
SOUTH AMERICA



Third Edition

ARTHUR MORRIS

SOUTH AMERICA

ARTHUR MORRIS

**CAMPUS
BOOKSTORE
SAVE ON BOOKS**

HODDER AND STOUGHTON
LONDON SYDNEY AUCKLAND

British Library Cataloguing in Publication Data

Morris, Arthur

South America — 3rd ed.

I. South America — Description and travel — 1987 —

I. Title

918 F2224

ISBN 0 340 40607 0 3rd edition

(0 340 27205 8 2nd edition)

(0 340 22625 0 1st edition)

First published 1979

Second edition 1981

Third impression 1991

Copyright © 1979, 1981, 1987 Arthur S. Morris

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system, without permission in writing from the publisher or under licence from the Copyright Licensing Agency Limited. Details of such licences (for reprographic reproduction) may be obtained from the Copyright Licensing Agency Limited, of 90 Tottenham Court Road, London W1P 9HE.

Typeset by BH Typesetters and Designers, Wardington Manor, Wardington, Banbury, Oxfordshire, OX17 1SW and printed and bound in Great Britain for Hodder & Stoughton Educational, a division of Hodder & Stoughton Ltd., Mill Road, Dunton Green, Sevenoaks, Kent by Courier International Limited, East Kilbride, Scotland.

Preface to the Third Edition

There have been a number of changes in South America since the First Edition of this book was published in 1979. I made some alterations for the Second Edition and further changes have been made for this new version. My own ideas have matured with respect to some themes and I have been able to glean some more information on others.

The chapter layout of this edition is made a little more logical and simple by having only two parts, systematic and regional.

There is a new chapter on Politics and Territory, examining the three themes of territorial disputes, including the Falklands, geopolitics and regionalism. The chapters on agriculture and on economic development have both been rewritten completely.

Most of the systematic chapters have substantial modifications. In Physical Geography there is new material on ecological problems and natural hazards. In Industry there is more emphasis on the process of industrialization and on location factors. In the Population chapter there is a substantial discussion of urban growth processes and models.

Some new developments in specific regions are covered in the regional chapters. For example, there is the conversion of the upper R. Negro in Argentine Patagonia to a chain of lakes with hydroelectric power plants. There is also the Brazil/Paraguay border region and its colonization with soya bean farming. Included as well are the problems of massive developments in Brazil's Amazonia, at Carajas, at Tucuruí, and on the Jari river.

Elsewhere there is general updating of the text, and a revision of all maps and diagrams.

Acknowledgments

The author and publisher wish to thank the following for permission to reproduce the illustrations in this book:

Booker McConnell Ltd., plates 35 and 26; the Brazilian Embassy, plates 5, 6, 7, 30, 31, 33 and 34; Christian Aid, plates 14, 20 and 21; Spectrum Colour Library, plates 3 and 22 (photographs by C.E.C. Gannon); John Topham Picture Library, plates 1, 37, 38, 41 and 43; David Wickers, plates 8, 9, 12, 13, 17, 23, 25 and 40.

Cover photo: Rob Cousins

The remaining photographs were taken by the author.

Cartography by Michael C. Shand and Kažia Kram

The following maps were based partially on these sources:

Fig. 1 — maps by J. J. Scholten in *Soil Map of South America* (see Ch.1 bibliography)

Fig. 6 — map of agricultural regions in *Goodes World Atlas* (1967), p. 24

Fig. 32 — maps in J. M. G. Kleinpenning, *T.E.S.G.* (1984)

Fig. 36 — map in J. Bähr and R. Riesco, *Revista de Geografía Norte Grande* (1981)

Preface

It is common for Northern Hemisphere readers to think of all South America as a fairly homogeneous unit, all of it belonging to the Iberian languages and civilization, all in the Third World category, nearly all of it characterized by simple economies, including subsistence agriculture and the production of one or a few items for export. The present text is intended to correct such views, by demonstrating the diversity of landscapes, societies and economies in the continent. In addition to presenting the physical, economic and other patterns, some attempt is made at analysis, based on the author's firmly held view that the best mnemonic for a geographical pattern is understanding of the underlying processes.

As the book is intended for readers not familiar with Spanish or Portuguese, only a limited number of foreign terms are used, with italics and accent marks except where an English form is well known. A glossary is included in the appendixes.

Any regional text in geography is inevitably, to a considerable extent, indebted to a wide variety of authors and to practical help from many sides. I cannot list here all those Latin Americans who have aided me while I was in the regions or my colleagues who have helped in many ways over the years. They must accept this non-specific note of my gratitude. I must particularly thank Mr I. Tilbrook of Chipping Campden and Dr R. P. Beckinsale of Oxford who taught me geography, and the latter especially for suggesting this book. My wife also deserves credit for forbearance, and for designing the maps.

Introduction

The weight of South America in world affairs is relatively slight. It is a continent of substantial size, with area comparable to that of North America, but its *oecumene*, the inhabitable area at the present stage of technological progress, is quite restricted. Areas of very slight population include the cold deserts of the mountain tops and middle-latitude Patagonia; hot deserts, especially along the west coast; and the upland parts of the hot and humid Amazon Basin, where alluvium is not provided by rivers and soils are infertile. Collectively these areas cover more than half the continent, and have defied man's attempts at permanent settlement to date. Thus the impression of the continent as a region of wide open spaces awaiting the settler is not accurate. Population figures of 219 million in 1975, compared to a resident population of nearly 213 million in the United States alone, should not lead us to suppose enormous possibilities for growth.

Nevertheless, the importance of the continent is growing. It is a part of the Third World, which also includes most of Africa, the Middle East and South-East Asia. As such, it is a region which attracts increasingly the attention of the developed countries, for a variety of reasons. First, there is competition amongst the major powers for political influence among these countries, which can give their support to big-power policies in international assemblies and litigation as well as in war.

Second, there is an economic interest in these countries of Latin America, on the part of indus-

trial powers which need their contribution of raw materials and foods in order to supply their manufacturing and processing enterprises. Japan, North America and Western Europe all rely on South American contributions of food and materials. On the other hand, these same industrial countries plus the Soviet bloc all seek to promote their own industrial products as exports to the continent, wherever possible exporting directly from home to a South American market, and if not permitted to do so, penetrating it by setting up subsidiaries on the continent.

Finally, much of the renewed interest in the region must derive from its evidence of internal change. There are all signs, social, economic and political, of a people in the process of development, a process more all-embracing than economic development, involving a challenge to old ideals and attitudes on class, religion and the State.

The violent political revolutions which have affected Bolivia (1952) and Cuba (1959) are indices of the forces for change, which are currently repressed to some extent in almost every country by military governments. Chile, with something of a democratic tradition, and Uruguay, where democracy had brought some aspects of the welfare state into being early in this century, have both had their floodtide of change abruptly stopped in recent years by military take-overs. To the pessimist this might seem merely a continuation of the secular situation of governmental disorder and imper-

manence, but there is evidence that dictatorial governments are having greater tasks because of the spread of political consciousness, and cannot continue indefinitely without popular support.

This political consciousness is itself a function of the rise in education, health and other welfare standards over the continent, which stimulates interest in a better life, the so-called revolution of rising expectations. It is also a function of urbanization, a universal phenomenon but one which has particular force in Latin America because of the rapidity of its occurrence. Within a generation, many families have pulled up their

roots and moved from completely rural to urban communities; the factory, or unemployment, has replaced work on a farm; the radio and newspaper replace illiteracy; concern for personal status replaces an unthinking acceptance of humble positions in a strongly stratified rural society.

To systematize the interrelated phenomena of this society in motion, and the physical and human factors involved in its varied face from one country and from one region to another, is the intent of the following chapters.



1 Lake Calima is a reservoir created by the Alto Anchicayá dam. This provides a source of power for Cali industries. It also serves to control flooding on the Cauca River

Contents

PREFACE	iv	11. Argentina: the Interior	139
INTRODUCTION	ix	12. Uruguay — the Small State	151
<i>Part I</i>		13. Paraguay	159
Systematic Geography		14. Chile	168
1. Physical Geography	1	<i>Brazil and the Guianas</i>	
2. Historical Aspects	18	15. Introduction to Brazil	182
3. Agriculture	32	16. Brazil: the Peripheral Regions	190
4. Industrial Infrastructure and Manufacturing	49	17. The Core Region of Brazil	204
5. Population Patterns	67	18. The Guianas	215
6. Politics and Territory	81	<i>The Tropical Highlands</i>	
7. Patterns and Policies for Development	87	19. Ecuador	228
<i>Part II</i>		20. Colombia	242
Regional Geography of the Component Countries		21. Venezuela	256
<i>The Highland Core</i>		<i>Appendixes</i>	
8. Peru — the Heartland	94	I. Glossary of Portuguese and Spanish Terms	271
9. Bolivia	115	II. Bibliography	273
<i>The Middle Latitudes</i>			
10. The Pampas Countries: Argentina and the Pampas Core Region	128	INDEX	281

Plates

1 Lake Calima, the reservoir created by the Alto Anchicayá dam	x	22 Llamas and alpacas grazing on the Bolivian altiplano	117
2 Espeletias in the <i>páramos</i>	4	23 Street vendors in La Paz	124
3 Arid landscape	6	24 The cathedral at Tucuman	137
4 A vineyard in Mendoza province, Argentina	41	25 The Iguassú Falls	141
5 The São Francisco river at the Paulo Afonso Falls	56	26 Careful vineyard cultivation	144
6 Peasants in a landscape	57	27 Shanty town at Asunción	161
7 The Transamazon Highway	60	28 President Stroessner bridge across the Paraná	163
8 A shanty town on the outskirts of Popayán	70	29 Nanduti, a traditional Indian craft weaving industry	164
9 Peasants transporting canes for thatching and craftwork at Capachica	74	30 Wooden and corrugated iron housing of a <i>callampa</i> in Santiago	176
10 A <i>barrio</i> in Baruta, Caracas	76	31 A colonial sugar <i>engenho</i>	185
11 Rural housing at El Quibor, Venezuela	77	32 <i>Jangadas</i> , primitive fishing craft, at Prainha, Ceará	199
12 Machu Picchu and llamas	95	33 The 'fossilized' city of Ouro Preto	206
13 The altiplano at 3500 m, north of lake Titicaca	97	34 The city centre of São Paulo	210
14 Work with hand-foot plough, Puno province	103	35 Ditch digging on a sugar estate, Guyana	220
15 Making adobe bricks in the Peruvian Sierra	104	36 A punt train on a sugar estate	221
16 Pitumarca, near Cuzco	105	37 Public wash basin, in the Sierra	232
17 Pucallpa, river port of the southern Peruvian selvas	107	38 Community work in the Cotopazi Sierra	233
18 The old and the new, Sicuani, Peru	110	39 Street selling in Quito	234
19 Wooden balconies of the Archbishop's Palace, Lima	111	40 Fishermen's huts at Tumaco, on the Pacific coast of Colombia	250
20 Landscape near Lake Titicaca	112	41 Bogata street child	253
21 Alto Pacagua, a squatter settlement	116	42 Central Caracas	266
		43 A Caracas motorway	268

Maps and Diagrams

1	Vegetation regions of South America	8	22	Mineral production locations and potential oil-bearing regions	125
2	Culture types in South America about AD 1500	19	23	The spread of settlement on the Pampas	131
3	The expansion of the Inca Empire	22	24	Railway map of Argentina	133
4	Colonial economy in 1700	27	25	Agricultural colonies and <i>estancias</i> in Leandro Alem <i>partido</i>	135
5	Administrative organization of the Spanish American Empire	29	26	Per capita Gross Domestic Product of Argentine provinces	140
6	Agricultural systems of South America	45	27	Hydro-electric plants in Neuquén, Argentina	142
7	Land use cross sections in the Ecuadorian Andes	47	28	Argentine mineral resources and the oil industry	146
8	Trends in railway development in South America	59	29	Agricultural economic regions of Uruguay	152
9	The Carretera Marginal de Las Selvas	61	30	Administrative divisions of Uruguay	156
10	Integrated steel mills, coal fields and iron ore deposits	64	31	Paraguay: land use, roads and hydro-electric power sites	162
11	Causes of death and infant mortality, Brazil	73	32	Colonization areas in Paraguay	165
12	Rural settlement in a part of Entre Rios, Argentina	75	33	Chile: the regions	169
13	Models of urban growth	78	34	Chilean boundary changes and claims	170
14	Income and socio-economic development	79	35	The nitrates region of northern Chile	173
15	Peru: income per capita of the regions	99	36	Santiago city and environs	177
16	Principal commercial crop regions, Peru	101	37	The industrial region of Concepción	179
17	Urban locations, mines, railways and river transport lines	108	38	Physical regions of Brazil	183
18	Lima and surroundings in 1928	113	39	The Brazilian road system	186
19	Lima and surrounding in 1980	113	40	Development projects in northern Brazil	193
20	Physical regions of Bolivia	118	41	Vegetation zones of the Nordese and the Drought Polygon	198
21	Maximum claims and present Bolivian boundaries	121	42	Brazilian regions and trade linkages	205
			43	Iron and steel making capacity in the Industrial Core, 1984	208

MAPS AND DIAGRAMS

44	Location and growth of <i>favelas</i> in Rio de Janeiro	211	51	Colonial foci of settlement and cultural identity in Colombia	245
45	Physical map of the Guianas	217	52	Roads and railways in Colombia	247
46	Bauxite and aluminium industries of Surinam	224	53	The CVC: main power projects and the floodable area of the Cauca Valley	254
47	Ecuador: geological structure	229	54	Locations map of Venezuela	257
48	Ecuador: road and rail transport	236	55	Flooded area of the Llanos, 1976	259
49	Guayaquil: site and situation	237	56	Coal, oil and heavy petroleum fields, oil refineries and pipelines	263
50	Coffee zones of Colombia	243	57	Caracas city	267

1. Physical Geography

The continent of South America occupies 17.85 million sq km, making it slightly smaller than North America but still a great land mass, far larger than Europe west of the Urals, which covers 10 million sq km.

STRUCTURE

In tectonic and structural terms this is an important continental block, and one exhibiting considerable activity, for its nearest relative, as predicted long ago by Wegener and recently substantiated by a variety of lines of evidence, is the shield block of Africa, from which it was separated in the Mesozoic era. The central unit of the South American continent is the Brazil—Guiana shield, occupying half the continent and most of Brazil and the Guianas, covered often with thin sediments or volcanic sheets, but not undergoing any kind of folding after the Assynt orogeny of late pre-Cambrian and early Cambrian time.

This shield is relatively young compared with the African and North American ones, and radioactive decay dating places most of its rocks as less than 1000 million years old. It seems to have grown from an ancient core in the Bolivian frontier region of Chiquitos, and to have added mountains in the pre-Cambrian, including the Espinhaço and original (now re-uplifted) Serra da Mantiqueira mountains, in the southeast of Brazil. To the south of Brazil there is another great shield unit, no doubt related to it, the Patagonian block, also locally covered with sediments and volcanics. In the north, the Guiana

section of the shield is separated by the rift valley of the lower Amazon, opened out in Tertiary time.

The Andes

Flanking the shield to west and north are high mountains. The Andes are the world's greatest range of continuously high (over 3000 m) mountains, along a line which extends from Tierra del Fuego, to Venezuela and through Colombia into Central America, linking to the North American systems. These mountains are of varying age, ancient remnants dating back to the early Palaeozoic, but the present height of the range and its latest immense fold—fault system are of recent origin. Fold movements producing mountains in the location of the present ranges have their beginnings in late Mesozoic time, probably related to the initial separation of America and Africa, and they continue well into the Tertiary, pushing up high mountains to the west of the roots of older Palaeozoic ones. At this same time, the strains on the earth's crust of continental drift were relieved by basalt outpourings over 2½ million sq km of the Paraná Plateau, in Brazil and neighbouring parts of Paraguay and Uruguay.

In late Tertiary time, after a period of relative quiescence, the mountain system was subject to massive uplift without much folding, to produce finally the present high mountains, fault-flanked horst blocks rather than fold mountains. Some of the recent uplift is shown in the high level marine terraces, now lying more than a thousand

metres above present sea levels though only recently cut by the sea, along thousands of kilometres of the Pacific coast.

Pleistocene glaciation was highly localized and did not produce ice sheets as in the Northern Hemisphere, but valley glaciers over most of the Andes. In the far south a fairly large glacier system in the Patagonian Andes was able to expand and form broad piedmont glaciers occupying the southernmost Patagonian plateau and reaching the Pacific to the west. Morainic material is abundant in central and southern Chile, from the several glaciations, and terminal moraines hold back the glacial lakes of the Argentine Patagonia, lakes Viedma, Argentino, Buenos Aires and San Martín. To the present day, a combination of low temperature and heavy precipitation in the southernmost Andes permits a discontinuous icecap of more than 10000 sq km, between 46°S and 51°S latitude, on the Chilean side of the mountains. The fact that there are moraine dams west of the main line of mountains means that there is a difference between the peak line and the drainage divide, creating room for problems between the two frontier countries, Argentina and Chile.

Further north in the Central Andes, there is evidence of Pleistocene glaciation, down to 3200 metres in Ecuador, except where active volcanoes like Cotopaxi have covered the moraines over with ash. In the Northern Andes, moraines reach down to 3000 m and some valley glaciers down to 2600 m in Venezuela, 2200 m in the Sierra de Santa Marta (Parsons, 1982). Cirque lakes are common at about 3500 m from Ecuador northward.

Tectonic activity has not come to an end in the continent. All along the Andean line, from the Chile icefields north into Venezuela, there is volcanic activity, occasionally causing damage through hot ash deposits on farmlands. More important by far are the earthquakes which have devastated many Andean towns more than once, either by direct shock waves, or as in the dramatic Peruvian quake of 1970, through dislodging pieces of ice and rock which then form landslides.

Topographically, the Andes do not form a single line of mountains. Three or more lines, subparallel to one another, are common. Between them are high basins, filled in with masses of detritus from the surrounding slopes,

and forming flat land areas which can be of great human significance. The altiplano of Bolivia and Peru is the largest of these upland basins, but there are many others on a smaller scale, and the advanced civilization of eastern Colombia, the Chibchas, occupied as centre, a series of small altiplanos formed in similar fashion on the eastern Cordillera of that country. In Colombia too, where the cordilleras open out more and present access to the Caribbean, major rivers occupy the intermontane valleys, the Cauca and Magdalena.

The plains

Between the Andes and the Shield there are broad expanses of plains country where the surface is of loose sediments of Tertiary or Recent origin, swept into the depression of the Shield adjacent to the mountains. Stream action and sheet floods form here an enormous flat surface, where there are indeed regional slopes to the east, though invisible to the human eye and creating the impression of a completely level plain. The Paraná—Paraguay system belongs to this region, as well as the Orinoco and Upper and Middle Amazon basin. The lower Amazon is of somewhat different nature, formed essentially as a rift valley, fault-lined, between the shield blocks.

In some places, the plains are broken by islands of old rock, either of the Shield or related to Andean structures. In the central part of the Bolivian Oriente, the thinness of the sedimentary fill allows low projections of ancient rocks in the Chiquitos uplands, and in northwest Argentina a series of fault blocks produces a basin and range topography something like that of the United States Southwest in the Sierras Pampeanas — literally the ‘hills of the plains’ — the mountain blocks parallel to but older than the Andes to the west of them; in the driest areas the basins have salt lakes and no drainage to the exterior.

Geomorphic processes

Landscapes in a largely tropical continent are often distinct from those of temperate lands. The rivers, for example, flood relatively easily over their floodplains, for the ultimate product of tropical weathering is clay particles, not silt or sand size particles in any quantity, so that levees are not built up in the same way as in middle latitudes for want of a heavy fraction, and the rivers soon swell beyond their beds. It has been claimed

that meanders are less frequent on this account, though no proof of this can be adduced. Tropical weathering is also probably responsible for the frequency of falls and rapids on the rivers, as opposed to the more usual middle-latitude graded courses of streams.

The processes of tropical weathering down to clay account for the typical tropical sugar-loaf mountains, rounded or chunky mounds standing above a general level. These are the result of very deep weathering, penetrating up to a hundred metres, of a chemical nature, followed by erosion which eats out in selective fashion the mass of rock waste, penetrating deep where joints have allowed water to penetrate and act chemically, and leaving behind hills which are giant joint blocks into which the ground water has not been able to run. Mass movement in landslides is the main form of wearing down of the rounded bosses themselves, and occurs frequently with devastating results in such areas as the Rio de Janeiro district of Brazil, where the sugar-loaf hills, the morros, have been colonized by shanty-town populations.

CLIMATE

South American climate is everywhere dominated by the oceanic circulation cells, giving no room for separate continental cells; although the continent is large, it has no great width in middle latitudes where continental air masses might be generated by the greater cooling of land during winter seasons.

On the other hand, lack of a forceful continental circulation in summer or winter allows the middle-latitude dynamic forces produced by the encounter of tropical and arctic air to have considerable penetration into the tropics, so that depressions originating in the South Pacific may curl round Cape Horn or over the lower Southern Andes to move far north and form the Argentine *pamperos* which sometimes reach into the Chaco and cause cold waves as far north as the Amazon. The depression eye usually moves along the coast, causing year-round but particularly spring and autumn rainfall in the Pampas, and into southern Brazil as far as the São Paulo — Rio region, though also at times on to the shoulder of Brazil and Cape São Roque.

Some further special factors may be noted here. First, climatic types are all closer to the

Equator than their Northern Hemisphere equivalents, partly because the world's heat equator is in the north, forming the base line for climatic zonation. Second, with only a small mass of subtropical land, there is nothing comparable to the Indian monsoon or even that of the Southeast United States.

Another important climatic factor is the strong northward-setting ocean currents, operating on both sides of the continent, and contributing to the northward displacement of climatic regions. The Humboldt current, a veritable river in the sea which moves millions of tonne/kilometres of water daily, is a determinant of the coastal desert which occupies the west coast from 30°S to near the Equator. Its cold water is due to both its origin and to upwelling of water along the coast, due to offshore winds and to a differential Coriolis effect on heavier, colder water.

This cold water cools the base of an already stable South Pacific anticyclonic airmass, forming ultrastable air all along a coast which curves round to the west, following the average anticyclone shape itself and helping in its prolongation northwards. On the other side, the Falklands current is equally cold, but can have less effect since it lies downwind of the continent. It is however true that the driest part of the Patagonian desert is adjacent to this coast.

The mountains themselves have their own climatic effects; forming such a high wall, they separate in good measure the circulation patterns on either side, allowing in particular little transfer of moisture from one side to the other. From the human utility point of view, the mountains are of the highest importance, for they penetrate into cool zones where moisture may be preserved as snow for the lowlands irrigation, and in the tropics they provide the oecumene for all man's activity.

REGIONAL CLIMATES

Amazon Basin

A continuous inflow of warm and humid air from the Atlantic in the easterly trades maintains an equatorial climate typified by thunderstorms at frequent intervals and little seasonality. However, there are dry spells everywhere of different length, and probably only the eastern Peru—westernmost Brazil zone has a year-round high level of rainfall. Cold waves from the south

also serve to provide occasional variety in temperature. Georgetown, Guyana, provides an example of the coastal, central phase of this climate, while Belem, near the Equator, shows a Southern Hemisphere seasonality reflecting the fact that heat equator and intertropical front remain north of the geographical equator for most of the year.

On the western edge of the Amazon Basin, rainforest continues under a slightly less equatorial temperature regime, in the eastern mountain fringe of Peru and Bolivia. Rainforest of a similar nature occupies the coast of Brazil in Ilheus, Rio and Sao Paulo, fed by constant rains and having equable maritime temperatures.

Pacific Coast equatorial climates are similar to those of the Amazon Basin, though the main source of moisture is now no longer the easterlies, but winds blowing in from the Pacific, which give enormous annual totals of rainfall, over 3000 mm, to the coast and mountains which face them directly in Colombia and Ecuador.



2 In the páramos, from Bolivia to Venezuela, unusual plant types are found. Espeletias, woolly-leaved and with bright yellow flowers, shown here in the Andes of Mérida, Venezuela, are common in the Northern Andes

(Equatorial highlands)

Rimming the Amazon Basin to north and west are high mountains with a complete set of climatic zones, equatorial to subarctic, though with special features because of their tropical location. The climatic differences are recognized in local usage, in most places denominated as *tierra caliente*, *tierra templada*, *tierra fría* (with European temperatures averaging around 15°C), and *páramos*, lying above the treeline and thus generally over 3500 m in altitude. *Tierra fría* and *tierra templada* are often considered to be optimal climatic locations, having the reputation of lands of eternal spring, because their seasonal variation, as in the neighbouring lowlands, is very slight, and the average temperatures very pleasant. This lack of seasonal variation is true even up into the *páramos*, as the figures for Cruz Loma, only three kilometres from Quito but 1000 m higher, indicate.

In fact one month is quite similar to any other in temperature, but diurnal temperature variation is great, with the rapid outward radiation of heat permitted by a thin cap of atmosphere, and comparatively little water vapour in this cap. Indians of the Ecuadorian altiplano wear woollen shawls and with good reason, for their nights are cold, regularly reaching freezing point at 3000 m altitude.

Tropical woodlands climates

Away from the permanent proximity of the inter-tropical convergence there are lower totals of precipitation and definite dry seasons, thus producing a less luxuriant forest cover or even grass and parkland landscapes. There are also larger seasonal variations in temperature, excluding some of the plant life of the equatorial belt which is not cold-tolerant. Cuiabá (see table) is typical of this climate, though it covers a large part of central Brazil and has many local variations on the central theme of seasonality.

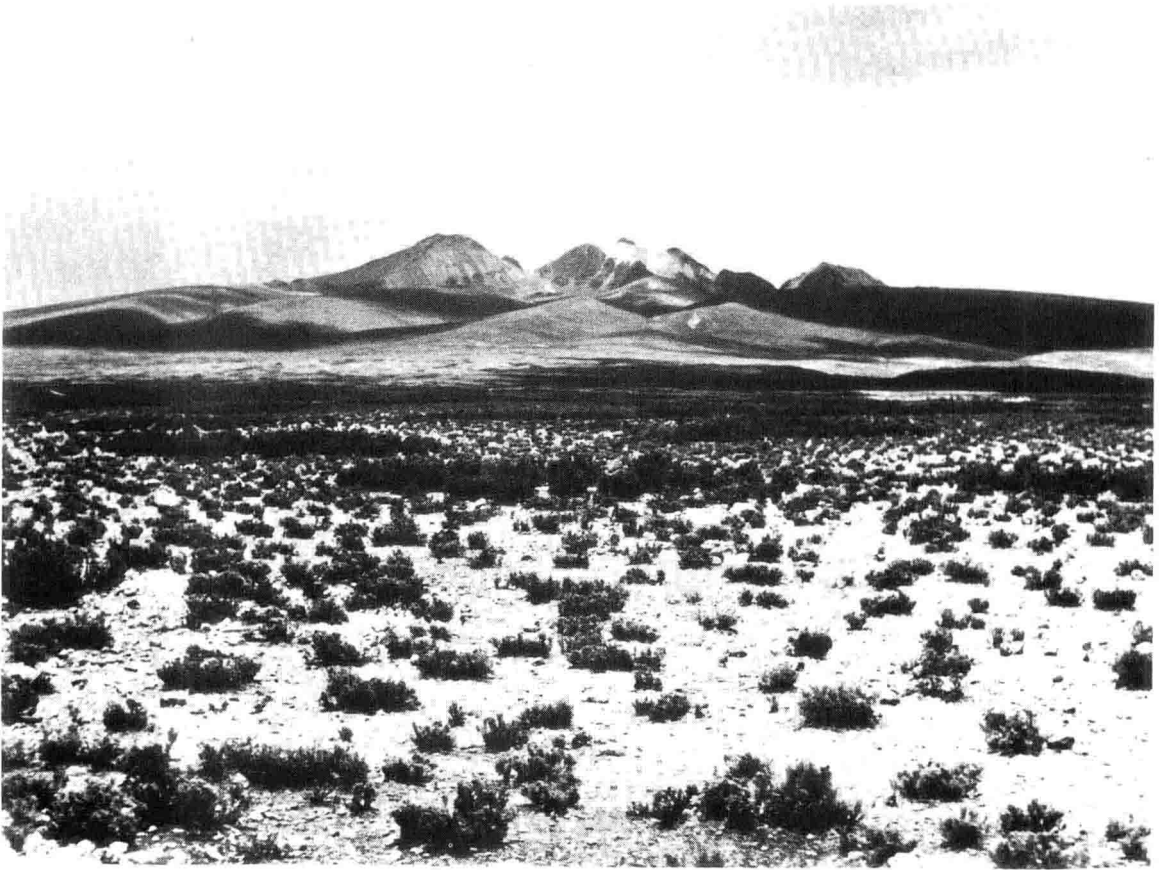
The dry lands

A large dry zone occupies the whole northeast shoulder of Brazil; it has no single name, for it merges gradually with other zones and to the Brazilians is merely part of the backcountry, the *sertao*, of interior Brazil. Nor is it always very dry, receiving an irregular amount of rainfall of perhaps 500–700 mm per annum, though rain usually comes in the form of brief heavy showers

CLIMATIC DATA FOR REPRESENTATIVE STATIONS

Type and Station Lat. and elevation		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<i>Equatorial Rainforest</i>														
Belém, Brazil 1° 28' S, 24 m	T	25.2	25.0	25.1	25.5	25.8	25.8	25.8	25.9	25.8	26.1	26.3	25.9	25.7
	P	339	408	436	343	288	175	145	127	118	92	86	175	2732
Georgetown, Guyana 6° 48' N, 2 m	T	26.3	26.4	26.8	27.1	27.0	26.7	26.7	27.2	27.7	27.7	27.4	26.7	27.0
	P	251	122	113	178	296	346	281	185	88	98	147	313	2419
<i>Tropical Forest and Campo Cerrado</i>														
Cuiabá, Brazil 15° 35' S, 171 m	T	26.4	26.2	26.2	25.9	24.3	23.0	22.5	24.8	26.6	27.0	26.8	26.5	25.5
	P	213	200	222	106	46	14	9	27	48	124	161	208	1378
<i>Equatorial Highlands</i>														
Quito Ecuador 0° 13' S, 2818 m	T	13.0	13.0	12.9	13.0	13.1	13.0	12.9	13.1	13.2	12.9	12.8	13.0	13.0
	P	124	135	159	180	130	49	18	22	83	133	110	107	1250
Cruz Loma, Ecuador 0° 13' S, 3950 m	T	6.1	6.5	6.7	6.8	6.4	6.2	6.1	6.0	6.1	6.4	6.7	6.4	6.4
	P	198	185	241	236	221	122	36	23	86	147	124	160	1780
<i>West Coast Desert</i>														
Lima, Peru 12° 30' S, 11 m	T	21.5	22.3	21.9	20.1	17.8	16.0	15.3	15.1	15.4	16.3	17.7	19.4	18.2
	P	1.2	0.4	0.6	0.1	0.5	0.8	2.0	2.3	1.2	0.4	0.1	0.4	10.0
La Serena, Chile 29° 54' S, 35 m	T	18.2	18.4	16.9	14.9	13.4	12.1	11.7	12.0	12.7	14.0	15.5	17.0	14.7
	P	0.1	0.8	0.6	2.6	21.9	43.7	29.7	23.2	6.0	3.7	0.7	0.3	133
<i>Argentine Deserts</i>														
Trelew, Argentina 43° 14' S, 39 m	T	20.6	20.0	17.3	13.2	9.6	6.1	6.0	7.6	10.2	14.0	17.3	19.3	13.5
	P	6	14	17	11	19	11	15	13	14	17	13	14	165
Mendoza, Argentina 32° 53' S, 769 m	T	23.6	22.5	20.2	15.6	11.5	8.1	7.6	10.2	13.9	16.7	20.4	22.7	16.1
	P	28	21	22	10	11	8	7	10	14	23	20	23	197
<i>Humid Pampas</i>														
Bahía Blanca, Arg. 30° 00' S, 10 m	T	20.6	20.5	17.8	15.0	11.1	8.3	7.8	7.7	11.2	13.9	17.0	17.7	14.3
	P	40	67	80	65	52	25	30	31	77	45	66	43	621
Córdoba, Arg. 31° 24' S, 425 m	T	24.2	23.2	20.7	16.8	13.8	11.0	10.6	12.3	15.1	17.9	20.8	23.1	17.4
	P	101	88	93	39	24	10	8	15	29	77	88	108	680
Artigas, Uruguay 30° 24' S, 117 m	T	26.6	26.1	23.6	19.1	16.2	13.9	13.6	15.4	17.0	19.2	22.6	25.2	19.9
	P	115	102	122	139	103	127	81	64	123	149	81	118	1325
<i>Middle Latitude West Coast</i>														
Valdivia, Chile 39° 48' S, 9 m	T	17.0	16.4	14.5	11.8	9.7	8.2	7.7	8.0	9.3	11.5	13.3	15.3	11.9
	P	65	69	115	212	376	414	374	301	214	119	122	107	2489
<i>Subtropical Uplands</i>														
Curitiba, Brazil 25° 26' S, 949 m	T	20.1	20.1	19.2	17.1	14.3	12.9	12.1	13.4	14.5	15.9	17.7	19.3	16.3
	P	183	149	106	75	88	104	69	85	124	122	120	138	1363

NOTES: Temperature in degrees centigrade, precipitation in millimetres.
Both temperature and precipitation are in the form of monthly means.



3 Arid landscape. Desert scrub on the Bolivian altiplano, with bunch-grass cover on the hills behind

which are of little benefit to plants, for they are soon dissipated, lost by runoff and evaporation from open soil surfaces.

For six months of the year the region is under the South Atlantic anticyclone, which retreats away in summer to allow the inter-tropical convergence zone disturbances to move in, but anticyclonic departure may be delayed thus provoking droughts of an extremely damaging kind, because this is a region of dense agricultural population, as it has been since the time of colonial plantations.

The West Coast subtropical desert is of somewhat different type. Here the anticyclone is stronger, reinforced in the east Pacific by the flanking action of the Andes and by cold water alongshore. The result is complete desert, with no recorded rainfall at some points in the

Atacama, and brief storms accounting for most of the record further north and south. At either end, the desert has its transition, rapidly to the north in Ecuador, more gradually in Chile in the Mediterranean and subtropical steppe zones of that country. Lima, Peru, is an example of the climate of the central desert; La Serena, at 30°S, of the transition through steppe to the Mediterranean climate north of Santiago.

East of the Andes there are other desert or semi-desert zones in the west of Argentina, with 200–500 mm of rainfall. Here the Pacific anticyclone is not active but the mountains themselves provide a substantial rainshadow, not from the immediate west but from the southwest where South Pacific depressions might otherwise enter. The region also holds an interior position with respect to the Atlantic depressions. A lee