to be around Moscow, thanks to the exploiting of its nodality by its Grand Dukes, who were not lacking in statecraft. Southwards lay the open steppes, which, extending to the lower and middle Danube basins, were the home of pastoral peoples, governed by the Mongols and the Turks, both ruling castes from the pastoral heart of Asia, who had pressed westwards across these almost illimitable plains to the gates of Vienna. From the sixteenth century onwards, the Russian tsars advanced southwards and eastwards. No longer compelled to lurk in the forests for fear of the Tartars, they were able first to gain a foothold on the grasslands, and later to extend their power to the Black Sea. The military superiority over a hitherto invincible cavalry was gained by numbers, artillery and fortifications, in the uses of which Peter the Great had been instructed in western Europe. New arsenals in Saint Petersburg were a correlative of the expansion of Russia to the northern and southern seas. But the consolidation of new territories was the task of the peasant. Agriculture was not unknown in these spacious grasslands. During the earlier Kiev period of the Russian monarchy, and still earlier, when Greek colonies flourished along the shores of the Black Sea, there was grain grown along the valleys of the Dnieper and Don. But successive westward migrations of militant pastoralists had retarded the work of the plough.

Late in the Middle Ages, the destructive Mongols caused most Russians to withdraw from Kiev to the upper Volga. The grasslands were thus largely preserved until modern times, for the sheep and horse. But then the military supremacy of a peasant people was followed by an economic revolution in the

steppes. Countless new villages were founded, until the Dnieper and Don basins were tilled from source to mouth. By the end of the nineteenth century, little of the steppe, west of the lower Volga, had not felt the plough share. A similar colonization of grassland had, meanwhile, been going on in the middle Danube basin. The Hungarians, who had established themselves astride the river in the early Middle Ages, were a people of the horse, and despised agriculture. Their subjugation by the Ottoman Turks in the sixteenth century, followed by Austrian campaigns leading to the recession of Turkish power to the Balkans, still further retarded the development of agriculture. But after the peace of Karlowitz (1699), the Hungarian *puszta* was converted from pasture to grain field. The Hungarians themselves, Germans from the west and Slavs from the south (seeking refuge, under a Christian monarch, from Turkish oppression), attracted by land freely granted in return for military obligations in a frontier region, established themselves in compact and originally fortified villages. Again, power won by artillery was consolidated by the plough. In the nineteenth century, after railways had been built, radiating south-eastwards from Vienna and Budapest, the Hungarian Plain became a granary from which an essential foodstuff was supplied to the new industrial cities of central Europe.

Thus western peoples succeeded in closely colonizing, during a period lasting more than a thousand years, first, the deciduous forest belt (in the Middle Ages), and, second (in modern times), the grasslands of south-eastern Europe. The capacity of the most tractable soils in the forest to maintain artificially enhanced fertility, and the notable reserves of humus in the grassland soils, had enabled rural populations to increase to densities of the order of 200–250 to the square mile, which is comparable with the population supported by irrigated rice-growing land in India and China. A belt of such dense population appeared on the map of Europe, extending along the northern edge of the mountain zone, beginning in northern France, and passing through central Belgium, central Germany, southern Poland to the Ukraine. Thus for the first time the population of Europe, north of the Alps became comparable with that of the Ganges valley or the Yangtse-kiang basin. The

western cereals regained equality with rice as a staff of life to the human race.

Coincident with this European fertile belt are the coalfields providing most of the fuel and power consumed in industrial processes. The European economy, then, reflects the exploitation of a quadruple discovery: first, that grasslands are infinitely more productive when tilled than when pastured; second, that a mixed husbandry incorporating a range of crops and domestic animals having, as part of its method, the increase and maintenance of fertility of soils won from deciduous forest can support a moderately dense sedentary population; third, that coal can be employed as the basis of industrialized society; and, fourth, that the use of enclosed seas as means of intercourse between economically complementary regions can be imitated on the much larger scale of the oceans and continents.

The extraordinarily rapid progress of settlement within the United States after 1815 was the outcome of a realization, by immigrant European peoples, that the environmental conditions which their ancestors had so laboriously learned to turn to their advantage coexisted also in the New World. To the temperate hardwood forests of the Middle Atlantic states and the Ohio valley succeeded the unbroken prairies of the Middle West. The single state of Pennsylvania contains a substantial part of the world's coal reserves. In one hundred and fifty years—instead of a thousand years—a manufacturing and farming belt similar, though somewhat smaller, has come into existence as the counterpart of the European original.

Limits to the Spread of Economies.

Till now we have considered this subject, in general, positively. Factors favouring the elaboration of economy, such as the enclosed seas of the West, or the ease of movement between piedmont oases in south-western Asia, or the exchange which could be effected between West and East via the Near East, have been appraised in turn. But the subject may also be considered negatively. In short, we may ask how environmental factors limited the spread of elaborate economies northwards into Europe and Asia, and southwards into Africa, causing expansion, on the whole, to be latitudinal rather than longi-

tudinal. Hitherto, negative, limiting influences have been rarely considered. No more than passing reference has been made to the Sahara as a barrier, to the massive build of Africa, and to the immensity of the forest in northern Eurasia, as environments tending to retard and handicap.

Of the limiting factors to the spread of the more elaborate economies, we may select three as outstanding: first, the geographical limits to cultivation; second, the extent to which humanity has remained, like plants and animals, subject to bio-geographical laws of distribution, and, third, the effects of parasites.

The poleward limits to the cultivation of important crops are shown in most atlases. Of the temperate cereals, certain types of barley and rye are the hardiest. These can be grown, in Alaska and Europe, some distance north of the 60th parallel; but eastwards in North America and Asia, the limit lies between 50 and 60° N. The poleward limit for successful wheat growing lies from 3 to 5° nearer the Equator. These are absolute limits to economies based upon cultivation, and, ultimately, are due to the influence of cold climates upon the plant world. Cultivation is practicable only if plants which can accumulate carbohydrates, oils or proteins in the seed or root will flourish. For such reserves to be produced, the climate must be sufficiently warm and moist, during at least a season, to enable, especially, starch to be rapidly synthesized. Along the shores of the Arctic Ocean, and for several hundred miles inland, there are but a few weeks of warm weather intervening between winters that are nine or ten months long. Neither the trees of the northern forests, nor the humbler plants of the tundra, provide food assimilable by man. Only small berries and rare edible roots are to be gathered, providing but a supplement to a diet which, mainly, must come from other sources. It should be added that the effective limit of agriculture is considerably south of the absolute limits. The northern coniferous forests have not anywhere been effectively penetrated by agricultural economies. In the greater part of eastern Siberia, the subsoil is permanently frozen; in Europe and North America, the recent glaciation has left innumerable small marshes and thin, stony soils. Even the deeper soils are acid and infertile. Moreover, the cultivation

of the temperate cereals is normally accompanied by rearing domestic animals, especially cattle, and for the latter, winter maintenance is very difficult. In Canada, recent successful farming within the northern forests in the clay belt of Ontario is based partly upon the lavish use of silage and substantial buildings in which animals are stall-fed in winter. In Norway, the rather older cattle breeding, with ancillary grain growing, is possible in a region where the climate is unusually equable for so northern a latitude.

Certain mosses of the tundra are, however, assimilable by the larger mammals, *e.g.*, the reindeer and caribou. The former, as already noted, has been domesticated by the Lapps in northern Europe and by the Tungus in Siberia. Quite recently, the reindeer has been successfully reared on the Barren Lands of northern Canada. Pastoralism is thus not precluded from the lands beyond the limits of grain growing. That in high northern latitudes it is practised only in the Old World is due doubtless to knowledge being gradually diffused northwards that cattle and other animals had been successfully domesticated in south-western Asia. In North America, domestication of animals and cultivation came later, and the northern part of the continent, within the northern forests and barren lands or tundra, was occupied by hunters and fishermen, practising complex and specialized economies. The caribou, which abounds in North America, is probably not incapable of domestication, for it is closely related to the Old World reindeer. The absence of pastoralism in the far north of Canada is perhaps due less to environmental prohibitions than to the bio-geographical laws now to be discussed, and to which man, despite his intelligence and culture, has been in subjection.

Alfred Russell Wallace, contemporary and co-discoverer with Charles Darwin of modern evolutionary theory, also contributed substantially to bio-geography when, by collating the increasingly precise knowledge of the world's fauna and flora then being rapidly amassed by exploring naturalists, he showed how geographical and geological changes had influenced the distribution of animals and plants. He pointed out that the equatorial forests of South America, Africa and the East Indies had so long been separated from each other that their similarity

of appearance concealed great floristic differences. Isolation in similar environments fosters parallel evolution. The several types of vegetation comprising plants adapted to heat and moisture, or to drought, appear as a result of natural selection in the climatic regions of land masses; but families, genera and species are different. But to isolation, in this sense, must be added remoteness from the theatres in which new forms of life appear. The most evolved families of plants and animals, capable of withstanding a considerable environmental range, and often, by the mechanism of seed dispersal, or speed of locomotion, able to migrate for long distances, have nevertheless incompletely colonized the world.

As an obstacle which could not be passed, the sea is foremost; and the islands of the world are remarkable for their limited, peculiar associations and more primitive plants and animals. Australia is the most remarkable of all the continents in this respect. Its geological evolution has preserved its isolation from the rest of the Old World since the end of the Mesozoic era, and thus no mammal is native to the continent. Marsupials and monotremes consorted with flightless birds in forests of strangely unfamiliar appearance, to astonish the first European explorers. Remoteness, accordingly, not only engenders peculiarity but also archaism. In the wider spaces of the greater land masses, environments are multiplied. Variability and mutations readily produce new species, the more so because migration mingles species and intensifies competition. Moreover—and this Wallace underestimated, for the geological and climatological study of the Quaternary or Ice Age was only just beginning in his day—many discontinuities in distribution have been caused by the frequently changing pattern of terrestrial environments in recent geological time. Many species of plants and animals, forced to migrate by the sudden onset of a more rigorous climate, could not survive elsewhere, when confronted with new competitors. Thus, today, even species of birds, having the mastery of air and distance, may be confined to distinct and widely separated regions of the earth.

It is necessary to distinguish between man and his culture, although both are subject to these laws. The principal races of modern man appeared in widely separated regions of the Old

World, and, initially, inherited physical traits derived from the already diverse strains of sub-humans. The occupation of the Old World, and later the New, brought many groups into a relative isolation in which further differentiation was promoted. But the limitations to man's mobility have been decreased by his culture, and over a considerable part of the Old World, interbreeding has more recently arrested the tendency for new races to appear. A substantial proportion of the human race is now of decidedly mixed ancestry. But the Pygmies, the Bushmen, the Ainu and the Andaman islanders remain to remind us that the human species, like any other, has the potentialities to proliferate new breeds, varieties, races and ultimately species. If the Australian aborigines had remained isolated from the rest of mankind for a million years instead of a few thousand, there would have arisen, not an Australian race of man, but a distinct species. Culture is often associated with race, and new cultures, *e.g.*, the spread of agriculture into Europe, have been often carried afar by movements of people. But intercourse alone can widely diffuse not only knowledge of new arts but also useful species of plants. (Maize, brought to the west coast of Africa from America by the Portuguese, was rapidly disseminated throughout the continent by being passed from one tribe to the next.) But, again, there are limitations, of which the geographical is not the least significant. Knowledge of agriculture, domestic animals and the art of using metals had not reached the Australian continent before its discovery by Europeans. Similarly, the use of the plough was confined to the Mediterranean, by the broad wastes of the Sahara, until the European penetration into the negro world. To the sea and the desert, as isolating factors we may add tropical and equatorial rain forests, especially when combined with mountainous terrain. The southern continents offer several striking illustrations of these principles.

Tierra del Fuego is without question the remotest part of the human habitat, from the original home of mankind, in the warmer parts of the Old World, by the only route available to primitive man, *i.e.*, north-eastern Asia and the whole length of the two Americas. To the immense distances to be traversed must be added the desert barrier of Patagonia, the forested

southern Andes and the stormy moat of the Magellan Straits. Slowly migrating hunters and food gatherers made their way hither, adapting economy to changing resources, and always maintaining a pure subsistence economy, *i.e.*, living entirely from the land they occupied. Those who reached the extremity of the continent were, until visited by Magellan and his successors during the age of oceanic exploration, in unconscious confinement and totally separated from the cultural developments of their own continent, quite apart from those of the Old World. A hermit people, aloof from the rest of humanity, they remained nearly naked in the frigid Antarctic gales, subsisting principally upon shellfish and debarred from intercourse with neighbours by which exchange of goods, and, more important, of ideas, might have been achieved. It is true that Tierra del Fuego is beyond the Antarctic limit of cultivation for any useful plant known in the Americas before the Age of Discovery; but this absolute limit was not the most critical factor. For, farther north, in what is now the Pampas of Argentina, over a plain which is now one of the world's granaries and stockyards, the aboriginal inhabitants lived by hunting until the nineteenth century. For the inability of the Fuegians to practise agriculture is less significant than the failure to invent tools and weapons which would widen the scope of hunting or fishing, to provide clothing and shelter in one of the bleakest regions of the earth. Apart from the change of diet, the Fuegians are living as if their island were tropical. They pluck shellfish from the shore instead of fruit from trees. Wandering from the warmer latitudes of their continent, they have not provided themselves with clothing, either by invention or by trade.

In south-western Africa, and now largely confined to desert or semi-desert, are the Bushmen, who contrive, much more ingeniously than the Fuegians, to wrest a living by hunting and gathering from plants in a dry and largely waterless country. By stature they are to be grouped with the smaller races of mankind. They are rarely more than five feet tall, and they lack the thick, everted lips of the Negroes. By these characteristics, and their tight, peppercorn curly hair, they appear to be related to the Negrito peoples of Malaya and the western

Pacific, suggesting that all are relatively archaic, and have been preserved only by their remoteness and isolation from extinction or absorption by the more numerous and physically stronger races which have occupied most of the Old World. They are unique in their tendency, especially among women, to steatopygy, *i.e.*, the accumulation of fat in the buttocks. They wander far in search of game and vegetable produce during the season when rain is more likely to occur, *i.e.*, the summer of the southern hemisphere (October to April), in families. But in the drier months they camp in larger groups nearer the rare permanent water-holes, to which they, as well as their game, are then bound. Uniting, the men then stalk the larger animals, especially species of antelope, such as the kudu, duiken and steenbok. Their economy is more elaborate than that of the Fuegians. Their knowledge of the topography of vast areas, of the habits of animals and the technique of hunting has been admirably described by many ethnologists.

It may perhaps be thought that the aridity of the country they inhabit debars any alleviation of their lot by the introduction of domestic animals or any form of cultivation. But, until the eighteenth century, they inhabited a far larger area in South Africa. Remains of their encampments, and their burials, have been investigated by archæologists at several places in the Veldt, where sheep now range and wheat is grown. The Bushmen have been confined to their present terrain by the southward expansion of Bantu peoples, who had not reached the Cape of Good Hope at the time of the first Dutch colonization, and by the Boers, who have displaced them in order to practise a pastoral economy in the north-western part of Cape Province. The coincidence today of the Bushmen with the Kalahari Desert is due to fact that stronger pastoral and agricultural peoples have no use for land which will not support their sheep or cattle. But a few centuries ago, the Bushmen hunted in lands which are well suited to pastoralism or agriculture. They appear, in fact, never to have had knowledge of even purely African cultivated plants, *e.g.*, millets, peas and water-melons; although they gather the fruit of a wild species of 'melon' (*Citrullus vulgaris*); and the less exigent millets could certainly be cultivated by the intermittent water-

courses of the semi-desert. Bushmen cave-art and weapons have suggested to more than one ethnologist a parallel with the later Paleolithic cultures of western Europe. Thus, by isolation in this corner of the Old World, a race and an economy have been preserved which has long been replaced elsewhere (cf. c. V).

The Australian aborigines, till the settlement at Port Jackson in 1788, lived by hunting, fishing and food gathering throughout the continent. Today, they are confined to the arid heart of the continent and to the tropical forests of Arnhem Land. To have reached Australia, their ancestors must have crossed the sea from Indonesia, perhaps during a maximum phase of the Würm glaciation, when the sea level was lowered and the straits narrowed, particularly between Cape Yorke and New Guinea. They may therefore have already ceased to have need of boats, if they entered Australia dry-shod along a broad land-bridge uniting New Guinea with the larger island. They have since had nothing to gain by learning or re-learning navigation in a land where rivers are shallow and variable, and coasts are surf-beaten.

The imperceptible rise of the sea level, during a period lasting perhaps 15,000 years, was probably unnoticed by peoples living from the land; and their increasing isolation from the rest of mankind unrealized. The aborigines of Tasmania, also, may have reached their homeland dry-shod, for Bass Strait is nowhere more than 600 feet deep, which is regarded as the probable minimum sea level at the time the continental ice sheets were claiming their maximum tribute from the oceans. But here, the restriction to a comparatively small island, with adjacent islets, may have stimulated attempts to navigate the sea, for remains suggestive of this form of activity have been discovered on small islands in the Bass Strait. But, apparently, intercourse by sea with the mainland, if ever established, was not maintained, for the Tasmanians, who were exterminated during the first half century of the British settlement, were not a seafaring people when contacts were first established by Europeans. At the time of the European discovery of Australia, the littoral tribes of the Arafura Sea and the Gulf of Carpentaria had acquired the art of canoeing long the coast and in tidal estuaries; but it seems likely that

this was a recently acquired skill, due to renewed intercourse with Indonesia, the connection having been established by Malays rather than Australians. Thus, immolated in an extremity of the habitable world, they continued to practise a Palaeolithic culture, using stone, wood and bone for their weapons and implements, in ignorance of metal, cultivation and the domestication of animals, weaving, pottery and building. The absence of mammals in their homeland may have inhibited domestication and pastoralism; but it seems unlikely that there is no Australian species of plant worth cultivating. Indeed, in Queensland, the seeds of wild grasses were gathered in the autumn, without any attempt being made to increase the yield by artificial means. Thus they neither cultivated nor kept animals in the plains and hills of New South Wales and Victoria, where today graze millions of sheep, wheat grows in profusion, the vine flourishes, and towns, villages, farmhouses, roads, railways, mines and factories have been established.

Fuegians, Bushmen and Australian aborigines have remained as exemplars of the first human economy because of geographical isolation, bred of the great distances which have separated these peoples, until recent times, from the knowledge of more elaborate technique and social organization which have been evolving elsewhere. To sheer distance was added formidable obstacles such as the sea, ice, the immensity of northern forests and the deserts of Patagonia. The economies of certain other peoples suggests that distance may be less important than impediments to free movement, on foot, to pack animals, vehicles or small boats. The mountainous larger islands between Asia and Australia, and the interior of Malaya, are thickly clad with equatorial forest. The Semang and Sakai tribes of Malaya, the hill folk of Sumatra and Borneo and New Guinea can creep only slowly and with difficulty through the gloomy labyrinth of trees, fallen trunks, climbing plants and undergrowth. They constantly wander, but never travel far. If they are more skilful in the art of penetrating and living in what, to Chinese or Europeans, is a fearsome, mysterious and repellant wilderness, they have nevertheless remained largely isolated from the far-reaching cultural developments of the adjacent Asiatic mainland. By navigation the Malays, and, later, folk from India and

China, have reached the shores of this island world, and established permanent settlements based upon rice cultivation. Almost everywhere, this agricultural economy is confined to coastal lowlands, although in Java, exceptionally, it extends much more widely. Thus, on plains accessible from the coast, where forest can be cleared to permit a permanent, irrigated and intensive rice cultivation, hunting and food gathering have been replaced by agrarian modes of life. In a few hilly or mountainous districts, the expedient of terracing has also permitted cultivation to become the basis of food production. Generally, however, the forest reigns unchallenged. To inaccessibility engendered by the rank vegetation has been added the difficulty of navigating even simple craft upstream against swift currents and frequent cataracts.

In the Amazon lowlands of Brazil, the equatorial forest, here called the *selvas*, is continuous for a thousand miles, east to west, and north to south. It is traversed by magnificent navigable rivers. Ocean-going steamers can ascend the main river for a thousand miles from the sea. But ships glide between unbroken green walls: there is never a glade, or a distant view, except along straight reaches of the river itself. Yet this means of communication is barely used; the river ports are no more than a row of shacks, and but a trickle of trade is borne by the greatest system of navigable rivers in the world. In more temperate latitudes, the Yangtse-kiang, comparable in length, volume and size of basin, traverses the homeland of more than 200 million persons. It is crowded with shipping, and on its banks stand numberless cities, towns and villages. Even if the Amazon lowlands possess what the interior of Borneo lacks, *viz.*, superb navigable rivers, they avail nothing. They link only the small riverine villages of whites and half-castes, who obtain produce from the forest. But to the indigenous peoples, the rivers are natural wonders, and, occasionally, sources of fish. The aborigines, in fact, remain in the depths of the forest, as far from the rivers as possible, and isolated from their neighbours, whom they see very rarely, for either peaceful or hostile purposes. Even before the advent of Europeans, there is nothing to suggest that the natives made use of these rivers for intercourse. Perhaps the fact that the *navigable* Amazon and its

tributaries are coincidental with the equatorial forest deprived navigation of utility, in that exchange between regions producing different commodities could not be achieved thereby. The gorges and rapids of the mountains were interposed to bar them from trafficking with the only people in the continent practising a more complex economy—the Incas—and thus they were as effectively imprisoned in the labyrinthine forest as the more primitive folk of the East Indies. The greater rivers rather were barriers to hunting and the search for fruits, and thus the community houses in which several Amazonian peoples dwell are quite inaccessible except to the native who is skilled in finding a way where the inexperienced would be helpless. Thus isolated, they have continued to live by a simple economy and form self-sufficing small groups. They are, it is true, not pure hunters and food gatherers, for they produce manioc and other crops. Also, they build houses and make use of a variety of weapons and implements. But they have been effectively immured by the all-pervasive forest. In Amazonia, as in the Congo basin and most of the East Indian islands, the forest has admitted many simpler societies to a kind of monastic seclusion, which debars from association with the rest of mankind.

Parasites.

Further limitations to the spread and development of economies are imposed by parasites. The aggregations of plants, domesticated animals and human beings which have been promoted by agriculture and pastoralism render the attacks of parasites more potent. Human societies have been weakened or destroyed by this vulnerability which, till the discoveries of modern science, could not be remedied. The scattering of individuals in the natural state; of plants in the forest or savannah, of animals, or the small groups of primitive man over wide territories, limits the incidence of disease. But the multiplication of contacts among sedentary populations, flocks and herds, or crops, have facilitated the deadly work of parasites, and have probably promoted new forms.

Plants are particularly susceptible to fungoids and insects. It will suffice to add brief further illustrations to the melancholy example of the Irish potato famine.

The extension of both cotton and potato growing to the United States has resulted in several insect attacks, which are only partially controlled by the most modern techniques. In South and Central America the potato, *Solanum tuberosum*, is not highly vulnerable to insect pests. But when cultivation, accompanying settlement of the Middle West, reached Colorado, an insect preying there upon an allied wild species of *Solanum* discovered (1858) that the cultivated potato was even more suitable as a host plant. Multiplying and feeding upon the young shoots and leaves during the period of most active growth, the Colorado beetle, as it came to be called, spread from its original home to the eastern and western seaboard of the United States, greatly reducing yields. For by its attacks upon foliage, it reduced the production and storage of starch by the plant, thus retarding and reducing the development of tubers. By the twentieth century, European government agencies engaged in control of pests were aware of the dire peril to which potato crops would be exposed if the Colorado beetle succeeded in crossing the Atlantic. Till the First World War, European immunity was inviolate; but in 1918 the insect was discovered near Bordeaux, which was an important base for the American army. It has not been eradicated, and attempts to limit its migration, which for two decades were in degree successful, broke down during the Second World War, leaving France and Belgium to be ravaged by the pest. The French, essentially an agricultural nation, nicknamed the invading and pillaging Germans as 'doryphores'; they were parasitic potato-eaters, like the beetle! Small-scale invasions of Britain have been defeated; but great vigilance is required every summer, for early potatoes are regularly imported from infested Continental countries.

The Mexican boll weevil, which penetrates the seed-case of the cotton plant and damages the lint, has scourged the 'South' of the U.S.A. in the past seventy years, moving westwards with the extension of cultivation. It was discovered that in drier Texas and Oklahoma its powers of reproduction were lessened, and the production of cotton was thus stimulated in these states.

The coffee plant, which by the nineteenth century was

widely cultivated in the tropics, was blighted by a fungus (*Hemileia vastatrix*) which destroyed its leaves. Appearing in 1868 in Ceylon, it spread to Mysore in 1869, the East Indies in 1876, Natal in 1878, Fiji in 1879, Mauritius in 1880, Réunion in 1882, the Philippines in 1885, Samoa in 1894, New Caledonia in 1909 and by 1911 it was widespread in Africa. In Ceylon, where coffee was being grown in a hot, wet, equable climate, the fungus completely triumphed, and tea was introduced as an alternative crop immune from such devastation.

In Europe, the vine has not been exempt from infestation. About a century ago, wild American vines were being imported to be used in the production of new varieties. With these new species came pests, to which the American species were tolerant, but which were deadly to the European vine (*Vitis vinifera*). The most destructive was the phylloxera. Whole vineyards were destroyed, and not until new varieties had been evolved by hybridization of the European with more resistant American plants, did recovery supervene. But when the destruction was greatest, thousands of workers from the vine-growing districts of southern France were compelled to emigrate to gain a livelihood. Vineyards were never replanted in many places.

Man, with his domestic animals, is subject to attack by a host of micro-organisms, which cause diseases of varying virulence. Some of these parasites scourge the whole of mankind, and can also kill mammals and birds. It is to be presumed that the higher animals have withstood their onset for long periods during the later phases of evolution. Other diseases have become universal only since the closer intercourse between continents which resulted from the discoveries of the sixteenth and subsequent centuries. Of greatest significance is the restriction of some diseases to certain continents or latitudes: a restriction which may be relative, when an infection is normally endemic in a particular area, from which it occasionally extends in epidemic or pandemic form, or absolute, as, for instance, sleeping sickness in Africa, which is confined to specific areas for biological and climatic reasons.

No systematic and agreed classification of the bacteria and other parasites which may infect man and the higher animals

as been invented by biologists and pathologists. Some diseases, *e.g.*, yellow fever and influenza, are caused by organisms so small as to be invisible under the most powerful microscope and are able to pass through porous materials such as the porcelain filters employed for certain chemical processes, which are barriers to the movement in fluids of bacteria and higher parasites. These extremely minute organisms are normally called filterable viruses. Larger, and thus visible through a microscope, are bacteria, which resemble fungi in many ways and are regarded as plants rather than animals. The cholera, or comma bacillus, the *spirochaetae* or filamentous bacteria which cause relapsing fever and syphilis; the bacteria of tuberculosis, plague, pneumonia, typhoid fever, tetanus, bacillary dysentery and diphtheria have all been identified, and the microscope is accordingly a diagnostic aid to the physician. True fungi which may attack man include those responsible for mycoses, such as Madura foot, which infests southern India. The simplest true animals, called the protozoa, include the malaria parasite and the organism causing amœbic dysentery. Higher still in the animal kingdom are the nematodes, or round worms, which cause serious and debilitating diseases such as filariasis and hookworm, and the trematodes, or flatworms, one species of which causes bilharzia.

The incidence of many diseases depends upon the association of man and the infecting organism with other organisms. A. Sorre applies the term *pathogenic complex* to this association. The nematodes, for example, are generally parasitic only in the adult form. Eggs are ejected from the host by natural means, and when hatched the immature forms may require an intermediate host before they are capable of intruding into the human system. Thus ankylostomiasis (or hookworm disease) is the work of a nematode which in the adult stage lives in the intestine, causing anaemia, colic and vomiting. The eggs, ejected in excrement, hatch in warm, moist soil, and the immature worms enter the human body by an abrasion, often on the foot, or through the mouth. The heat and moisture required for the free stage in the life-cycle limit this parasite mainly to the humid tropics, but it is common in parts of the 'South' of the U.S.A., where the summers are hot and moist, and it is not

unknown in Europe. The social effects of hookworm are grave, because the induced lethargy greatly retards the mental and physical development of children. Bilharzia, the scourge of Egypt, is caused by a flat-worm or fluke, *Schistosoma haematobium*, which in the adult stage lives in the liver, intestines and bladder. The eggs, ejected in urine or faeces, are hatched and develop inside certain fresh-water mollusca. Leaving this intermediate host, and infesting the water of canals, ditches and wells, the parasite enters the human body by penetrating the skin, and completes its life-cycle at the cost of serious illness to the host. Bilharzia has been greatly intensified in Egypt by perennial irrigation; which enables the intermediate host to flourish throughout the year and consequently facilitates the multiplication of the parasite.

Malaria, which is endemic throughout the humid tropics, and appears in summer in sub-tropical regions, is caused by a genus of protozoa called *Plasmodium*. Several species are known, corresponding with the alternative forms of the disease, such as intermittent, remittant, tertian and blackwater fever. The *Plasmodium* can reproduce itself asexually within the human body, where its multiplication is associated with the acute symptoms of the disease. But in addition, the parasite can reproduce itself sexually within seventy species of the anopheline mosquito. This mosquito, as principal host and vector, is essential to the propagation of malaria, since infection cannot be transmitted directly from one human being to another. Sucking the blood of an infected person, the female mosquito receives plasmodia which develop sexually within its intestine, and then pass to its salivary glands, from which they are injected into the circulation of another human being prior to blood being sucked. The parasite cannot pass from one person to another except by the agency of the mosquito, and thus the disease is confined to regions where the latter flourishes. But the conditions required for breeding by the anopheline mosquitoes are not exacting. Its eggs are laid in stagnant water, and hatch in a few days. In the dense, moist jungles of south-eastern Asia, adult mosquitoes are as thick as clouds. Modern science has discovered how to control malaria. Paludrine and mepacrine suppress the activity of the parasite in the human body. The

mosquito usually flies only a short distance from trees or bushes; and feeds at night. Draining possible breeding places, screening houses, and the use of insecticides have successfully eradicated malaria in small areas, *e.g.*, in Crete. But these measures are expensive, and require intelligent and methodical application by a corps of sanitary officers, as well as understanding and co-operation by the general population. The poverty and ignorance of most peoples living in the tropics has hitherto prevented substantial victories being gained in the conflict with this enemy of mankind. Thus human efficiency is undermined, and life is shortened; for the parasite can rarely be eradicated from the human system whilst the sufferer remains resident in the tropics. The Negro race appears to possess a certain degree of tolerance to the *Plasmodium*, which is less effective with regard to *P. falciparum* (the species causing subtertian or malignant malaria). Individuals surviving acute attacks in youth can live for many years without exhibiting symptoms of infection or subject only to mild recurrences. But for all this, malaria remains the greatest killer of mankind. The Health Organization of the League of Nations estimated in 1932 that not less than 300 million cases occurred every year.

The triumph of sanitary science in the Panama Canal zone, and the more recent extirpation of the anopheline mosquito from Crete mainly by the use of D.D.T. are but local successes. These hardly counterbalance the conquests of malaria in the pre-scientific age, when the nature, cure and the prevention of the disease were unknown. It is now generally accepted that malaria, although present in Mediterranean lands from at least early historic times, became more grave early in the Christian era, when the formation of coastal marshes was accelerated by reckless felling of forests in the hills, thus creating conditions favourable to the breeding of the anopheline mosquito. The populations of Greece and southern Italy, chronically infected by the parasite, and liable to epidemics every summer, became debilitated, and have remained so until recent times. In Ceylon, the collapse of the ancient Sinhalese kingdom was partly a victory for malaria. For 1,500 years, from the Aryan settlement in the sixth century B.C., the northern and eastern lowlands were populous and cultivated. Water for irrigation,

in a region of uncertain rainfall, was supplied from reservoirs resembling the tanks of southern India, or from larger artificial lakes filled by diversions from the main rivers at gorges in the foothills of the central massif. Aggression by the Chola (Tamil) kingdoms of southern India from the eleventh to the fourteenth centuries A.D. brought devastation to Ceylon. The royal administration of irrigation works ceased. *Bunds* were broken and beds of reservoirs became marshes in which mosquitoes could breed unchecked. Villages and even cities were engulfed in resurgent tropical jungle. Only a decimated and enfeebled population has survived in huts built of bamboo and dried coconut-palm fronds, cultivating rice patches by the aid of trickles of water emerging from ruined reservoirs. Thus the basis of prosperity and health—the reservoir—which enabled cultivation to be carried on by means of running water, became an Achilles' heel; a deadly weakness which overwhelmed a whole nation when the controlling administration was shattered. (Fig. 4.)

Yellow fever, like malaria, is transmitted by a mosquito, and the incidence of the disease is related to the distribution of the vector, *Aedes aegypti* which occurs widely in tropical lands. But the disease is more virulent in West Africa, eastern South America and the Caribbean. Young persons often develop a mild form, and gain immunity from further attack, for the causative organism is a filterable virus. But severe epidemics may occur from time to time, resulting in heavy mortality among adults. Research in Brazil in recent years has shown that the virus can be transmitted by many species of mosquito, and that the 'selva fevers' prevailing in the interior are due to the same virus introduced into the human circulation by another species. The requirements of *Aedes aegypti* are somewhat exacting. It flourishes best in temperatures between 80° F. and 90° F. Below about 72° F. its activities are much retarded, and at temperatures below 63° F. it disappears. It is known that if the mosquito is subjected to temperatures mainly below 80°, the time required for the virus to reach the salivary glands from the abdomen—and thus to be capable of infecting another human being bitten by the mosquito—is greatly increased from the minimum of four days. Thus, although the coastal lowlands of Brazil have long been ravaged by epidemics of yellow fever,

the plateau, where nights are usually cool, is normally immune, for the mosquito usually bites at night. But during unusually hot weather, sudden and virulent outbreaks may take place. It has been realized that air transport could spread yellow fever to other tropical regions, *e.g.*, India, Indo-China and the East Indies, hitherto free from its toll, and rigorous precautions are now taken to ensure that neither mosquitoes nor infected persons arrive in immune areas.

Sleeping sickness (trypanosomiasis) is associated with the tsetse fly, of the genus *Glossina*, which is limited to certain habitats. The most important species is *Gl. palpalis*, which can live only in forest or in the shadow of trees growing along rivers in the savannahs. Unless the air is very humid, it cannot survive; and thus except where dense trees are accompanied by epiphytes and lianas, the *Glossina* is absent. The arrival of men and beasts to drink or bathe attracts the fly—the dark skin of the negro more than the pale pigmentation of the European—and when it bites, before sucking blood, an elongated, motile protozoa, *Trypanosoma gambiense*, is introduced into the circulation. Multiplying and lodging in the brain, the organism causes lethargy, paralysis and often death. Like yellow fever, the disease may be non-fatal, and recovery appears to confer immunity, although medical opinion is not unanimous about this. Severe outbreaks, attended by heavy mortality, have occurred in Nigeria, Uganda and Tanganyika. In the tropical grasslands, and on plateaux at altitudes as high as 4,000 feet, two other species of trypanosomae are associated with certain varieties of the tsetse fly which can flourish in less humid air, although still confined to the shade of trees or bushes. (Fig. 5.)

The exigencies of *Glossina* appear to have prevented its migration to other tropical lands, although, again, air transport is not without its risks. And its ravages have been successfully controlled by destroying dense vegetation near villages, or removing the population to unwooded areas free from the fly. Thus the distribution of population is influenced by the location of fly-infested forests. But human societies are not only influenced by the risk of the disease in man. Cattle, as well as many wild mammals, may be infected and die. Thus, in large

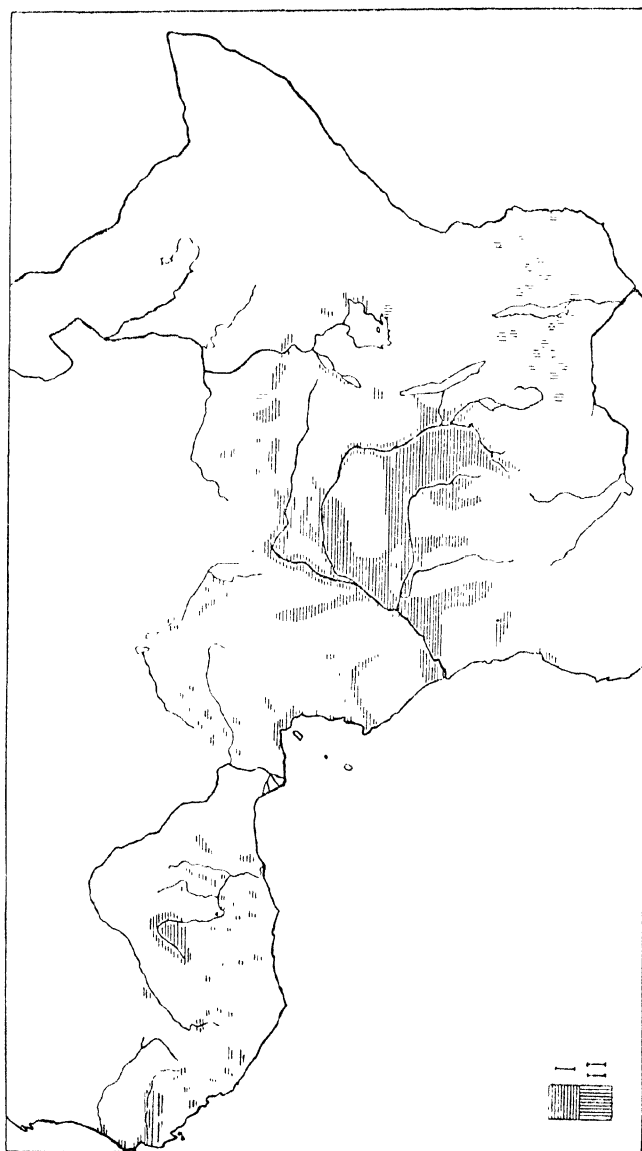


Fig. 5
THE DISTRIBUTION OF SLEEPING SICKNESS IN AFRICA (AFTER MANSON)

- I. Tr. gambiense;
- II. Tr. rhodesiense.

areas of tropical Africa, neither cattle nor horses can be reared. Thus the economy and use of resources may be profoundly affected by the incidence of this disease.

There are remarkable analogies between the incidence and distribution of disease and the dissemination of domesticated animals and cultivated plants in the world. This is readily comprehensible, because both parasites and the animals or plants upon which man depends are closely associated with human settlement and migration. All form a vast complex, having man at the centre. Just as we may distinguish several regions, in both Old and New World, within which associations of animals and plants were domesticated, to be transported later much farther afield, so we may also define regions, each the home and origin of particular diseases.

Adopting the conclusions of Professor Sorre, we may divide the Old and New Worlds into tropical and extra-tropical sectors, each having characteristic diseases as well as those which are world wide in their incidence.

1. In Europe and temperate North America, especially among the city-dwelling millions, bacterial and virus infections spread by contagion or droplets breathed out by sufferers, in food or drinking water, have long been liable to epidemic outbreaks, partly under the influence of meteorological conditions. Typhoid fever and dysentery tend to claim their victims in summer; colds, influenza and pneumonia in winter. The list of common diseases is long, and includes smallpox, tuberculosis, diphtheria (thought to be of quite recent origin), venereal diseases (including syphilis, introduced from tropical America at the Great Age of Discovery), infantile paralysis, meningitis and the less serious ailments such as whooping cough, scarlet fever and measles. Insect-borne diseases are unimportant, and those due to nematodes and allied organisms not severe. The incidence of nearly all these infections has been greatly reduced by improved sanitation, inoculation, hygiene and more refined treatment of those who have contracted disease. Apart from these measures, it is inconceivable that these immense aggregations of people, where daily contacts are multiplied, could have grown to their present size.

It is noteworthy that diseases due to protozoa, worms and

flukes are unimportant. From the bacterial and virus diseases which are most common, recovery is normally complete and often further immunity is assured. Thus the working capacity of survivors is not impaired. The continuing debility caused by many tropical diseases is absent. Thus since the more effective control and treatment of the characteristic diseases in these regions, a notable increase in the longevity and working capacity of the average person has ensued.

2. Tropical Central and South America. This region is the home of syphilis and yellow fever. The former has become universal since the Great Age of Discovery. Yellow fever has crossed the Atlantic to West Africa. Certain mycoses (*i.e.*, infections by fungi), forms of typhus and plague are also confined to this part of the New World.

3. Tropical Africa is the place of origin of several important diseases. The most serious is undoubtedly sleeping sickness. Ankylostomiasis may have first attacked mankind here, to be transported to tropical America by slaves. Malaria, like the diseases specified in 2 and 4, is endemic.

4. The Monsoon Lands, including the East Indies. Dense populations, inhabiting large villages and many market towns, are liable to be attacked by all bacterial diseases in epidemics, and mortality is often appallingly large. Malaria is endemic; leprosy appears to take its greatest levy upon human vitality in China; and both cholera and bubonic plague remain latent, to stalk over whole provinces as the emissary of death to millions. Certain types of typhus originated within this part of the Old World.

5. The Interior of Asia. Associated with rodents, and the fleas living thereon, is plague, especially the invariably fatal pneumonic form. The steppes and semi-deserts must be regarded as the true source of this dreaded disease, and from these lands it spread to become endemic in the Monsoon Lands and epidemic in Europe, until invasions could be checked by modern medical controls. Certain types of relapsing or recurrent fevers due to *spirochaetae* (or filamentous bacteria) are also endemic in scattered valleys and oases.

The social consequences of uncontrolled disease are immense. For heavy general mortality from infectious diseases

shortens the average working life and thus diminishes the power of production in a community. There is thus a positive connection between a high incidence of disease and low standards of living. Moreover, in the tropics, the frequently high incidence of illness and mortality from diseases caused by bacteria and viruses is conjoined to the effects of ailments caused by protozoa, fungi and worms. Malaria, hookworm, bilharzia, dysentery and sleeping sickness are not only killing diseases but also chronic diseases. The Negroes, for instance, generally survive attacks of sleeping sickness; but whilst they are fighting the invasion of trypanosomes they suffer from a lethargy which may last for months. The anaemia accompanying hookworm infestation is extremely common throughout the tropics, and in warm climates where extremely simple housing and clothing permit survival and food is readily grown, has much to do with retarded social and economic development. Hot climates do not stimulate physical activity, and when to this influence is added the devitalizing effects of chronic disease, the inactivity and low productivity of the average native of central Africa, Ceylon or Sumatra is not difficult to understand.

Disease, too, has considerably diminished the numbers of primitive peoples in the world. Many maladies of the Old World were absent from the New until the sixteenth century, and were likewise not introduced into South Africa or Australia until Europeans began to settle. Smallpox, tuberculosis, measles and scarlet fever have all slaughtered peoples suddenly exposed to infection by the arrival of European explorers or traders. The aborigines of the West Indies—not numerous when the Spaniards arrived—were eliminated as much by epidemics as by a harsh slavery. The Indians living along the coasts of British Columbia were reduced to less than half their former numbers early in the nineteenth century by smallpox and tuberculosis. The Hottentots, in South Africa, were exterminated by smallpox in 1713, and their land was then easily occupied by the Boers. In the Pacific Islands about a century ago, measles acquired a virulence unknown in Europe, and many islands were almost depopulated. In the struggle between primitive peoples—hunters and simple cultivators—and the more advanced, lethal bacteria have helped to weaken the weaker.

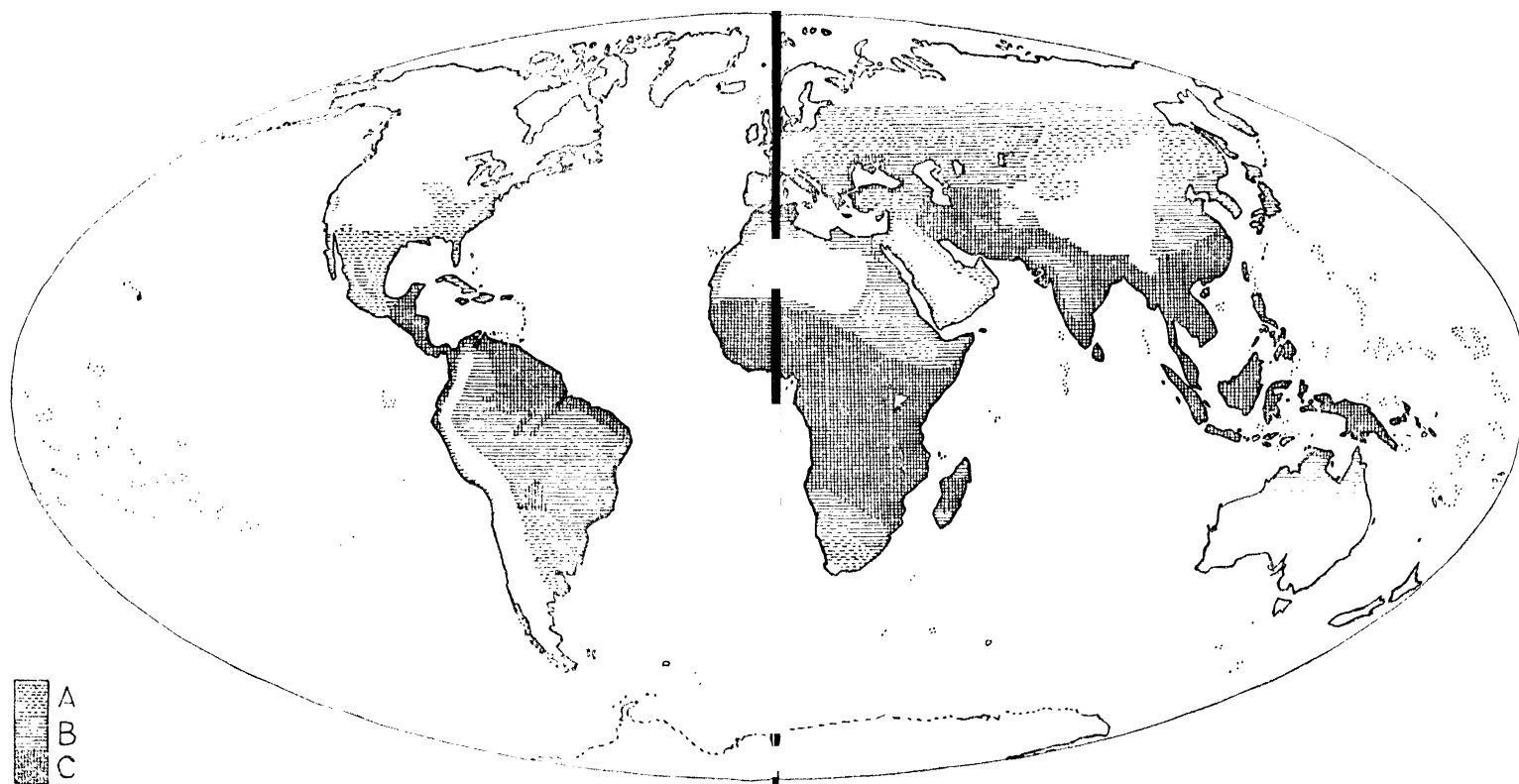


FIG. 4
THE DISTRIBUTION OF MALARIA
A. Low Endemicity;
B. Moderate Endemicity;
C. High Endemicity.

CHAPTER V

POPULATION, RESOURCES AND THE PHENOMENA OF CONTACT BETWEEN SOCIETIES

MANY primitive peoples seem to have established a kind of equilibrium which is partly internal and partly external. They do not increase their kind rapidly, as if they are aware of the dangers of over-population. Frequently, they maintain positive checks upon too-frequent pregnancy, such as prolonged abstention from intercourse after the birth of a child. The immediate objective is doubtless to avoid burdening the parents with several young children, who would gravely handicap the family during wandering or seasonal migration and also intensify the effects of dearth. Probably, among the Australian aborigines and Bushmen, the limitation of food supplies in arid countries is also realized. But small families—perhaps an average of two or three children to each mother, surviving to adulthood, so Sir Alexander Carr-Saunders thinks—and a stable population seem to be the social objective among rain-forest peoples in the East Indies and Melanesia.

Such peoples are normally in a balanced relationship with the environment upon which they depend for their sustenance and other needs. They do not extirpate other animals or plants, or disturb the balance between them. The fauna and flora remain unchanged: for man is too puny to alter either. One or two positive instances to the contrary do not nullify this general rule. It is thought by some ecologists that the *eastern* Prairies of North America would be forested apart from the influence of fire, introduced by man and used by him in hunting bison. But other instances are hard to find; and in general hunting folk neither exterminate beasts nor destroy vegetation.

Pastoralists and agriculturists, however, rarely seem to achieve such stability. In the Old World, pastoralism has engendered recurrent over-population, which, aggravated at

intervals by drought cycles (see Chap. II) has caused nomads to prey upon sedentary peoples. Moreover, the goat, especially, has prevented the regeneration of trees after felling or forest fires in southern Europe or western Asia. Shepherds or herders in the mountains of the Balkans or Armenia often kindle fires to burn young trees or shrubs and thus regenerate exhausted pastures. In modern times, the Egyptian fellahin and the Japanese have multiplied upon a very limited extent of arable land, and neither intensification of agriculture nor the development of commerce and industry has averted a population crisis in both countries. The northern Chinese, pent into the Plain by the Wall and the policy of the Manchu emperors, burst out as the dynasty weakened, and swarmed into Manchuria, where they and their descendants now number almost forty millions.

The Chinese and Japanese, notably, are conservative and intensive in their agricultural methods. Through irrigation, they renew fertility by trapping sediment and soluble plant food washed from hills and mountains. By composting and the use of manure they increase fertility and maintain it artificially at a high standard. Yet they are destructive of forests. Not only in China and Japan, but throughout the Monsoon Lands, uncultivated land is a common, from which villagers cut firewood, or remove tender foliage for composting, or where they graze animals. Where rice growing has penetrated into tropical rain-forests, natural growth can withstand such depredations; but in the northern half of China, and over much of India, forests have been reduced to scrub or heath. Other agriculturists have been even less successful in replacing natural vegetation by cultivated. European peoples, migrating to the New World, Africa and Australia, and taking with them their domesticated animals, familiar cultivated plants and the plough, have discovered that in many climates where farming or pastoralism was at first successful, a stable relationship with environment is hard to achieve. In the cotton-growing south of the U.S.A., the clearance of forest to plough for maize and cotton led to soil erosion so severe that often only gullies and bare rock were left. When the drier grasslands of the West were ploughed, dust-storms removed the soil to blacken the skies above Chicago and even Washington. In Australia, merino sheep nibbled the sparse

grass and small bushes to the ground; and plains where the soil was originally firmly held by the spreading roots of plants were converted into drifting sandy deserts. Readjustment of the methods of cultivation and grazing are far from complete. The technology has been invented by scientists; but the need for a conservative rural economy and a stable relationship with the soil has not been accepted by 'free societies' which, implicitly, cherish the right to impoverish their descendants.

Equal in importance and excelling in complexity are the problems which exist where, through recent migration, peoples practising different economies have come together and live side by side. New social and environmental relations arise, which are either left unsolved or are settled by the stronger people in its own interests.

The settlement of North America by Europeans affords some interesting contrasts. Along the eastern coast, from the Saint Lawrence southwards, Europeans and American Indians were in irreconcilable conflict. The European, desiring to clear the forest and farm the land, sought to destroy the Indians' livelihood. Treaties reserving certain areas to tribes, and providing that these would remain inviolate by settlers, were not kept, because new immigrants after 1815, moving steadily westwards, infiltrated into Indian territories. Maintaining themselves in defiance of both the U.S. Government and the Indians, in the course of time these newcomers made good their possession of the land. By the time the government was able to police the country effectively and preserve the security of Indian reservations, the aboriginal population was largely exterminated. The existing reserves are so small that the survivors cannot exist by hunting. They are compensated by the receipt of State pensions, and by new welfare schemes initiated by the first Roosevelt administration, which encourage the Indian to graft his traditions and social pattern on to a western economy.

But in the south-west, the tide of European agricultural and even pastoral settlement slackened. Parts of Arizona and New Mexico, cleft by deep canyons and inaccessible even to the rancher, were allowed to remain in the occupation of the Hopi or Pueblo Indians, who live mainly by growing maize, pumpkins

and other crops upon land irrigated from gullies flooded after summer thunderstorms. In most of Canada, the climate is too severe for agriculture. The Indians have been dispossessed of their lands in the St. Lawrence lowlands and the Prairies; but farther north, the forest is still continuous. The few European trappers and traders in these cold regions have been able, broadly, to establish an identity of interest with the Indians. The latter now hunt to obtain skins, which can be exchanged for previously unknown foodstuffs, improved weapons and better clothing. The Indians' economy has been modified, but they still live on their ancestral lands.

In Australia, as in the U.S.A., Europeans appropriated lands suitable for agriculture or pastoralism, and the aborigines, like the Bushmen of South Africa, are confined to the desert interior, or to the thorny forests of Arnhem Land, impenetrable to the stock-farmer. But in Australia, desert is proportionably more extensive than in the U.S.A. On the other hand, nearly all is more utterly barren than Arizona, and the indigenous Australians could not—even if they knew—practise the flood farming which sustains the Pueblo Indians with much less arduous effort than hunting and gathering. In New Zealand, the Maoris, who were simple cultivators and fishers, were again compelled to fight for their patrimony, and were much reduced in numbers by war. Disease reinforced the acquisitiveness of English and Scottish settlers. But when the power of the newcomers could not be disputed, a belated recognition of the natives' right to at least some of the soil was accorded, and Maoris, now enjoying full civil rights, own land and live side by side with the European farmer.

Within the tropics, the contact of European and indigenous societies resulted in the appearance of the plantation economy. Economic and climatic factors contributed to this end. In Europe, a feudal structure in society was very firmly established during the Great Age of Discovery. During the Middle Ages, when the sugar-cane was introduced into the Mediterranean from India, the art of milling cane and concentrating the resulting liquid into sugar was elaborated, and both in Spain and the Byzantine dominions, small sugar mills were established to manufacture the product. Such sugar mills were generally

owned by the landed proprietor and workers were drawn from the servile class in society. The sugar-cane was taken to the West Indies and 'plantations' were established by French, Dutch and British. As in Mediterranean lands, the necessities of production—chiefly the capital required to construct a mill and the large acreage of sugar-cane which had to be cut in an orderly way if the mill was to be profitable—caused large units to come into existence. That they were owned and operated by a white upper class was due not only to their original monopoly of knowledge in regard to growing, manufacturing and marketing, but also to the desire to avoid manual work in a hot climate. The small native population of the West Indies proved inadequate to provide the labour needed by plantations. The importation of negro slaves from West Africa thereupon began. Three centuries of the slave trade followed, and caused racially mixed societies to extend widely in the low latitudes of the New World. Sugar-cane was later carried to Mauritius, the Philippines, to Pacific islands, including Hawaii and to Peru—everywhere to the accompaniment of slavery, serfdom or of a servile labour force racially different from that of the owners and managers. Later, other products were obtained by the same methods. Cocoa was planted in Brazil; tobacco, and later cotton, in the southern states of the U.S.A.

But the plantations in the Monsoon lands of Asia have been established in a different manner. They are adjacent to long-settled, dense agricultural populations. Moreover, by the nineteenth century, slavery as an institution had become repugnant to western peoples. But the tendency to over-population in India and Java, in any case, rendered slavery unnecessary. Lower-caste folk, otherwise doomed to a bare subsistence, were willing to work on the new estates as indentured labourers, or, later, as day labourers provided with lodgings. Conflict in the use of the land was averted by the nature of the chief crops grown. Tea and coffee, the earliest plantation crops in India, Ceylon and Java, are trees and not annuals. They flourish on hill slopes not occupied by indigenous rice producers. (Sugar, however, in Java, competes with rice for the use of irrigable land, and it has been necessary to restrict the extent to which village lands can be leased for this crop.) Neither tea nor coffee

gives a return till the fourth or fifth year after planting. The resources and enterprise required to clear jungle, plant the crop, build factories in which a marketable produce could be prepared, were provided by Europeans, who have maintained their position as owners and managers until today. The manual work has been performed by the near-landless or landless peasants of Bengal and Madras, for whom a lodging and a regular wage provide a good standard of living and a surplus which can be saved for old age.

In general, India and neighbouring countries compare very favourably with North America when the nature of the contact between very dissimilar societies is considered. Little-used land has been employed for intensive production; a good livelihood has been given to many thousands who would otherwise have been near starvation, and the increase of wealth thus accruing has been shared between west and east. Moreover, no destruction of social traditions and customs has ensued; and effectively working communities in which, often, may be represented several eastern and western societies continue unimpaired for decades. But the relation with the soil is less satisfactory. Tea planting has caused severe soil erosion to take place on steep slopes which receive a heavy rainfall. Most planters now realize that, initially, terracing should have preceded tea growing, and the only methods of soil conservation which can now be practised, *e.g.*, frequent tillage, cutting oblique drains and pit composting, are but palliatives.

It is South Africa's peculiar misfortune to be confronted, in the most acute form, with the problems attending the mingling of peoples practising widely differing economies, as well as fundamental disharmonies between these economies and the environment. It is not unique in the association of two distinct communities of European origin, divergent in economy and tradition. In Canada French and British have been associated for nearly two centuries; but a degree of territorial segregation, and a wide margin between population and available resources has enabled the two nationalities to maintain a stable *modus vivendi*, reflected in the peaceful course of federal government. In South Africa, the two white communities—British and Boer—are more intermingled, not only amongst each other,

but with the far more numerous Bantu. Moreover, the whole population is living in an unbalanced relationship with the land. Here indeed is a precarious situation.

Africa is essentially a vast plateau, descending to the sea by bold, rugged escarpments. In South Africa, the edge of the plateau is most clearly defined in the east, where the Drakensberg (Mountains) rise to more than 10,000 feet at a distance of 100 to 150 miles from the coast of Natal. Sandstones, of which much of the plateau is composed, form immense bastions and castellated crests. The seaward slope, eroded by many short and cascading streams, is a land of rolling hills, which continue almost to the shore of the Indian Ocean. Inland, in Basutoland, the hilly relief continues at an altitude of 6,000 feet; but otherwise the plateau is unbroken (apart from the valleys of the main affluents to the Orange river system), and declines gradually westwards from 4–5,000 feet to less than 3,000 feet in the heart of Bechuanaland. In the extreme south, the level plateau continues to the zig-zagging and broken ranges of the Roggeveld Mountains, the Nieuveld Mountains, the Sneeu Berge and the Storm Berge. These are about 200 miles from the sea. The intervening zone forms two giant 'steps' (the Great and Little Karroos) each bordered on the seaward edge by a kind of rim (the Zwarte Berge and the Lange Berge).

Only a small part of the country receives a moderate rainfall, and even less can boast of a reliable rainfall. The immediate environs of Cape Town and Cape Agulhas receive cyclonic rains in winter from the west, and, climatically, resemble the Mediterranean Lands in régime, amount (20–30 inches, rising to 60 inches in the hills) and reliability (average deviation fifteen per cent). Northwards, in the Karroos, the amount decreases to but 5–15 inches, falling in infrequent showers. Elsewhere, the source of rainfall is the Trade Winds of the Indian Ocean, which are strongest during the summer. Impinging at right angles to the coast, they bring a moderate rainfall (30–60 inches) to the coastal slope and the Drakensberge; but inland the amount decreases, because the winds are descending and distance from the source of water vapour is greater. Over the plateau of the Orange Free State and Transvaal, the annual average fall is 20–35 inches; in Bechuanaland, only 10–20 inches.

The Trade Winds weaken towards the south. Between the Orange river and the Little Karroo the annual fall is extremely light (5–15 inches). These summer rains are accompanied by thunder: indeed, the danger from lightning stroke in the Orange Free State and the Transvaal is great. Thus heavy rain falls for a few hours, and is then succeeded by days or weeks of sunshine. Everywhere, the incidence is uncertain, and the annual totals fluctuate greatly. Even near Port Elizabeth, where the summer régime of the Trade Winds meets the winter régime of the Westerlies, the fall is not heavy from either; and both sources can be deficient in the course of a year, the average variability being fifteen to twenty per cent. Inland and northwards, the variability is greater.

The Tropic of Capricorn crosses northern Transvaal, and thus nearly the whole of South Africa is extra-tropical. It would be near-tropical, however, apart from the high average elevation. Exceptionally, the coastal lowlands of Natal prolong the tropical coastal lowland of Mozambique. Durban, for instance, has a mean annual temperature of 71° F.; its cool season (July, 65° F.) being short, and its hot season (January, 77° F.) being long. But the southern coast is warm temperate, and at Cape Town the mean annual temperature is 62° F. Inland, the elevation of the plateau offsets the decrease of latitude. Although Pretoria is seven degrees of latitude nearer the Equator than Cape Town, its mean annual temperature is only one degree more (63° F.). The climate of the plateau is bracing. The air is dry—often excessively dry—and days are hot; but the air becomes cool very quickly after sunset. There is a true winter (the mean July temperature at Pretoria is 52° F.), and night frosts are common. It has been thought by some doctors that the brilliant sunshine over-stimulates people of the white race, and there is some evidence of degeneration among the 'Poor Whites' who now number more than 100,000. On the other hand, it may be contended that this group is no larger than the lowest stratum of any society, into which sink the less intelligent and sub-normal, to reproduce their kind nowadays with a much better chance of survival, thanks to modern standards of public health. As will be shown later, the 'Poor Whites' of South Africa are much more significant socially

and politically than in a country having a population racially homogeneous. They are a highly inconvenient social phenomenon, rather than a climatically determined racial variant. On the whole, there is little to contradict the opinion, derived from the experience of settlers, that South Africa is a 'White Man's Country', in the sense that people of European stock can maintain their vigour, and transmit it to their offspring, whilst living fully normal lives; in particular, engaging in vigorous muscular exercise. The maintenance of vitality is undoubtedly aided by the absence of tropical parasitic diseases. Malaria, endemic throughout tropical Africa, persists as far south as the Limpopo valley, which is the northern boundary of the Transvaal; but ceases where the land rises southwards about 3,500 feet. The tsetse fly and sleeping sickness, likewise, are absent.

The rainfall is only locally sufficient for the growth of forest. Along the east coast from Port Elizabeth northwards, a low, sub-tropical forest formerly flourished; but has now largely been cleared. Patches of similar forest survive on the exposed and inaccessible escarpment of the Drakensberge. In the region of winter rains, near Cape Town, evergreen sclerophyllous forests clothe the mountains, and include yellow-woods, ironwoods, the assegai wood and many smaller bushes, bulbous and tuberous plants; the latter formerly dominant on lower ground. Grasslands are much more extensive, and include both tropical and temperate types. In the former, as usual, trees and bushes mingle with grasses to comprise the Buschveld of northern Transvaal (near the Limpopo). A similar association extends along the east coast, mingling with the sub-tropical evergreen forest. A true grassland, growing in the temperate climate of the plateau, in the Orange Free State and the Transvaal, dominated by the red grass (*Themeda triandra*), and accompanied by many herbaceous perennials, which beautify vast expanses in summer, is known as the Veldt or the High Veldt. A somewhat similar grassland, broken by thorn trees and Cape lilac, extends in a zone parallel to the east coast, between the forests of the littoral and the escarpment. The interior of Cape Colony, between the Orange River and the littoral, receives insufficient rainfall to maintain a grassy sward, and the

plant growth displays the characteristics of semi-deserts. Small, succulent plants, storing water in their tissues and thus able to withstand prolonged drought (such as the mesembrythemum, euphorbia and aloes, bulbous and tuberous plants, or the Karroo bush) are sparsely scattered, and scattered bunch-grasses are green only after rain.

Like central Africa, which abounds in wild animals, the grasslands of South Africa once swarmed with antelope, of many species, small and large, upon which preyed the greater carnivores. As will be shown later, the earlier indigenous inhabitants, and earlier white settlers, all depended to a considerable extent upon game for sustenance.

Considered thus apart from its human inhabitants, South Africa may be conceived as a plateau, descending to the sea by escarpments or terraces, and subject to a warm-temperate or sub-tropical climate. A light or moderate rainfall, very variable in its incidence, is insufficient, except quite locally, to sustain a forest cover; and the greater part of the country is grassland or semi-desert. The combination of grassland and plateau imparts a spaciousness to the South African landscape which remains among the most enduring impressions of those who have travelled between the Cape and the Limpopo. The veldt is an apparently illimitable, gently undulating plain. South of the Orange river, the broken rim of the African plateau, and the ranges separating the Karroos, veiled in mysterious blue haze, rise from the plain, and in the clear, dry air may often be seen from a distance of more than a hundred miles. There are few obstacles to movement. The rivers, though dangerous in flood, can be forded when the waters subside. Domestic animals can be assembled and driven from exhausted pastures to new. Over the level and normally dry soil, the ox-drawn wagon can freely go. Thus the past three centuries have witnessed remarkable human movements: more striking, perhaps, than even the dauntless pioneering in the Far West of the U.S.A., before the railways had spanned the continent. For in South Africa, a people drawn from the long-sedentary nations of western Europe, turned to a pastoralism which, at its fullest development, was semi-nomadic. Its effects upon the land and the social problems of South Africa have been profound.

It may be postulated, then, that to the ease and freedom of movement in this open, pastoral country we may attribute the intermingling of peoples. Briton, Boer and Bantu were already interlocked before the first railways were built. Modern commerce, mining and industry have accentuated the tendency.

Two primitive peoples were being driven southwards and south-eastwards when the first permanent European settlement was established at the Cape of Good Hope in 1652. Ethnologically, the Bushmen and Hottentots are closely allied; and both have wandered from the north, where, in central Africa a thousand years ago, they were the sole occupants alike of forest and tropical grasslands, with the allied Pygmies who now shelter in the Congo forests. Both groups are short of stature, and although their mode of life required great powers of endurance, they do not equal either the Whites or the Bantu in physical strength. The typical Bushman is less than five feet in height, and adults measuring only four feet two inches have been observed. Yellow-brown in colour, with sparse, peppercorn tufted hair; pot-bellied from their infrequent gorging, they hunted game, trapping their quarry in pitfalls or killing with bow and poisoned arrows. Facially ugly, they were rendered more repulsive by dirt and rancid fat which they daubed on their skins, and they have been compared with young baboons. True nomads, and remaining in their brushwood shelters only for a few weeks or months, they have been forced into the Kalahari Desert and the arid region between the lower Orange river and the Cape of Good Hope by the aggressive migrations of stronger and better-equipped peoples. Closely allied to the Bushmen were the Hottentots, who, in the sixteenth century lived south of the Orange river and west of the Kei river. Resembling the Bushmen in physique, and speaking an allied language, the Hottentots were nevertheless pastoralists rather than hunters. They drove herds of long-horned cattle and hairy, fat-tailed sheep from one pasture to another. Living primarily upon the milk of cows and the flesh of sheep, they also gathered berries, bulbs, roots and wild honey. To a certain extent, they were also hunters.

Rock-paintings and place-names of Hottentot origin indi-

cate that these peoples formerly lived in the region between the Orange and Limpopo rivers, from which they were expelled by the advance of Bantu peoples, whose ancestors began to migrate southwards from the region of Victoria Nyanza about the ninth century A.D. The advancing vanguards drove Hottentot and Bushmen southwards. As more land was needed, the Bantu settled in areas adjacent to those already occupied, dispossessing, and often doubtless killing, Hottentots or Bushmen. To their strong, negro physique—most writers apply the adjective magnificent to the Zulus and other tribes of the southern Bantu—were allied the advantages of a well-knit tribal organization and of better weapons, which included well-made spears (for they had knowledge of iron-working) and shields. Unquestionably superior to the other indigenous peoples, they disputed the country with the Europeans, and did not succumb until beaten in a hard struggle. After crossing the Limpopo, they penetrated into South Africa along two well-defined routes.

More important was the coastal, through Natal, which, with what is now Cape Province as far as the Fish river, was thickly peopled by the seventeenth century. Although the population of this coastal zone extended to the Drakensberge, the High Veldt was to a certain extent avoided. The Bantu disliked the cold nights and the lack of shelter. The westward tongue of Bantu peoples accordingly was thrust southwards along the eastern margin of the Kalahari desert and the western Low Veldt of Transvaal. For their subsistence they depended upon hunting, pastoralism (for they kept cattle and goats) and simple agriculture. From their domestic animals the men drew milk, which, drunk fresh or sour, was their staple diet. They did not slaughter their animals for food, although they would eat a carcass when death had occurred from natural causes. They normally obtained fresh meat by hunting. Cattle, especially, were the chief wealth of a Bantu family and the standard of value in which fines and bride-price (*lobola*) were paid. The men and boys of each family tended the herds on the common pastures of the tribe, in which private rights or ownership were unrecognized. But a tenancy based upon the occupation of land for dwelling houses and cultivation, *i.e.*, usufructory, was granted by a chief or headman. On land thus allocated, wattle-

and-daub huts were erected; enclosures were constructed in which cattle could be penned at night and plots were cleared of natural growth so that cultivation could take place. Care of the gardens was women's work, after the men had cleared bushes and trees from the ground. The women broke up the soil with wooden or iron hoes; sowed sorghum, maize, millet, pumpkins, melons, sweet cane, peas and beans; scared away predators and finally reaped the harvest. Manuring, irrigation and crop rotation were unknown; when the soil was exhausted, it reverted to common pasture, and fresh land, duly allotted, broken elsewhere. For nearly all purposes, each family was self-sufficient. The preparation of skins for clothing, the making of wooden utensils such as pails, bowls, spoons and head-rests by the men, and the weaving of mats or simple pottery by the women being universal. Only metal-working was restricted to a small class of men skilled in smelting and fabricating; but even among these, it was a part-time occupation.

"For a primitive people, the Bantu were comparatively advanced, and a formidable obstacle in the way of advancing colonists. Unlike the Hottentots, they had some skill in metal work, being armed with assegais. Like Caesar's Germans, whom, in fact, they closely resembled, they did not specially devote themselves to agriculture, living rather on milk—that is, the nutritious curdled milk which they preserve in gourds known as *kalabashes*—on beef, and to some extent on the game they took. Yet even their rough and superficial cultivation of maize and Kafir corn (millet)—the latter used especially to make their native beer—raised them many stages above the mainly nomadic Hottentots. If their tillage was, and is, wretched, they had in older, roomier days a shrewd eye for the best patches of soil, and habitually settled in one spot for from five to seven years; then, even if the ground was not exhausted, their huts needed to be moved for hygienic reasons, and they moved slowly on 'picking out the eyes of the country' in their progress. This, no doubt, was highly wasteful, but the Bantu were tribally rather than territorially organized, and since land was plentiful, their ideas of boundaries were as vague and rudimentary as their notions of land ownership. Yet they were definitely attached

to their own 'country', and the traditional reverence for the graves of their great chiefs suggests that the Bantu were no mere nomads. Thanks to their agriculture, and to the fact that in winter, or in time of drought, their cattle got some sustenance from the stubble of the fields, their food supply was far more regular than that of the Hottentots. This may account for the generally magnificent physique of these Bantu peoples. It also explains how, whatever their actual numbers, they were relatively closely settled, and for that reason more formidable. The Hottentot mode of life under the best circumstances could hardly support as many as three to the square mile, whereas the Bantu system could probably, without undue pressure, maintain a population of at least ten, and possibly more, anywhere in the important Cape-Natal area. Conditions in the north-west or Bechuana area being less favourable, but the country less important, there the rather scanty population has been forced into relatively large villages in the immediate neighbourhood of the stronger springs, whereas in the east, except where they clumped together for defensive reasons, the *kraals* (huts belonging to a family unit) tended to be scattered broadcast" (W. M. Macmillan).

This author goes on to emphasize how this mode of life, which freed many men from continuous and arduous toil not only enabled a part of the man-power to be habituated to hunting, cattle-thieving and fighting, but was sufficiently sedentary (it may perhaps be described as semi-sedentary) to admit of a tribal organization, the chief being aided by headmen and a council. With other writers, he observes that tribal coherence depended much upon the character of the chief; but that the form of government, in a rudimentary way, was constitutional. He might perhaps have added that the more temperate climate and the absence of parasitic diseases which debilitate so many negro peoples elsewhere in Africa contributed to the vigour of the South African Bantu.

Their weakness, derived from the long centuries of southward expansion into apparently illimitable grassland or bushland peopled only by a few Hottentots or Bushmen, was an inexorable demand for land. In the early nineteenth century,

when missionaries, traders, administrators and the vanguard of Boer migration were enlarging our knowledge of the Bantu peoples, inter-tribal warfare was commonly attributed to mere savagery. But it was rather due to white aggression against the southernmost tribes, in the basins of the Fish river and Kei river, where the expansive tendency of both races came in conflict, and which (to use a physical metaphor), generated pressure far to the north. Thus the French missionary Casalis, writing from Basutoland in 1848, commented:

"Much confusion arises from the limited and erroneous ideas generally entertained. . . . The population is underrated, the actual and future wants of the tribe are not taken into consideration. . . . The present lamentable war of the Basutos and the Mantatees, which originated in nothing else than a land question, shows sufficiently how keen and deep are the feelings of the natives on the subject."

European settlement in South Africa began in 1652, when the Dutch East India Company founded Cape Town as a revictualling station for its ships sailing between Holland and the East Indies. The original intention was strictly limited, and it was conceived that a population of a few hundreds would suffice to produce the goods and services required by passing ships. It was hoped that cattle could be obtained by trading with the Hottentots. This proved impracticable; and so 'free burghers' were given land in the environs of Cape Town, but within the Cape Peninsula. This they farmed with such success that the later governors provided themselves with estates, upon which they cultivated the vine and wheat, or kept large herds of cattle. The free burghers were augmented in 1688 by Huguenots from France, and soon the produce available far exceeded the needs of ships and the inhabitants of Cape Town. In fact, the estates of the Governor and other officials were quite able to provide all that was required. Having a privileged position in the market, they deprived the free Burghers of the economic function for which, as a class, they were originally created. The Burghers accordingly began to migrate eastwards, to be beyond the Company's writ and its powers to tax or exact rent. Their desire was soon fulfilled; for, reaching the semi-arid lands where pastoralism alone was practicable, they helped themselves to

land which seemed boundless. They learned to relish a diet of little else than animal food, hunting game rather than slaughtering their cattle and sheep. They became accustomed to live in tent-wagons, and acquired a fondness for a healthy, independent, simple, hardy life. In short, they were bred, in one or two generations, into a race of frontiersmen and pioneers. Adapting elements in their European knowledge—horsemanship, the use of the rifle and of the wagon, they made themselves possessors of the land. It was indeed from the Old Testament that these bold adventurers gained inspiration. Like the Israelites, they believed that they were divinely commissioned to subjugate an inferior race, predestined to a life of servitude. Miscegenation between Burgher and native was a mortal sin: the two races must for ever remain distinct.

Hottentots and Bushmen did not succumb without a struggle. The former stole cattle; the latter stole or hunted cattle and even stalked men. The earliest strife was with the Hottentots, soon after the foundation of the colony; but it was disease rather than warfare which broke this people. They were almost annihilated by an epidemic of smallpox in 1713, and the survivors submitted to the Burgher yoke. The Bushmen remained, perhaps because their less gregarious life limited the spread of infection, and, continuing to hunt and steal cattle, they were exterminated. Commandos, *i.e.*, small bodies of armed horsemen, were formed to pursue cattle-thievers. On interception, the men were shot, and the women taken into captivity. The resistance lasted a century. During the last ten years of the Dutch rule (1785–95), 2,500 Bushmen were killed and nearly 700 were taken prisoner, at a loss of 276 persons—coloured and white—killed by the Bushmen. By then, Bushmen only survived in the most arid northern regions of Cape Colony. Captives, interbreeding with Hottentots and descendants of slaves introduced in the first days of the Company, formed the Cape Coloured community. Till 1833, these remained a class of slaves; since that date, they have been labourers and small tenants.

After the Hottentots had been crushed, the Boers could occupy land for a considerable distance. They followed the line of least resistance, *i.e.*, eastwards from Cape Town, along the

longitudinal valleys, and the littoral, more productive because of its higher rainfall. The Great Karroo, baked and arid in summer, was not permanently occupied; but herds were driven there for wintering from the valleys of the Nieuweld Berge and the Roggenveldt Berge. For much of the eighteenth century, the expansion continued. Such was the spirit of independence that no man could brook seeing the smoke of a neighbour's chimney from his own steading. It was customary to walk a horse for an hour from one homestead before choosing a site for the next. This, and the preference for pastoral farming, caused the average farm to extend to several thousand acres. Cultivation was restricted to the kitchen garden and a few acres of grain near the house, intended to provide only for home consumption. The country was devoid of effective communications with the ports, and it would have been futile to produce more. Hides and tallow could, however, be carried in ox-waggons to the coast, and it was from the sale of these commodities to traders that the Burghers obtained the means to purchase cloth, tools, weapons, ammunition and a few luxuries. But they were not avaricious. They valued their herds more than luxurious living. They preferred independence and a simple life. Yet it would be wrong entirely to attribute their way of life to freedom of choice. Life was too uncertain and dangerous for refinement in the manner of living. Apart from this, they were becoming isolated from the developing European economy.

We may detect, in their mode of living, consequences both of the nature of the land they were making their own, and of their relations with the indigenous peoples. Throughout the eighteenth century, the Bushmen, lurking in the gullies and caves of the mountains, remained an ever-present danger. The lion and the jackal, too, preyed upon herds. The price of survival was ceaseless vigilance. When a Burgher was not serving in a Commando, he was patrolling his own lands. He was thus in a quasi-feudal position: ownership of land brought with it the obligation—of natural rather than legal necessity—to be perpetually in arms. The labour of the Cape Coloured servants—living in families in simple huts adjacent to the Burgher steadings—was essential; not to relieve the dominant race from servile toil but to ensure that cattle, white womenfolk

and all the coloured dependents, were protected. It is not surprising, therefore, that the cattle were Afrikaner, *i.e.*, of African and not European stock: small, large-boned, large-horned and inured to walking far for food and water. They were reared by Hottentot methods, *i.e.*, exclusively by grazing on open range, 'kraaling' at night to give security from wild beasts. To control grazing by means of enclosures would require experimentation and training the coloured labourers in unaccustomed methods. It was far simpler to let the Hottentot go on tending cattle in his traditional way.

The isolation in which this semi-patriarchal economy grew up fostered these peculiarities. Several writers, soon after 1800, commented on the absence of towns or villages. The settlements consisted entirely of scattered, single steadings. Inter-course was confined to neighbours, and even the stimulus of commerce was absent. As the traveller Lichtenstein remarked:

"In an almost unconscious inactivity of mind, without any attractions towards the great circle of mankind, knowing nothing beyond the little circle which his own family forms around him, the colonist of those parts passes his solitary days, and by his mode of life is made such as we see him."

As if this was not enough, there was no immigration. The Burghers, or Boers, increased rapidly, for they had large families. Were not these open spaces to be possessed by the people of God? Their sons were needed to make good their hold upon the land and aborigines. It is a remarkable fact that the whole Afrikaner community in South Africa today, numbering more than 1,200,000 (1946) is descended from the few hundreds of Dutch, Germans and French who set foot in the continent at the Cape between 1652 and about 1690. Between the arrival of the Huguenots (1688-90) and that of the British "1820" settlers at Algoa Bay, there were no immigrants into South Africa. The Huguenots brought viticulture: the British sheep-farming and handicrafts. In the intervening one hundred and thirty years, Afrikaner pastoral society was cast in its tough, refractory metal, and, resistant to the roughest usage, it has survived until today.

Towards the end of the eighteenth century, the outposts of

Boer settlement had met the van of the southward-moving Bantu along the Great Fish river. The Negroes were checked, and even today, after 150 years of internal population movements, few Bantu are to be found to the south-west in Cape Province. At the time, the Fish river valley became a no-man's-land. The Bantu stole cattle, and the Boer commandos raided native kraals in reprisal. About this time, sovereignty passed, during the Napoleonic Wars, from the Dutch to the British Crown. This brought South Africa into the British commercial system, which was soon to be fully transformed by the Industrial Revolution. British immigrants and British capital were to penetrate far beyond the limits of Boer colonization, and were to exploit the country as a source of primary products in exchange for manufactures which were being poured from British factories. The belief in freedom for labour instead of slavery or serfdom, among the middle classes which led the Industrial Revolution, was allied to a humanitarianism evoked chiefly by the brutality of the African slave trade, and considerably influenced the course of events, settlement, migration and thus the present-day geography of South Africa.

To stabilize the Bantu frontier, the new government at the Cape decided to promote immigration to the hinterland of Algoa Bay. The '1820 settlers' numbered about 4,000, and were selected from perhaps 20,000 or more applicants. Of better calibre than the ne'er-do-wells settling elsewhere at this period, they have contributed substantially to the leadership of the British community in South Africa. Farmers rather than semi-nomads, such as were the Boers, they introduced sheep, grew grain and founded some towns, the original nuclei being the forts built to render military control effective in protecting the zone from the Bantu. From the beginning surplus produce, mainly wool, was exported.

About the same time, British missionaries entered the country, soon to penetrate far beyond the previous limits of European settlement. In the interior, after crossing the Orange river, they followed the western axis of Bantu migration in the reverse direction, thus making the 'missionary road' which, passing through Kuruman, provided for Livingstone his approach to the heart of Africa. Missionaries were the heralds,

as elsewhere, of the flag; and the annexation of British Bechuanaland was a direct consequence. Later in the century, when German imperialism sought footholds in this continent, the Bechuanaland Protectorate was proclaimed. In both territories, but especially the latter (which is administered by the Colonial Office and not by the Union of South Africa), the Bantu have to a certain extent been insulated from the full consequences of the European penetration into South Africa.

But the missionaries were also the watch-dogs of the anti-slavery movement in England. Insisting upon the full application of the emancipation Act of 1833, they helped to provoke the Boers to leave Cape Colony. The latter, Calvinistic Christians, believed that the black races were predestined to serve the white. Depending upon their black servants, whom they generally treated not unkindly, their economy was undermined by emancipation. They believed that a feudal society was still essential, for they asserted that the government's capacity to police the country and to defend against the Bantu was ineffective. Moreover, their slaves, if freed, would probably prefer to revert to their original economy, and would become squatters rather than paid labourers. The Boers, having no liking for commerce, had no means to pay wages. In 1836, many thousands of Boers packed their families and household goods into ox-drawn wagons and crossed the Orange river. The Veldt lay before them. It was largely unoccupied by the Bantu, and the Boers could live as they desired unhampered by the British colonial government. Their main thrust carried them almost to the Tropic of Capricorn, where, reaching the malarial Buschveld, they stopped. A subsidiary stream of *Voortrekkers* crossed the Drakensberge and entered the hinterland of Durban, which had been previously occupied by the British to deny its useful harbour to the French during the Napoleonic Wars. British colonists had been penetrating into the same hinterland, and the desire of the Boers for independence east of the Drakensberge was disappointed when the British government annexed the whole coastal slope shortly after the Great Trek. But on the plateau proper, the Voortrekkers and their descendants felt that they had made good their independence when the British Crown recognized the

Orange Free State and the Transvaal as sovereign states.

But Boer and British rule over South Africa had not quite reached its fullest development. The early British administration at the Cape had sought to stabilize the relations with the Bantu by promoting and recognizing small native chieftaincies, across the Kei river in what was then called Kaffraria, in Griqualand East and Griqualand West along the Orange river. It was hoped that the recognition of chiefs would strengthen their authority and enable them not only to control their people but preserve themselves from despoliation by European settlers and traders. The policy did not achieve success; and the colonial government had to assume responsibility. But the chieftaincies have become native reserves from which white settlement has been prohibited. Farther north, in Basutoland and Swaziland, protectorates were established; the former mainly at the initiative and diplomacy of a remarkable native chief who realized that the British Crown alone could protect from ultimate absorption by the Boers and the disintegration of his people.

Thus the peoples and races of South Africa are today to a great extent distributed as they were in 1850 when the tides of Boer migration and British immigration temporarily ceased to flow. And the distribution of communities is reflected both in the ownership and occupation of land, and the political geography. The two tongues of Bantu migration today correspond with the protectorates, east and west of the Veldt, and with the native reserves of Natal and Cape Province. The Boer policy of occupying the whole country, and bringing the natives into servitude, combined with the paucity of Hottentots in Cape Colony and of Bantu north of the Orange river cause the Orange Free State and the Transvaal to be largely void of native reserves, except in the unwanted Buschveldt in the extreme north. The descendants of British settlers are strongest in the districts just inland of Durban and East London. In Natal, where the coastal lowland is tropical, sugar-cane was planted and indentured labourers brought from India to perform the manual tasks in cultivating, cutting and extracting. Their descendants form a sixth distinct racial group in South Africa. They are small holders and retail traders.

But the distribution of peoples in the countryside gives little indication of the situation in the towns. The Orange Free State and the Transvaal had been recognized for only thirty years when the discovery of gold in the Rand and the foundation of Johannesburg in 1886 disturbed the precarious balance. The diamond mines at Kimberley, discovered in 1870, had previously provided justification for extending the railways into the interior. Now, into the heart of the Voortrekker's utopia came British engineers, Jewish financiers and adventurers from most countries. Within ten years the Boer republics were confronted with a completed railway network and a rapidly growing mining city which might become the economic capital of South Africa. Here, and in older settlements which had become railway junctions, British business men and engineers rapidly increased in numbers and acquired control of commerce and transport. The new urban development, from the first, began to suck in the Bantu. They came from the reserves and the protectorates to work as labourers under contract, or to live in native quarters, earning their livelihood by unskilled and semi-skilled work.

Two other aspects of the South African economy remain for comment. The Bantu are a vigorous and fecund people. Tribal warfare tended to check their increase before their subjugation by Europeans; but during the past century they have greatly multiplied, and they now number 7,800,000 (1946). Apart from European immigration, they would probably have occupied the whole country as far as the Cape, conquering the more primitive peoples and taking their land. But the European conquest has disrupted their social order and their economy. Tribal society has largely disappeared in the areas occupied by Europeans. Native families are scattered among the European farmers and estates, as servants living in quarters close to the proprietor's house, as labourers permitted to till for their own use small arable plots near their huts or as tenants of small holdings. They are not permitted to keep weapons of any kind, and hunting has therefore ceased to be a means of providing fresh meat. They live nowadays on millet or maize, with only occasional milk or meat. In the native reserves or the protectorates, the position is no better. Hunting, again, has ceased, though small animals or birds

may be snared. The small-scale cultivation of suitable patches close to *kraals* continues, with the use of remaining land as common grazing. But the production of grain is pitifully small and the cattle half starved. The cultivation and over-grazing of hill-sides is exposing the soil to severe erosion.

The Chief Magistrate of the Transkei Reserve wrote in 1936:

"The native is now primarily an agriculturist and secondarily a pastoralist. In other words he exists on mealies grown by himself and regards his cattle as wealth negotiable only in times of dire need. . . .

He has increased considerably in numbers and the Territories can now be said to be over-populated and over-stocked, the latter condition arising out of the former. . . .

Grazing grounds are largely trodden out, seeding rarely takes place and quality of grazing is seriously impaired.

Every available foot of arable land is used. Lands have been badly located and frequently occur on very steep slopes.

Indigenous forest and bush have largely disappeared.

The number of stock is far in excess . . . of what it should be . . . but the number per family is barely sufficient. . . .

Native customs and mode of living render effective reclamation measures exceedingly difficult . . . drastic steps only . . . will solve the problem:

1. Reduction in the number of stock.
2. Purchase of additional land to alleviate the over-population.
3. A . . . scheme of stock and grazing control."

The growing towns have absorbed a large Bantu population, but for the contract labourer and the permanently urban-dwelling Bantu alike, the poor housing and the demoralization brought about by separation from the family and the sense of inferiority, have been most detrimental, and vice abounds. It has been stated by experienced doctors in South Africa that the health of the Bantu is not so good as it was fifty years ago. Despite the availability of more than a rudimentary medical service, the bad social conditions of the towns and the meagre subsistence in country districts are undermining the physique of the native population.

The geographical distribution of the natives and the native

reserves has another important aspect. The Bantu are particularly numerous in the eastern highlands, in which rise the chief rivers of the Union. Both the extent to which the land was already occupied, and the ruggedness of the terrain, deterred the British or Boer settlers. But the increasing native population has intensified erosion along these critical watersheds, and it is an axiom of soil conservation that effective control must begin at the sources of rivers. In a report to Parliament on Basutoland in 1935 it was stated that

“erosion in its many aspects is now the most immediately pressing of the many great problems which confront the Administration.”

The Colonial Office has begun remedial works; but it is realized that the only complete solution rests with the population; and no one would confidently assert that, short of the direst compulsion, the native economy could be revolutionized in the way demanded by the situation.

The erosion of soil is not confined to the native reserves. It is practically universal in South Africa. To this both pastoral and arable farming have contributed. Burning grass and other plants of the natural vegetation, prior to ploughing and sowing wheat or maize has exposed the soil to the disintegrating effects of rain. Sheet or gully erosion has become universal. Sheep and cattle, grazing over wide areas, have changed the character of the natural vegetation, and have thinned the plant cover. Moreover, the kraaling of cattle at night and the frequent visits of large flocks or herds to a small number of watering places tramples the soil and gullies often develop which extend far from the valleys.

The effects of over-grazing and soil erosion are intensified by drought, which is recurrent in these regions of light, intermittent rainfall. Losses of stock were very serious just after the First World War, and it was feared that much of Cape Province and the Orange Free State might become a desert. A Drought Commission in 1924 reported that both pastoral and arable farming required reform. Grazing, to be less destructive, would need to be controlled by fencing; gulleying checked, and the water-table raised by damming small streams to form reservoirs. Arable farming on sloping land should only be conducted by

means of contour ploughing, and, probably, terracing such has been widely and successfully adopted in the 'South' of the U.S.A. Irrigation should be greatly extended to provide the water-supply needed by more intensive farming, which could enhance soil fertility and avoid erosion. Of this programme, the last recommendation has perhaps been most fully carried out. The streams draining to the east coast can usually be dammed at a point well above the embouchure, where a sufficient head of water is commanded to enable land along both sides of the channel to be irrigated. Many thousands of acres are thus much more intensively tilled than before, and the citrus fruit orchards of the Union, notably, have been greatly augmented. But fencing to control grazing, reservoir construction and the reform of non-irrigated farming has been tardy; and critics write of the misapplication of funds which have been provided by the government.

Whilst gold remains the principal base of the country's economy, the wastage of the land has seemed to many to be trivial. But the gold now being mined so fast from the Rand is a diminishing asset. Geologists speak of a decline in production within the next twenty years. When the thousands living on the Rand can no longer live by mining and selling gold to the world, South Africa may regret the wastage of the only permanent asset of any country. South Africa has, in fact, been mining its soil as well as its gold. Briton, Boer and Bantu alike have been consuming the land instead of conserving it so that a regular return may be permanently assured. To restore the land to its original capacity as pasture or cropland requires the repayment of an immense capital debt. To increase and maintain its fertility artificially—the objective of all good husbandry—requires further immense capital investment. South Africa has an invisible national debt greater in proportion to the population than the actual national debt of Great Britain incurred by the expenditure of the twentieth-century wars. This debt has been accumulated not by borrowing in war time but by improvident grazing and cultivating in times of peace. The few millions of pounds spent annually in the past twenty years are probably insufficient to make good even current wastage, without beginning to make good past damage. Only a revolution

in the attitude towards the land of both White and Bantu alike can be effective, and of this there is little evidence today. The great public question is conceived to be the present and future relationship between the British, Boer and Bantu. This is no doubt true; but the unrest due to this is not the only jeopardy to the ship of State. More insidious, but not less threatening, is the destruction of the soil.

BIOGRAPHICAL AND BIBLIOGRAPHICAL NOTES TO CHAPTER ONE

Brunhes, Jean (1869–1930). Professor of Human Geography, Collège de France, 1912–30. The first edition of *La Géographie Humaine* was published in 1910. An abridged and edited translation, by E. C. Le Compte, I. Bowman and R. E. Dodge, appeared in New York, under the title of *Human Geography*, in 1920. A new translation, by E. F. Row, has just been announced.

Geikie, Archibald (1835–1924). The leader of outstanding Scottish geologists, Geikie's career was within the Geological Survey of Great Britain (1855–1901), of which he became Director-General, apart from an interval (1870–81) when he was Murchison Professor of Geology in the University of Edinburgh. He was President of the Royal Society from 1908 till 1913. His *Physical Geography*, in a series of Shilling Primers on Science, introduced the term to the English language. In 1884 he expanded this work into his larger *Lessons on Physical Geography*.

Humboldt, Alexander Freiherr von (1769–1859). After studying at Frankfurt, Berlin and Göttingen, H. travelled in Western Europe (1790), and from 1799 till 1804 widely in Central and South America. In 1808, he went to Paris on a diplomatic mission, and remained until 1827. During these years he wrote his renowned narratives, which were translated into English by H. M. Williams (1814–29) and by Thomasina Ross (1852–3). In 1829 he travelled to Central Asia. Settling afterwards in Berlin, he wrote his *Kosmos*, which was published in five volumes between 1845 and 1862 (English translation, by E. C. Otté, London, 1849–58).

Hutton, James (1726–97). After qualifying as a doctor, and practising for some years, H. retired and settled in Edinburgh in 1768, devoting the latter half of his life mainly to geological studies. His *Theory of the Earth* was published in 1795.

Malte-Brun, Conrad (1775–1826). Danish by birth, and a poet in early manhood. M.-B. was expelled from his native land because of his partisanship for Revolutionary ideas. He settled in Paris, where he became a founder and first Secretary of the *Société de Géographie*. His *Précis de Géographie Universelle* was thrice republished (1831, 1841, 1856–7). Under the title of *Universal Geography* an English translation of the original edition was published in Edinburgh in 1822–3.

Mill, Hugh Robert (1861–1950). *The Realm of Nature* was the outcome of lectures given at the Heriot-Watt College, Edinburgh, between 1884 and 1892. From the latter date until 1900, M. was Librarian to the Royal Geographical Society, London, and afterwards, until his retirement in 1919, was Director of the British Rainfall Organization.

Münster, Sebastian (1489–1552). Mathematician, geographer and hebraist. M. was born in the Palatinate, was admitted to the Franciscan order as a young man, and embraced Lutheranism in 1529, afterwards teaching in Basle. His *Cosmographia* or universal geography, in the compilation of which he was assisted by 120 collaborators, was first printed in 1544. The best edition, in Latin and German, is that of 1550, which contains many illustrations of cities and costumes.

Playfair, John (1748–1819). Professor of Mathematics in the University of Edinburgh from 1785 till 1805, and afterwards of Natural Philosophy. His *Illustrations of the Huttonian Theory of the Earth* was published in 1802.

Ratzel, Friedrich (1844–1904). Trained originally in natural sciences, R. became travelling correspondent of the *Kölnische Zeitung* in Europe and North America. In 1880 he became Professor of Geography at Munich, and in 1886 at Leipzig, where he remained until his death. He was a prolific writer, and published many shorter volumes on geographical subjects in addition to the greater treatises cited in the text. Only the *Völkerkunde* was translated into English, but E. C. Semple's *Influences of Geographic Environment on the Basis of Ratzel's System of Anthro-Geo-Geography* (London, 1911) may be consulted by those unable to read the *Anthro-Geo-graphie* in the original language.

Reclus, Jean Jacques Elisée (1830–1905). Elisée was the eldest of four distinguished sons of a Protestant pastor. Two others, Onésime and Armand, were also geographers; the fourth was a surgeon. Of radical and republican persuasion, Elisée left France at the foundation of the Second Empire in 1851. After his return, in 1859, he collaborated in founding the *Revue des Deux Mondes*. In 1867, he completed *La Terre et L'Homme, Description des Phénomènes de la Vie du Globe*, which was translated into many languages (English edition, edited by A. H. Keane, London, 1886). The English translation of the *Universal Geography* was published in London between 1878 and 1894.

Ritter, Carl (1779–1859). The first modern professor of geography, at Berlin, from 1820. Only his last work, expounding his

geographical principles, was translated, by W. L. Gage, under the title of *Comparative Geography* (Edinburgh, 1865).

Sorre, Maximilien (1880–). Professor Sorre's career has been entirely academic, and in France, where he has held appointments as Professor, Dean or Rector in the Universities of Lille (1917–31), Clermont-Ferrand (1931–4), Marseille (Aix) (1934–42) and in the Collège de France at Paris. The first volume of the *Fondements Biologiques de la Géographie Humaine* was published in 1943; the second, in two parts, followed at the end of the Second World War, and the third has not yet been completed.

Strabo (c. 64 B.C.–c. A.D. 21). Educated in Rome, Nysa and Alexandria, S. seems to have written most of his *Geographica* in Egypt (where he derived much material from earlier Greek authors), and the remainder in Rome. The best English edition, by H. L. Jones, was published in the Loeb Classical Library in eight volumes (1917–32). A more literal translation, in Bohn's Classical Library, by H. C. Hamilton, was published in 1854–7, and reprinted in 1906–13.

Vidal de la Blache, Paul (1845–1918). Professor of Geography at the Sorbonne, Paris, from 1889. The *Tableau de la Géographie de la France* was published in 1903 as volume I of Lavis's *Histoire de la France*. The first part only, under the title of *The Personality of France*, was translated by H. C. Brentnall (London, 1928). The *Principes de Géographie Humaine* was translated by M. T. Bingham in 1926.

Varenus, Bernhardus (1622–50). Born near Lüneburg in north Germany, V. at first studied medicine, but was attracted to geography through friendships with Dutch explorers and cartographers. His *Geographia Generalis*, first published in 1650, was the best treatise on mathematical geography for a century. English translations were made by Dugdale in 1733 and Shaw in 1736.

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INDEX

A

Acosta, 42
Adam's Peak, 43
Addison's disease, 44
Aegean Sea, 95
Aeschylus, 16
Aeta, 59
Afghanistan, 71
Africa, 11, 18, 51, 63, 80, 102-3,
106-7, 119, 131, 132, 155
—— central, 54, 58, 92, 151
—— eastern, 58, 69
—— northern, 23, 53, 58, 71, 112,
113
—— South, 136, 159-79
—— south of the Sahara, 58
—— tropical, 150
—— western, 58, 62, 146
Agathe, 16
Agde, 15, 16
Agriculture, 91, 103-4, 108, 114,
116, 120, 165
Ainu, 134
Aix-en-Provence, 15
Alpilles, 21
Alpine flora, 80, 82
—— (sub-) race, 60, 63
Alps, 14, 17, 60, 111
Amazonia, 60, 139
America, North, 59, 71, 80, 90, 125,
132, 154, 156
—— North, temperate, 149
—— South, 87, 92, 97, 98, 126, 132
—— South, eastern, 146
—— South, tropical, 62, 150
Americas, The, 32, 59, 97, 119
Amerindians, 59, 156
Anatolia, 60, 105, 107
Andaman Islands, 59, 100-1
Andes, 42
Animals, 33, 133
Ankara, 105
Antarctica, 32, 40, 79, 83
Anthropology, Physical, 49
—— Social, 17, 37
Antibes, 15, 17

Antipolis, 15, 17
Ape-men, 51, 52
Apes, 49
Apian, 13
Apollo, 15
Arabs, 76, 127
Arabia, 41, 48, 54, 94, 95
Arauris, 16
Arctic Ocean, 32, 59, 73-4, 131
Arelate, 16
Argentina, 102-3
Aristotle, 16, 18
Arles, 16
Armenia, 60, 76, 105, 155
Artemis, 15, 17
Aryans, 60, 76, 111
Asia, 51, 53, 54, 77, 78, 79, 80, 91,
128, 138, 150
—— central, 52, 54, 55, 94, 95, 106
—— Minor, 11, 18, 71, 95, 111
—— northern, 52, 87
—— southern, 53
—— south-eastern, 47, 55, 69, 81,
109
—— south-western, 54, 58, 106, 107,
108, 130
—— western, 155
Assyria, 107
Athens, 112
Atlantic Ocean, 23, 32, 105, 118
Augustus, 11
Aurignacian (period), 87, 89
Aurochs, 90
Australia, 32, 54, 55, 79, 80, 102, 123,
126, 127, 133, 155, 157
Australian aborigines, 58, 86, 100,
134, 137-8, 151, 154
Azov, Sea of, 105
Aztecs, 102-3

B

Bacon, Roger, 118
Baeterra, 16
Baghdad, 13
Bahia, 126
Balkan Peninsula, 105, 155

Baltic Sea, 60, 73, 105
 Bantu, 99, 136, 164-7, 172-9
 Barbados, 64
 Barley, 95, 96, 117, 131
 Barometric pressure, 41-2
 Basutoland, 160, 168, 174
 Batavia, 70
 Bates, H. W., 60
 Bay Islands, 64-5
 Beaucaire, 15
 Bechuanaland, 160, 167, 173
 Beduin, 48, 94, 100-1
 Behring Straits, 32, 59, 79
 Beziers, 16
 Bilharzia, 64, 66, 144
 Bio-geography, 18
 Bison, 87, 92
 Black earths, 85-6
 Black Sea, 60, 76, 105, 112, 128
 Blaeu, Jan, 19
 Blascon, Isle of, 15
 Boers (Burghers), 151, 159, 168-75
 Bombay, 127
 Boro, 98, 100-1
 Bornes, 17
 Brazil, 70-1, 102-3, 126, 158
 Brisbane, 67
 Britain, 89, 110
 British Columbia, 89
 Bronze Age, 60, 74, 99, 111
 Buenos Aires, 126
 Bundaberg, 67
 Burdekin River, 68
 Burma, 81, 90, 98, 102-3
 Bushmen, 58, 100-1, 134-5, 154, 164-7, 169
 Buxton, C. H. D., 45

C

Caesar, 15
 Cairns, 67
 Calcutta, 127
 California, 76, 100, 124
 Callao, 126
 Camargue, 23
 Cambodia, 98, 102-3
 Canada, 100-1, 102-3, 123, 132, 157, 159
 Cape Colony (or Province), 124, 162, 169, 173-4, 177
 — Town, 160-1, 168
 Caracas, 126
 Caribbean (Sea), 62, 64-5, 146
 Casalis, 168
 Caspian Sea, 60
 Cattle, 93, 99, 100, 116, 123-4, 132, 147, 149, 164-5, 171
 Celebes, 59, 80
 Cemmenus, 14, 16
 Cereals, 22, 71-2, 91, 93, 95-8, 102, 110, 131
 Cevennes, 14, 16
 Ceylon, 18, 43, 59, 69, 90, 98, 142, 145-6, 151
 Chibchas, 102-3
 Chile, 124, 126
 China, 51, 67, 76, 96, 99, 102, 104-6, 109, 112, 120, 125, 129, 150, 155
 — central, 107
 — northern, 52, 55, 74, 96, 104, 106-7, 109, 120
 — Sea, 105
 — southern, 105
 — south-western, 98
 Chinese, 59, 78, 104, 112, 124-5, 155
 Chota Nagpur, 59
 Cimmerians, 76
 Ciotat, La, 17
 Cities, 110, 112, 115, 125-8
 Citrus fruits, 96, 97, 120, 124, 180
 Climate, 31, 41-9, 52, 55, 66, 69, 70-8, 79, 105-6, 160
 Colombia, 97
 Colorado beetle, 141
 Columbus, 13, 97-8
 Communications, 98-9, 101, 103
 Comtat, 21-3
 Configuration, 25, 105-6
 Cooktown, 68
 Cordoba, 13
 Corn belt, 124
 Costa Rica, 63, 71
 Côte d'Azur, 22
 Cotton, 93, 95, 96, 120, 124, 141, 158
 Cox, Sir P., 47
 Crau, le, 16, 18, 21, 23-4
 Crete, 95, 111-2, 145
 Cuba, 63, 71
 Cultivation, 72, 91, 95-103, 110, 166
 Cuzco, 126
 Cyrenaica, 75

D

- Danube, River, 74, 110, 121, 128, 129
 Darwin, Charles, 27, 31, 37, 132
 Darwinism, 40
 Denmark, 64, 74
 Dog, 92, 96
 Domestication of animals, 90, 92-4
 Dordogne, River, 73
 Drakensberge (mountains), 160
 Dravidians, 44
 Durance, River, 21, 24
 Durban, 161
 Dutch, 18, 65, 70, 168, 171

E

- East Indies, 32, 54-5, 69-70, 79, 97, 105, 112, 132, 142, 147, 150, 154
 East London, 174
 Ecuador, 97
 Egypt, 72-3, 76, 90, 95, 104, 107-8, 110-11, 113, 144, 155
 Elephant, 90, 96
 England, 35, 60, 63, 64, 99, 116, 118, 125
 Environment, 28, 78, 130
 Equatorial rain forest, 80, 81
 Eskimos, 43, 45, 87, 89
 Ethnology, 17, 37
 Euphrates, River, 71, 72, 112
 Europe, 11, 51-3, 58, 60, 76, 77, 80, 90, 95, 102, 105-6, 111, 119, 120, 125, 129, 141, 149, 150
 — central, 107, 111, 121
 — eastern, 90, 105, 111
 — northern, 59, 94
 — southern, 63, 94, 123, 155
 — western, 32, 35, 51, 60, 73-4, 119, 121
 Europeans, 46, 60, 63, 118, 125, 147, 155-7, 159, 168
 Evaporation, 47
 Evolution, 35, 49-50

F

- Far East, 96, 109
 Feudal system, 117
 Fèvre, J., 20, 24-5, 27-8

- Finland, Gulf of, 105
 Flax, 72, 95
 Food collecting, 86-88, 100, 134-8
 Forests, 73, 80-2, 110, 115, 128-9
 Forum Julium, 17
 France, 63-4, 99, 110-14, 116, 129, 141
 Fréjus, 17
 Fuegians, 45, 100-1, 134-5.
 Fulani, 100-1

G

- Galton, Sir F., 90
 Ganges, River, 104, 112, 127, 129
 Garrigue, 24
 Geikie, Sir A., 36
 Genoa, 23
 Geography, Economic, 34
 — Physical, 18
 — Political, 14
 Geomorphology, 37
 Germany, 60, 74, 115-17, 123, 129
 Graeco-Roman civilization, 75, 104
 Grand Cayman Islands, 64
 Grant, C. P., 78
 Grasslands, 80, 82-3
 Great age of discovery, 18, 35, 62, 78, 97, 104, 119, 120, 149, 157
 — Lakes, 97
 — Trek, 173
 Greece, 21, 111, 124, 145
 Greeks, 113
 Greenland, 89, 118
 Guayakis, 87
 Gunz (glaciation), 60

H

- Hallstadt, 111
 Hauser, H., 20, 24-5, 27-8
 Heracles, 16
 Herault, River, 16, 23
 Hiong-Nu, 76
 Hissarlik, 111
 Hittites, 107, 111
 Hoang-ho, 96, 104
 Holland, 64, 117-18
 Homer, 12, 113
 Hominids, 51-2
 Honduras, 65

Hookworm, 64, 66, 143-4
 Hottentots, 151, 164-71
 Humboldt, 36
 Humus, 84-5, 129
 Hungary 105, 129
 Huns, 76
 Hunting, 72-3, 86-8, 100-1, 110,
 115, 135, 164-5
 Huntington, E., 75-8
 Hutton, J., 36
 Hydrosphere, 28, 38, 79

I

Ice Age, 32, 51, 71, 79, 91, 133
 Incas, 102-3
 India, 11, 53, 60, 69, 76, 81, 90-1,
 96, 99, 102, 104-5, 106, 109, 112,
 120, 125, 127, 129, 147
 ——— northern, 48, 96, 106
 ——— southern, 44, 59, 143
 Indian Ocean, 105, 118, 160
 Indo-China, 59, 79, 81, 97, 105, 147
 (see also Asia, south-eastern)
 Indus, River, 104, 109
 Industrial Revolution, 35, 109, 112,
 125, 127, 172
 Iphigenia, 43
 Iran, 76, 107 (see also Persia)
 Irish, 12, 122
 Iron Age, 111
 Islam, 13, 107
 Italy, Italians, 21, 67, 99, 111, 114,
 121-2, 145

J

Japan, 80, 96, 102-3, 105, 112, 155
 Java, 51, 53, 54, 70, 102-3, 105, 139,
 158
 Johannesburg, 175
 Juan Juan, 76

K

Kalahari Desert, 106, 164, 165
 Kalmuck, 100-1
 Kanakas, 67
 Karachi, 127
 Karroos, 160, 161, 169
 Kazacks, 100-1
 Kenya, 69

Kimberley, 175
 Kirghiz, 100-1
 Korea, 112
 Kubu, 59
 Kurds, 100-1

L

Labat, Father, 65
 La Guayra, 126
 Lake-dwellings, Swiss, 75
 Lamanon, Gap of, 21
 Lanarkshire, 125
 Languedoc, 21-3
 La Plata, 97
 Lapps, 132
 Latifundia, 114
 Latium, 113
 Lauraguais, 24
 Levant, 78, 95, 96, 104, 106, 108,
 111, 118, 120, 122
 Lez, River, 23
 Lichtenstein, 171
 Lignes, 16
 Lima, 126
 Livingstone, D., 38, 172
 Loess, 74
 London, 31
 Lyell, Sir E., 32

M

Mackay, 67
 Mackenzie, River, 59
 Macmillan, W. M., 166-7
 Madras, 127
 Madrid, 105
 Magdalenian period, 87
 Magellan, 13
 Maghreb, 21
 Maize, 92, 97, 99, 102, 117, 120, 121,
 124, 134, 166, 177
 Malaria, 64, 66, 144-5, 162
 Malaya, 59, 69
 Malays, 44, 59, 119, 138
 Malte-Brun, C., 19, 20, 24, 29, 39
 Manchuria, 155
 Maoris, 157
 Marius, 16
 Marseille, 23
 Maryborough, 68
 Masai, 100-1

Massilia, 14, 15, 25
 Massiliotes, 16, 17, 25
 Mediterranean economy, 113
 — France, 14–18, 20–4
 — lands, 11, 110, 111, 113, 117
 — race, peoples, 60, 63
 — Sea, 23, 60, 71, 75, 81, 104, 105, 111, 112, 124
 Melanesian(s), 44, 80, 154
 Mesolithic period, 110
 Mesopotamia, 48, 72, 73, 95, 104, 107, 108, 110, 111
 Mesozoic era, 35
 Metayage, 114
 Mexican boll weevil, 141
 Mexico, 97
 Micronesia, 80
 Migrations, Human, 14, 33, 35, 62–77, 118, 165
 Mill, H. R., 37
 Millet, 95, 96, 99, 102, 120, 166, 175
 Mindel glaciation, 60
 Mississippi, River, 124
 Mohammed, 76
 Mongoloids, Mongolian man, 53, 55, 59, 87
 Mongols, 77, 100–1, 128
 Monoculture, 22, 114
 Monsoon lands, 96, 158
 Montelimar, 20, 21
 Montevideo, 126
 Moscow, 128
 Mulberry, 22, 96, 120
 Munster, S., 13, 39

N

Nairobi, 69
 Narbo, 14, 16
 Narbonitus, 14, 17, 18
 Natal, 160, 161, 173, 174
 Neanderthal man, 52, 55, 58, 60
 Near East, 35, 71, 73, 78, 96, 110
 Negrillos, 58
 Negritos, 59, 60, 135
 Negroes, 44, 45, 46, 58, 62–4, 145, 151, 158
 Nemausus, 14
 Neolithic age, 35, 72, 74, 94–5, 110
 Netherlands, 63
 New Guinea, 55, 80, 137, 138

New World, 35, 59, 79, 80, 94, 102–3, 122, 124, 134, 149, 151
 New York, 126
 New Zealand, 123
 Nicaea, 17
 Nice, 17
 Nile, River, 40, 71, 72, 99, 112
 Nîmes, 14
 Nomadism, Pastoral, 72, 76, 100–1
 Nordic (sub-) race, 60, 63
 Northern coniferous forests, 80, 82, 125, 131
 Nyasaland, 69

O

Occidental economy, 102–3, 109–30
 Oceanography, 37
 Okhotsk, Sea of, 106
 Olbia, 17
 Old World, 32, 35, 48, 71, 76, 77, 79, 80, 90, 94, 105, 106, 107, 109, 134, 149, 151
 Olive, 22, 95, 113
 Oman, 47
 Orange Free State, 160, 161, 176, 179
 Orbis, 16
 Ox, 93, 95–6, 110

P

Pacific Ocean islands, 32, 80, 103, 151, 158
 — peoples of, 59, 60
 Paiute Indians, 91
 Palaeolithic Age, 51, 58, 73, 87, 89
 Palestine, 75
 Palmyra, 75
 Palus, 21
 Panama Canal and Zone, 66–7, 119, 145
 Papuans, 100–1
 Parasites, 140–51, 167
 Pastoralism, 89, 94, 96, 100–1, 115, 132, 134–5
 Peake, H., 90
 Peking, 105
 Pernambuco, 126
 Persia, 95, 107 (*see also* Iran)
 Peru, 42, 97, 126, 158
 Philippine Islands, 59, 63, 79, 105, 142, 158

Philosophy, Greek, 11, 12
 Phocaeans, 15, 23
 Phoenician, 23, 122
 Pig, 95, 96, 124
 Pigmentation, 44
 Plains Indians, 87, 89, 92
 Plantations, tropical, 64, 158
 Playfair, J., 36
 Pleistocene period, 50, 51, 71
 Pliocene period, 50-1
 Podzols, 86
 Polynesia(ns), 59, 67, 80, 118
 Pompey, 15
 Population, 12, 13, 99, 100-4, 109,
 117, 129, 154
 Porto Rico, 63, 71
 Portugal, 63, 119
 Port-Vendres, 20
 Poseidonius, 16
 Potato, 97, 102, 120, 122, 123, 141
 Prairies, 83, 130, 154
 Pretoria, 161
 Provence, 21, 22, 23
 Ptolemy, 13
 Pygmies, 58, 100-1, 134, 164
 Pyrenees, 14, 16

Q

Quaternary era, 52, 133
 Quechuas, 42, 102-3
 Queensland, 63, 67-8, 70, 126

R

Race, 25, 53, 55-60
 Radiation, 43-4
 Ratzel, F., 37-9
 Raynal, 65
 Reclus, E., 19, 20, 39
 Regions, 30
 Rhodanus, 14, 15, 16
 Rhodesia, northern and southern, 69
 Rhône, River, 14, 17, 23, 26
 Rice, 91, 96, 102, 109-20, 122, 124
 Rio de Janeiro, 126
 Riss glaciation, 52, 60
 Ritter, C., 19-20, 27, 29, 40
 Rockhampton, 67
 Roman Empire, 11, 117
 Romans, 15, 114

Rome, 113, 118
 Romulus, 90
 Rousillon, 16, 21, 22, 24
 Rubber tree, 92
 Ruscino, 16
 Russia(ns), 60, 128

S

Saba Island, 65-6
 Sahara, 58, 71, 106, 131, 134
 St. Kitts, 64
 — Tropez, 17
 Sakai, 100-1, 138
 Salisbury (Southern Rhodesia), 69
 Santiago, 126
 Sao Paulo, 126
 Scandinavia, 71, 73
 Science, Physical, 36
 Scythians, 76
 Semang, 100-1, 138
 Semi-deserts, 80, 82, 163
 Sequoia, 75-6
 Settlements, 99, 101, 103, 124
 Sheep, 93, 95, 96, 110, 114
 Shikoku, 105
 Siam (Thailand), 102-3
 Siberia, 41, 44, 54
 Sicily, 99
 Skin, 47
 Sleeping sickness, 147, 162
 Society, Human, 33
 Soil, 23, 79, 84, 156, 176, 177
 Sorre, M., 40
 South Pole, 32
 Spain, Spanish Empire, 63, 64, 73,
 105, 111, 113, 119, 124
 Stein, Sir A., 78
 Steppes, 60, 76, 80, 83, 128
 Stomalimne, 16
 Strabo, 11-18, 24-6, 39
 Sub-tropical evergreen sclerophyllous
 forests, 80-1, 162
 — rain forests, 80-1, 162
 Suez Canal, 23, 26, 119, 127
 Sugar-cane, 96, 157-8, 174
 Sumatra, 59, 151
 Sumeria, 108
 Sweden, 60
 Switzerland, 73
 Syria, 76, 94, 111

T

Tamils, 124
 Tarusco, 15
 Tasmania, 55, 137
 Taurentium, 17
 Temperate deciduous forests, 80,
 82, 115-17, 129
 ——— grasslands, 80, 82, 128-30, 162
 Temperature, 45, 47, 48, 51
 Terrestrial unity, 31-2
 Tertiary era, 35, 50
 Tibet, 42
 Tigris, River, 112
 Toala, 59
 Tobacco, 97, 120, 158
 Topography, 26
 Townsville, 68
 Transvaal, 160, 161, 174
 Tripolitania, 75
 Tropical grasslands, 80, 82, 162
 ——— red soils, 84-5
 Tse-tse fly, 147, 162
 Tundra, 71, 83
 Tunguz, 100-1, 132
 Turan, 95
 Turks, Ottoman, 129
 ——— Seljuk, 76

U

Ugernum, 15
 United States (of America), 60,
 102-3, 124, 130, 155, 156, 158, 163,
 180
 Ural Mountains, 106

V

Varenius, 36
 Varus (Var), River, 14, 16, 17

Vasco da Gama, 13
 Veddahs, 59, 88
 Vegetation, 21, 25, 33, 74, 79, 133
 Veldt, 162, 173
 Venice, 23
 Vidal de la Blache, P., 19, 39
 Vidourle, River, 23
 Vikings, 118
 Villae (Roman), 99, 114-15
 Vine, 95, 113, 114, 124

W

Wagner, Moriz, 38
 Wallace, A. R., 132-3
 Wallace's Line, 54
 Water-mill, 117
 Weald, 30
 Wegener, A., 32
 West Indies, 63, 70, 158
 Wheat, 93, 95, 96, 117, 120
 White Sea, 105
 Windmill, 117
 Würm glaciation, 52, 55, 58-60, 74,
 137

Y

Yangtse-kiang, 96, 104, 112, 129, 139
 Yellow fever, 143, 146-7, 150

Z

Zeus, 16
 Zulus, 165

