GEOGRAPHIES FOR ADVANCED STUDY

EDITED BY PROFESSOR S. H. BEAVER, M.A.

LAND, PEOPLE AND ECONOMY IN MALAYA

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LAND, PEOPLE AND ECONOMY IN
MALAYA

BY

OOI JIN-BEE
M.A., D.Phil. (Oxon)
Senior Lecturer in Geography
University of Singapore

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To

Pin, Su-lin and Yu-lin

PREFACE

I have attempted in these pages to provide a modern systematic study of Malaya which is sufficiently comprehensive to serve as a basic text for students, and as a source of detailed information for other readers, in Malaya and elsewhere, who would like to know more about this rapidly developing country. The first part of the book deals with the natural setting of the Malay Peninsula, the second with the evolution, distribution and composition of the population, and the third with the economic patterns.

I have, in writing this book, drawn on my native knowledge of the country, and have in addition consulted a great number of sources, the most important of which are listed in the bibliography. I have also discussed various aspects of this work with experts and officials in the Federation of Malaya and in Singapore, and I would like to place on record my thanks to them for their advice and suggestions. I am, of course, solely responsible for all statements and opinions expressed in the book. I must also acknowledge my debt to:

Professor S. H. Beaver, for his editorial advice and suggestions.
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Professor K. M. Buchanan, Editor, *Pacific Viewpoint*, for kind permission to republish my article on 'The Nature and Distribution of the Natural Vegetation of Malaya' (September 1960).

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Professors W. A. R. Wikkramatileke and H. B. Gilliland, Messrs. Chee Keng Soon, Charles Keel and Richard D. Smith, the Shell Company of Singapore, Ltd. and the Straits Times Press for kind permission to reproduce their photographs.

Professor Wikkramatileke, for his support and encouragement at all times.

My wife, for her patience and tolerance.

OOI JIN-BEE

St Antony's College,
Oxford,
December 1962

Values given in dollars refer to Malayan dollars at app. 2*s*. 4*d*. in September 1961.

The statistical data used in this book are drawn mainly from official sources—statistical bulletins, census reports, government departmental reports, etc. In some cases, e.g. statistics on padi acreages and rubber smallholdings, the figures quoted are estimates, and must be treated with some caution.

The maps and diagrams have been drawn by Mr Poon Puay Kee under the direction of the author.

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PLATES

Acknowledgments

Plates 7, 13, 18, 21, 30, 31, 32, 33, 48 are by Chee Keng Soon; Plates 5, 6 by H. B. Gilliland; Plates 10, 19, 28 by C. A. Keel; Plates 1, 3 by Richard D. Smith; Plate 43 by Straits Times Press; Plates 2, 4, 8, 9, 11, 12, 14, 15, 24, 26, 36, 39, 46 by Prof. R. Wikkramatileke.

MAPS AND DIAGRAMS

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For permission to use official and other copyright maps as bases for our maps we are indebted to the following:—The Surveyor-General, Survey Department, Federation of Malaya for Figures 4, 32, 35–46, 48, 50, 51 and 58; The Chief Surveyor, Singapore for Figure 64. Figure 1 is published by permission of the Director, Geological Survey, with the authority of the Minister of Rural Development, Federation of Malaya. Butterworths Scientific Publications for Figure 26 from Hardy, *Tropical Agriculture*, 28, No. 1, 1951; The International Bank for Reconstruction and Development and The Johns Hopkins Press, Baltimore for Figures 67, 68 from *The Economic Development of Malaya*; Macmillan & Co. Ltd. for Figure 3 from Scrivener, *The Geology of Malaya*; Martinus Nijhoff, The Hague, for Figure 2 from Van Bemmelen, *Mountain Building* and the Rubber Research Institute of Malaya for Figure 23 from their *Bulletin*, No. 4, p. 11.

TABLES

GLOSSARY OF MALAY TERMS

atap: roofing thatch made from the leaves of the *nipah* palm.

belukar: secondary forest, sometimes also referred to as *utan muda.*

dusun: orchard, fruit holding.

gantang: Imperial gallon (1 gantang of padi weighs approximately 5.5 lb.).

gelam: a swamp tree *Melaleuca leucadendron.*

kampong: used in two senses: (1) a Malay village or settlement; and (2) a mixed garden composed of a heterogeneous collection of tree and bush crops.

kuala: estuary, or junction of two streams.

ladang: shifting cultivation; a clearing planted to dryland crops.

lalang: a coarse grass *Imperata cylindrica.*

mukim: subdivision of an administrative district.

nipah: brackish-water palm *Nipa fruticans.*

padi: the growing plant and unhusked grains of *Oryza sativa.*

parang: a long-handled cleaver.

permatang: beach ridges.

picul or *pikul:* 133⅓ lb.

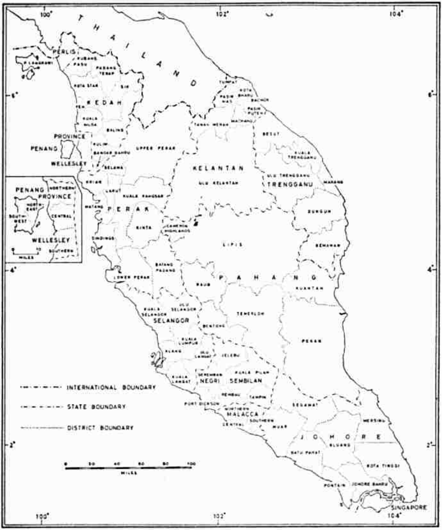
sawah: flooded padi field (south Malaya).

seladang: the Malayan wild buffalo (*Bos gaurus*).

sumatras: local line-squalls, common in the Straits of Malacca.

sungei: river, sometimes abbreviated to *S.*

tuba: roots of plants belonging to the genus *Derris*, used for poison-fishing, and commercially valuable as an insecticide.



Political Divisions, 1961.

PART I

THE LAND

CHAPTER 1

GEOLOGICAL EVOLUTION, RELIEF AND DRAINAGE

THE GEOLOGICAL EVOLUTION OF THE MALAY PENINSULA

In early Palaeozoic times, an extensive land mass lay between present-day Asia and Australia. This ancient land mass was composed of crystalline rocks such as schists, gneisses and plutonites. Van Bemmelen calls it the Indonesian Primeval continent. During the course of the Palaeozoic era parts of this continent, including the part now occupied by the Malay Peninsula, began to subside, creating geosynclinal conditions. A long period of quiet subsidence and sedimentation was followed in the course of time by a very long and involved cycle of mountain building. The geological history of the Malay Peninsula forms part of the story of this orogenesis, which is still continuing in some areas of present-day Indonesia.

The geosynclinal areas were covered by seas, but their limits are uncertain. It is probable that most of the Indo-Chinese Peninsula, the Malay Peninsula, parts of western Borneo, south-eastern Sumatra and most of Java were covered by such geosynclinal seas, though not all at the same time. Sedimentation in the Malayan section of this South-East Asian geosyncline began in early Palaeozoic times, as evidenced by the recent discovery of Ordovician-Silurian fossils in limestone outcrops in the Langkawi Islands, in north-west Perlis, in the Kinta Valley and near Kuala Lumpur. In-filling of the site of the Malay Peninsula with detritus eroded from the neighbouring land masses continued until the end of the Palaeozoic. During this tremendously long period of sedimentation the sea was gradually filled in with many thousands of feet of eroded material and might have become progressively shallower. It was during this period that the Palaeozoic sedimentary rocks which cover such a large part of the Malay Peninsula today (Fig. 1) were laid down. These include the rocks of the 'Older Arenaceous Series', comprising quartzite, conglomerate, phyllitic and carbonaceous shales and chert, which make up the foothills east of the Main Range of present-day Malaya. These old arenaceous (sandy) sedimentary rocks are about 2,000 feet thick in the Kuala Lipis area. Rocks of the Older Arenaceous Series are also present in the States of Perlis and Kedah. In the Langkawi

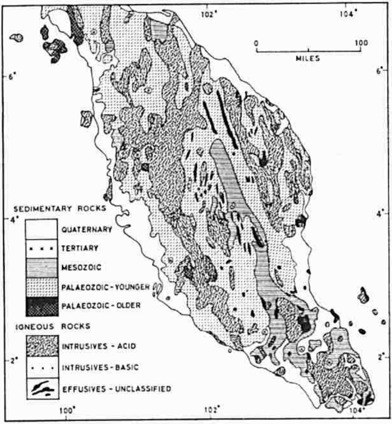


FIG. 1. Geology

Islands these bedded rocks of quartzite, shale and impure limestone are at least 5,000 feet thick. They are of doubtful age, but are believed to be Carboniferous.

The sedimentary rocks belonging to the Calcareous Series are known to have been deposited in the shallow sea which covered Malaya during the whole of the Carboniferous and Permian periods.

Examinations of the composition and texture of the rocks and of the fossils discovered in them indicate that the Series was deposited in a shallow water (neritic) environment, that is, that part of the sea-floor between low water mark and the 100 fathom isobath. The Series is composed of beds of limestone alternating with beds of shale. The limestone assumes greater prominence in northern Malaya—in the Langkawi Islands about 5,000 feet of limestone is interbedded with 700 to 1,200 feet of shale, and in Perlis and Perak the limestone is practically unbroken for a thickness of about 2,000 feet. Limestone forms the country rock of most of the Kinta Valley, and limestone outcrops form striking hills standing out above the general level of the alluvial plain. The proportion of limestone gradually declines with distance southwards and eastwards, while the shale beds become more prominent in the southern part of the Peninsula. No limestone has so far been discovered south of a line drawn through Kajang. The alternation of argillaceous and calcareous rocks, which are contemporaneous, indicates that the conditions under which they were deposited varied considerably, since shales and mudstones are usually laid down in waters which are charged with silt, while calcareous rock-building organisms responsible for the limestone beds can only flourish in clear waters. According to Richardson, there are two possible explanations for the alternations of limestone and shale in the Calcareous Series: first, they might have resulted from the periodic shallowing and deepening of the sea in which deposition was taking place. Alternatively, the limestone beds might have been laid down in locally clear waters, but at depths similar to those where shale was formed.

Sedimentation of the Malayan arm of the South-East Asian geosyncline continued from the close of the Palaeozoic through the Triassic, at the end of which sedimentation was almost complete. In the appreciably shallower sea over Malaya in the Triassic were deposited the sand, silt, clay and quartzite pebbles which later consolidated to form the sandstone, quartzites, shales and conglomerates of the Younger Arenaceous Series. It is possible that dry land might have actually appeared in places. In the Fraser's Hill area the sedimentary rocks of the Younger Arenaceous Series comprise beds of quartzite, schist and shale about 1,000 feet thick, and are probably separated from the older rocks by an unconformity.

Meanwhile the volcanic activity, which commenced feebly, probably during the Lower Carboniferous when the Older Arenaceous

Series were being laid down, reached a climax in the Carbo-Permian, and continued into Triassic times. The rocks associated with this vulcanicity are known as the Pahang Volcanic Series, which is a remnant of this great but intermittent period of volcanic activity which took place along the site of eastern Malaya between 150 and 250 million years ago. The volcanic eruptions were mainly explosive in nature, and fragmental pyroclastic rocks make up a greater proportion of the Series than lavas. Most of the Pahang Volcanic Series consists of tuffs of rhyolitic and andesitic composition, with rhyolitic tuffs predominating. The lavas are usually associated with shales and water-deposited tuffs of Carbo-Permian age, and are believed to have been derived from volcanoes, some of which were located on the sea-floor some distance off-shore, and some on small islands near the coast, so that in both cases the lava streams settled directly on the sea-bed. As the name suggests, rocks of the Pahang Volcanic Series are best developed in Pahang. They are also distributed in the other parts of eastern Malaya, in a belt running roughly north–south. They are conformably interbedded with the sedimentary rocks of the Calcareous Series laid down during the Carboniferous and Permian periods, and are therefore contemporaneous with them. That vulcanicity occurred also in the Triassic and possibly also the Lower Jurassic period is indicated by the fact that rocks of the Pahang Volcanic Series are also interbedded with the arenaceous (sandy) beds of the Younger Arenaceous Series, deposited in the shallow sea covering the Peninsula during this period. Extensive exposures of such rocks have been discovered in Kelantan, with other small occurrences in Singapore, Johore, Negri Sembilan, Selangor, upper Perak and Kedah.

According to van Bemmelen the rocks of the Pahang Volcanic Series were deposited in Carbo-Permian times, during a period of orogenesis affecting the area where the present Anambas Island is located (east of the present east coast of Malaya). A geanticline was pushed up in this zone, with compensatory subsidence of the adjacent regions. The northern border deep was situated in the area where Natuna Island now stands. The southern border deep was wide and shallow, occupying a belt extending from the eastern part of Malaya (with the Kelantan–Trengganu Border Range and the Tahan Range as central axis) to the island of Karimata and the southern part of West Borneo (Fig. 2). Both the northern and southern deeps were centres of volcanic activity. The products of vulcanism in the southern deep were the clastic ejectamenta known as the Pahang Volcanic Series. These were deposited during Carbo-Permian times when the neritic sediments of the Calcareous Series were filling up the deep. Volcanic activity appeared to have been confined to the submerged area over eastern Malaya, since the sedimentary rocks of the western

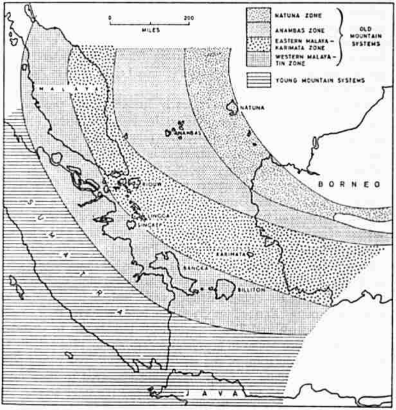


FIG. 2. Structural belts in the Sunda area (after van Bemmelen)

part of Malaya (then also covered by the sea) do not show the volcanic facies of the eastern zone.

The next phase in the evolution of the Malay Peninsula occurred at the end of the Palaeozoic era when the geosynclinal strip along eastern Malaya, Karimata and the southern part of West Borneo was uplifted by orogenic forces. The geanticlinal ridges so formed were intruded by granitic magma. The uplift of a geanticline along eastern Malaya brought about compensatory subsidence along western Malaya. During Triassic times subaerial denudation and subsidence of the geanticlinal ridges resulted in a general lowering of the relief, so that by late Triassic times the sea again covered most of the Malay Peninsula. At the same time a phase of active vulcanism set in along eastern Malaya. The volcanic products were conformably interbedded with the sedimentary rocks of the Younger Arenaceous Series, laid down in the shallow sea. The material eroded off the mountains of eastern Malaya during Triassic time helped to fill in the western Malayan geosyncline (referred to as the Tin Zone by van Bemmelen).

Van Bemmelen states that in early Jurassic times the eastern Malaya–Karimata zone was uplifted by orogenic forces for the second time, to form imposing mountain ranges which were probably also volcanic. The mountains were again intruded by granitic magma, in composition more homogeneous and richer in silica than the granitic intrusions of the earlier period of orogenesis. Geological evidence found in the Gunong Gagau Plateau on the Kelantan–Pahang–Trengganu border indicates that at least a major part of the folding of sediments and emplacement of granite which accompanied mountain building in this part of the Peninsula occurred early in Jurassic times. During the process of orogenesis the thick sedimentary cover deposited in the earlier periods of sedimentation slipped from the shoulders of the rising basement and piled up in the adjacent subsiding troughs. Parts of the crystalline basement with their cloaks of Carbo-Permian and Triassic sediments also began to slide towards the western Malayan geosyncline (Tin Zone), thus helping to fill it up. Sedimentation of the western Malayan geosyncline continued during middle Jurassic times, and appeared to have been almost completed by late Jurassic times, when the stage was set for the final and most important phase in the evolution of the Malay Peninsula—the upraising of the mountain chain along western Malaya.

In late Jurassic and early Cretaceous times (between 127 and 152 million years ago) the centre of diastrophism had shifted from the eastern Malaya–Karimata zone to the western Malaya–Tin Zone (Fig. 2). A mountain chain was pushed up from the western Malayan geosyncline. During this period all the major intrusive masses of western Malaya were emplaced by tin-bearing granitic batholiths. Similar intrusions occurred in the islands of Singkep, Bangka and

Billiton. According to Richardson, after the granitic magma had been emplaced, the peripheries cooled relatively rapidly to form a solid 'skin' of granite which acted as an insulating cover keeping the interior magma molten for a long period of time. However, the granitic 'skin' was fractured occasionally as a result of internal pressures built up by convectional movement in and shrinkage due to cooling of the magma. The differentiated fractions of the magma, including the tin fraction, were injected into the cracks, fissures and faults of the granitic skin.

This phase of mountain building gave rise to a double orogen in the Malay Peninsula, consisting of two parallel mountain arcs. The younger and more imposing outer arc, which was non-volcanic, was dominated by the mountain range now known as the Main Range, some 300 miles long and from 30 to 40 miles wide, and in places over 7,000 feet above present-day sea-level. The Benom Range of western Pahang, occupying about 560 square miles and rising to a maximum height of 6,916 feet, as well as the complementary synclinorium of the Main Range foothills, were the other major structures formed during this orogenic phase. The inner or eastern arc, comprising the Kelantan–Trengganu Border Range (or the East Coast Range) and the Tahan Range, was made up of remnants of the older volcanic chain of the eastern Malaya–Karimata zone.

The Main Range, with its heavy load of compressed sediments, formed an unstable geanticlinal structure which later collapsed under its own weight. Some of the collapsed parts slumped towards the new geosyncline located over eastern Sumatra, which was later (in Middle Cretaceous times) pushed up into a new mountain chain as the centre of diastrophism shifted westwards. By this time orogenic forces in the Malayan area had waned.

The intrusion of the granitic batholiths in the central Sunda area during the Permo–Triassic–Jurassic phases of mountain building and their subsequent crystallization consolidated the whole region into a rigid continental block, now known as the Sunda Shelf or the Sunda Platform. The Malay Peninsula today forms the western part of this shelf.

The emplacement of the granites in the Malay Peninsula during late Jurassic and early Cretaceous times, and the earth movements that preceded it and continued during and after its emplacement brought about both thermal and regional metamorphism of the sedimentary rocks. As would be expected, those rocks which flanked the

Main Range suffered the most severe metamorphic alteration, while those along the margin of the Benom Range were less severely altered. The sedimentary rocks in contact with the smaller intrusive masses were still less affected. Rocks of the Arenaceous Series making up the Main Range foothills were metamorphosed to schistose conglomerate, schistose, quartzite schist, phyllite, hornfels and slate. The degree of schistosity and foliation decreased with distance from the margin of the Main Range granite. The limestone rocks of the Calcareous Series were converted to form a crystalline marble, while argillaceous and arenaceous rocks of this Series were converted to schist and quartzite respectively.

The granitic magma, on cooling, solidified as granite and other plutonic rocks such as hornblende-granite, syenite, diorite and gabbro. These were initially buried under a thick overburden of sedimentary rocks. Most of the mineral wealth of Malaya is derived from the granite. The rich alluvial tin fields of Larut, the Kinta Valley, the Klang Valley and Negri Sembilan are located on the western flanks of the Main Range, while the other tin fields of Malaya are associated with smaller granite intrusions.

From the period in which the Malayan double orogen was formed until the present day, land has existed in Malaya. The structural framework of the Peninsula has remained substantially the same, though the relief has everywhere been greatly reduced by denudation, and the shape of the Peninsula has varied over the years as a result of sedimentation along the coastal peripheries as well as fluctuations in the relative levels of land and sea.

As soon as the primitive Malayan land mass appeared from the geosynclinal sea it was subjected to weathering, probably of tropical intensity, which in time stripped off tens of thousands of feet of sedimentary and metamorphic rocks, in places laying bare the underlying granite and other igneous rocks. For example, the thick cover of sedimentary rocks of the present-day Bintang Range, the Kledang Range, the Main Range, the Benom Range and the East Coast Range (Fig. 3) has been almost entirely removed by subaerial denudation over millions of years, so that today their granite cores lie exposed. The weathering processes are accelerated under the conditions of constantly high temperatures and heavy rainfall which prevail in the Peninsula, and weathering extends to great depths. Quartzites and sandstones of the Arenaceous Series break down into loose sands, while shale reverts to clay. The weathered zone may exceed

100 feet in depth. Schists and phyllites weather readily to clay. Limestones of the Calcareous Series, being more soluble in water, have, of all the geological formations, suffered the greatest downgrading.

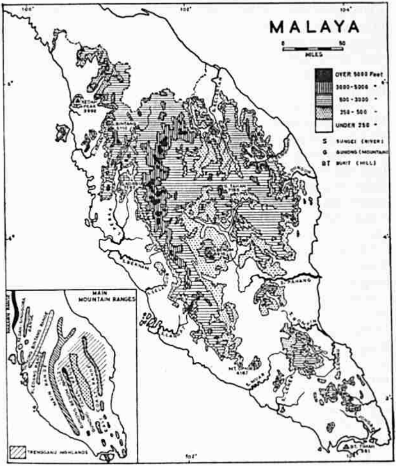


FIG. 3. Relief and main mountain ranges

The weathering of limestone does not lead to the formation of the weathered products normal to other rocks, but to the solution of the limestone itself. Only a thin covering of dark red earth remains after its solution. Prolonged weathering has resulted in the removal of most of the thick mantle of limestone which once covered a large part of the Peninsula, and today the limestone in valleys such as that of Kinta is buried under a layer of alluvium. The steep-sided limestone hills which are found in northern Perlis, Pulau Langkawi, the Kinta Valley, south Selangor, and north-western Pahang are thought to be remnants of a thick, once continuous limestone sheet. Granite disintegrates under tropical weathering to a red, orange or yellow soft mass which may be anything from 6 to 200 feet in depth. Core-boulders which have resisted weathering are commonly found within the weathered mass.

The twin processes of weathering and erosion have reduced the Malayan land mass to an advanced stage of maturity. The great thicknesses of sedimentary rocks which were stripped off the crests of the mountain ranges were, for the most part, carried out to sea. Part of this transported material was deposited in the large alluvial plains. In some cases the upraised, metamorphosed sediments have proved unusually resistant to erosion, the best example being the Tahan Range (Fig. 3) which is composed of quartzites and sandstones.

The geological record of the Malay Peninsula shows that during Tertiary times, long after the formation of the Malayan double orogen, coal-bearing strata were laid down, probably in isolated freshwater swamps and lakes, in many widely separated places. They are known to occur in five localities in Malaya: in the north at Bukit Arang on the Perlis–Thailand border; at Enggor near Kuala Kangsar in Perak; at Batu Arang in Selangor where the deposits consist of beds of shale, sandstone, coal and conglomerate resting unconformably on quartzites and phyllite of Triassic age; near Kluang and Niyor in Johore; at Kepong in Johore (Fig. 1). Some coal was mined from the Enggor coalfield before it closed down in 1928. The Batu Arang coalfield in Selangor produced more than fifteen million tons of coal between 1915 and 1960, when it was finally forced to close down as a result of competition from imported fuel oil. None of the other deposits contain coal of any economic importance. The total area of the five Tertiary coal-bearing outcrops is less than 100 square miles.

From the end of the Tertiary to the present day, that is, during the Quaternary period, alluvium brought down by the rivers has caused widespread sedimentation along the coasts of Malaya. Wide alluvial plains have been built up from the bases of the inland mountain ranges to the coast. These coastal plains average about 20 miles in width along western Malaya, broadening out to a maximum of 40 miles in west-central Malaya, in the lower courses of the Perak and Bernam Rivers. They are narrower along eastern Malaya, the maximum width being about 20 miles along the lower course of the Pahang River. These recent and unconsolidated sediments have been deposited under both marine and fluvial conditions. They vary in thickness from about 30 feet around Kampar, to 80 to 100 feet around Ipoh, to 150 to 250 feet in Telok Anson District, to 365 feet at Sitiawan, and to about 450 feet around Kuala Perak and Kuala Bernam.

The inland valleys are covered with a thin mantle of recent river muds, sands and gravels, while the upland areas usually have a cover of eluvial material of varying thickness. Included with these deposits of Pleistocene and Recent age are the deposits of rhyolite ash which have been found in Perak and Pahang. They are believed to have originated from the prehistoric volcanic eruption at Toba (now Lake Toba) in Sumatra.

The development and present position of the coastal alluvial plains of Malaya are related to the changes in the relative levels of land and sea which have occurred in the Quaternary period. There is no general agreement as yet on the number and magnitude of eustatic changes that have occurred in Malaya and the Sunda area. There appeared to have been several (probably three) phases of high sea-level in Sundaland before the final transgression at the end of the Quaternary. During such periods (which might be correlated with the melting of the great ice sheets in the higher latitudes), the sea covered much of Sundaland, reducing it to a number of archipelagoes. In Malaya the physical evidence of a maximum high sea-level includes that of an eroded marine terrace on the Dindings coast about 250 feet above present mean sea-level and marine platforms of about 230 feet in the Kinta Valley. During this and the three other probable periods of transgression, the coastlines of Malaya receded and the lower portions of the drainage systems were drowned, creating extensive neritic conditions for alluvial deposits. The streams filled in their drowned estuaries and, as sedimentation continued, extended the alluvial formations seawards.

Conversely, the eustatic lowerings of sea-level in Malaya and Sundaland during the Quaternary periods of glaciation exposed much of the area as dry land as the sea receded and the coastlines were extended. According to Scrivenor, the Middle Pleistocene was probably the period of maximum lowering in Malaya, when sea-level stood about 100 metres (328 feet) lower than present mean sea-level. The Malay Peninsula, Sumatra, Java and Borneo were then probably connected to the Asian mainland by dry land. During this and other periods of exposure the rivers of the Malayan land mass might have been rejuvenated, renewing downcutting of their valleys. The present drowned tin alluvials of Bangka and Singkep were probably produced during one or more of these phases of lowered sea-level.

The final melting of the great ice sheets at the close of the Pleistocene brought about a rise in sea-level of 80 to 100 metres in Sundaland, submerging the lower parts under a shallow sea, and producing the present Sunda Shelf or Sunda Platform. Sea-level in the Malay Peninsula at that time was thought to have been about 50 feet higher than present mean sea-level. Fitch, on the basis of evidence in the form of beach ridges, caves at different levels in limestone hills, river terraces, and rapids at Sungei Karang, believes that the land in east Pahang has risen twice in recent times, the first being an uplift of 20 feet and the second 10 feet. There might have been an earlier rise of about 20 feet. Nossin, working on the beach ridges of north-eastern Johore, has recorded evidence of a recent fall in sea-level of about 20 feet. Roe states that the western portion of the Peninsula appears to be subsiding, and postulates that the relative rise in sea-level in western Malaya and the relative fall in sea-level in eastern Malaya are due to a regional tilting of the whole Peninsula towards the west, with the Main Range as the main axis.

RELIEF

The Peninsula of Malaya[1] extends from latitude 1° 20′ N. to latitude 6° 40′ N., and from longitude 99° 35′ E. to longitude 104° 20′ E. The total length of this long and narrow peninsula is about 500 miles. The peninsula is linked, at its northern end, to the mainland of Asia by the Kra Isthmus, which at its narrowest is only about 40 miles wide. The island of Singapore lies at the southern extremity of Malaya and is separated from it by a shallow strait—the Strait of Johore. Today the island of Singapore is physically linked to Malaya

[1] The term 'Malaya' is used throughout the text to denote West Malaysia (formerly the Federation of Malaya) and does not include the Republic of Singapore. The geographical term—the Malay Peninsula—is, however, used to cover both political territories.

by a causeway across the Strait, but remains politically separate from it.

Malaya covers a total area of 50,886 square miles; in contrast, the Republic of Singapore, together with its adjacent tiny islands, occupies only 225 square miles. About half of the total area of Malaya is covered by granite and other non-volcanic igneous rocks, about one-third by stratified rocks older than the granite, and the remainder by alluvium. Highlands cover a large part of the country, and over half of the total area is more than 500 feet above sea-level (Fig. 3). Singapore is an island of subdued relief, with its highest hill—Bukit Timah—rising to only 581 feet above sea-level.

The Malay Peninsula forms part of the old continental block known as the Sunda Platform. Most of the Platform is at present inundated by uniformly shallow seas following the rise in sea-level at the close of the Pleistocene when the great polar ice caps melted. The portions of the Platform which are not submerged are the Malay Peninsula, southern Thailand, southern Indo-China, eastern Sumatra, northern Java and the island of Borneo. That part of the Platform between the Malay Peninsula and western Borneo is an old stable region which has been peneplaned. The partial submergence of this peneplane has left groups of rocky islands—Natuna, Anambas, Rhio-Lingga, Bangka, Billiton, Karimata and Karimundjawa (Fig. 2)—between present-day Malaya and western Borneo.

Orographically, Malaya is dominated by its mountainous core, which in detail consists of a series of roughly parallel mountain ranges aligned longitudinally (Fig. 3, inset). The Benom Range, the Main Range and the subsidiary ranges west of the Main Range are the remains of an ancient mountain system formed in late Jurassic and early Cretaceous times, between 125 and 150 million years ago. The Tahan Range and the East Coast Range of eastern Malaya are the remnants of a still older mountain system formed at the end of the Palaeozoic. Tropical weathering and erosion over these millions of years have, except in the case of the Tahan Range, removed the cloaks of sedimentary rocks with which these mountain ranges were once clad, subdued their relief and exposed their crystalline cores.

Scrivenor has described the structure of Malaya as consisting of eight mountain or hill ranges. These are, from west to east (Fig. 3): (1) The Nakawn Range, a low ridge in the extreme north-west of Malaya. The southern half of this ridge is of limestone, and forms the boundary between Perlis and Thailand. (2) The Kedah–Singgora

Range, and its southerly continuations. It is composed of quartzite with granite outcrops, and runs from Singgora in Thailand to west-central Kedah. Outliers of this Range include the granite mountain Gunong Perak, the quartzite mountain Kedah Peak, the low granite hills forming the boundary of south Kedah and Province Wellesley, and the island granite mass of Penang. (3) The Bintang Range, dominated by the peak of Bintang, 6,103 feet high. This granite range runs from southern Thailand through Intan in upper Perak to Bruas. The granite hills of the Dindings are outliers of the Range. (4) The Kledang Range, an offshoot of the Main Range. Where it separates itself from the Main Range (in the vicinity of Enggor), the Kledang Range has an average elevation of over 3,000 feet, but south of Gunong Hijau the Range drops from about 2,000 feet to below 250 feet. The Range is formed of granite. (5) The Main Range, composed mostly of granite with some patches of altered stratified rocks. The top of Gunong Korbu (7,162 feet) is of phyllite. The Main Range is the most prominent and continuous of the mountain ranges of Malaya. It runs all the way from the Thai border with elevations rarely less than 3,000 feet and peaks of over 7,000 feet to as far south as Negri Sembilan where its altitude gradually diminishes until it abuts on the coastal plain in Malacca. It has an average width of 30–40 miles and is continuous for about 300 miles. On the east the Range is flanked by foothills of sedimentary rocks of the Older Arenaceous Series, wide tracts of which have been converted by dynamic metamorphism into schistose conglomerate, schistose quartzite, quartz schist, phyllite and mica schist. (6) The Benom Range, which takes its name from Gunong Benom, 6,916 feet high. The Range is of granite and is believed to have been formed at the same time as the Main Range. South of the Benom Range are some small isolated hills composed of the same hornblende-granite as the Benom. The best known of these outliers is Mount Ophir (4,187 feet), located near the meeting point of the boundaries of Negri Sembilan, Malacca and Johore. The granite of this outcrop has been deeply weathered, although many of the slopes are steep and bare. The Benom Range is flanked on the west by a range of foothills composed of ultra-basic rocks of post-Triassic age, with individual hills rising to 2,000 feet. (7) The Tahan Range, named after Gunong Tahan, which rises 7,186 feet above sea-level and is the highest mountain in Malaya. This range is composed of sedimentary rocks—conglomerate, quartzite, sandstone and shale—which have been over-folded. Along many parts of the Range the greater resistance of the quartzite to weathering has resulted in a markedly rugged outline, with frequent cliffs and an occasional canyon. The jagged outline of the Tahan Range contrasts sharply with the smooth, gently curving outlines of the Benom and other granite ranges of Malaya. Another unusual feature of the Tahan Range is that it has only a sparse cover of vegetation because of the poverty of the soils derived from quartzite and shale. The continuity of the Range is interrupted by the Rompin River. The Range extends southwards as low ridges along east central Johore, and as the Mount Faber ridge in Singapore. (8) The East Coast Range, extending from the Kelantan coast in the north, through interior Trengganu, to the Pahang River. The Range is discontinuous south of the Pahang River, and is marked by low granite hills standing above swamp level and by granite ridges in eastern and south-eastern Johore.

The Trengganu Highlands (Fig. 3, inset) occupy the area bounded by the lower Pahang River, the eastern flanks of the Main Range, south Kelantan, and the whole of Trengganu inland from the coast and consist of the northern parts of the Benom, Tahan and East Coast Ranges and their foothills, the whole forming a highly dissected mountainous mass with deep narrow valleys. The average height of the Highlands is about 2,500 feet.

The limestone of the Calcareous Series is often buried under a layer of alluvium. But in parts of central and north Malaya limestone hills with precipitous sides are distinctive features of the landscape (Plate 1): on either side of the Pahang–Kelantan border in the headwaters of the Galas, the Kuantan District, the upper Sungei Lipis valley east of Raub, and some other areas in Pahang, at Kanching and Batu near Kuala Lumpur, in the Kinta Valley and the Sungei Siput and Batang Padang Districts of Perak, along the Perak–Kedah border south-east of Baling, in the headwaters of the Sungei Muda, and the alluvial plain of north Kedah, along the western part of the Perlis–Thai border, and in the Langkawi Islands. Richardson is of the opinion that most of them have been formed by normal denudation, controlled by joint and bedding-plane patterns. Ingham and Bradford believe that the limestone hills of the Kinta Valley are the result of faulting, jointing, folding and denudation.

These limestone hills are from a few hundred feet to over two thousand feet high. They are conspicuous landmarks not because of their height but because of their characteristic steep sides which are often bare of vegetation and of the fact that they are often isolated hills rising abruptly from flat land. The appearance of these hills contrasts sharply with the rounded slopes and open valleys associated with the other geological formations of Malaya. Solution of the limestone along cracks and joint-planes has produced intricate patterns of caves, potholes and chasms in the limestone hills. Many of the caves are of great size, as, for example, the Batu Caves near Kuala Lumpur. A large Chinese temple has been built in one of the caves of Gunong Rapat, a limestone hill near Ipoh. Stalactites and stalagmites are commonly found in the caves. Along the limestone ridge which separates Perlis from Thailand are great basins and hollows known locally as *wangs*. Each consists of a low-lying flat piece of land surrounded on all sides by vertical limestone cliffs. Some of the *wangs* are large enough to support Malay settlements. This limestone ridge is also honey-combed with solution caves and passages cut by subterranean streams. Some of the caves contain rich deposits of tin-ore.

The large extensive plains which are characteristic features of the landscapes of Burma, Thailand and Indo-China are not found in Malaya. The only flat pieces of land of any size are the coastal plains which lie between the mountainous core and the coast on either side of the Peninsula. There is a sharp demarcation between the flat coastal plains and the steep mountain ranges, which is seen in the sharp angle in the profile of the rivers at the foot of the mountains. Scrivenor attributes the contrast between the lowlands and the mountains to marine denudation, which carved out wide valleys in the bedrock during the Pleistocene period of low sea-level. These valleys were subsequently filled up with alluvium. The depth of the original valleys is indicated by the great thickness (up to 450 feet in places) of alluvium which now covers the modern river beds and the bedrock.

These flat coastal plains have a gentle gradient. For example, the average gradient of the Pahang river-bed between Kuala Lipis and Kuala Pahang on the coast is only about 0·9 feet per mile, that is, less than 1 in 5,280. The gradient of the lower course of the Perak River is about 1 in 7,000. The coastal plains are most extensive along western Malaya. They average about 20 miles in width, and reach their maximum width in the lower courses of the Perak and Bernam Rivers where the alluvium extends inland for some 40 miles. The continuity of the western plains is broken in the region between Port

Dickson in Negri Sembilan and Tanjong Kling in Malacca where the older sedimentary rocks extend to the coast, and there are only local patches of alluvium. The western plains continue, south of Tanjong Kling, as a narrow band of alluvium which broadens out all along the Johore coast. The central Malacca–Johore stretch of the western plains is interrupted in three places by granite outliers—at Serkam in south Malacca, near Parit Jawa south of Bandar Maharani (Muar) and at Bandar Penggaram (Batu Pahat).

The alluvial deposits of the western plains are predominantly clayey in composition, the actual succession in depth varying from place to place. Those of north Selangor, for example, consist of a dark-blue clay which is comparatively free from sand and having a high proportion of decaying vegetation. A bore sunk on a site on the Bernam River in north Selangor showed the following succession: a top layer of clay with beds of sand 69 feet thick, followed by a 7-foot layer of sandstone, beneath which was another thick (57 feet) layer of clay with sand, followed again by a 15-foot layer of sandstone, then a 24-foot layer of clay with vegetable matter, and a 73-foot bed of sand with gas and water, and finally a 135-foot layer of clay with sandy beds. The bore was sunk to a depth of 380 feet without reaching the bottom of the alluvium. The alluvium in the swampy stretch north of Batang Berjuntai in the Selangor River valley averages 87 feet in depth. Here the surface is covered by peat with an average thickness of 20 feet. Beneath the peat is a layer of soft, grey clay about 30 feet thick, followed by sandy clay, sand and gravel at the lower levels. The discovery of sea shells and brackish water at various depths in a bore sunk in the south Perak alluvium at Bagan Datoh indicates that the coastal plains are made up of marine as well as fluvial deposits.

The process of land aggradation is going on rapidly along western Malaya, resulting in a gradual widening of the coastal plains. Rapid sedimentation and the comparatively calm seas of the Straits of Malacca have caused the building up of large tracts of alluvial flats along the coast. Some of these flats extend far seawards, raising the sea floor to such an extent that the sea in such places has become very shallow. For example, the 3-fathom limit opposite Jeram in Kuala Selangor was 26 miles out to sea in 1919, and is probably further out today. The alluvial flats which are inundated by high tides are usually colonized by mangroves. Mangrove swamps occupy a belt which stretches practically uninterruptedly from Perlis to

Johore. Along this part of Malaya the coastline is very slowly being pushed out into the Straits of Malacca as the mangrove swamps extend by degrees outwards into the sea. As the process of encroachment continues the innermost or landward edges of the mangroves pass beyond the limits of the tides. The mangroves then give way to other species of the rain forest which can tolerate the different conditions of soil and water. In time to come this piece of land is entirely won from the sea and becomes a part of the total land area of the Peninsula, provided that in the meantime sea-level does not change. The indiscriminate felling of the mangroves can slow down the process of land aggradation appreciably since the mud and drifting vegetation which are normally trapped within the stilt roots of the mangroves are thereby exposed and may be carried away by waves or tidal currents.

The coastal plains on the eastern side of the Peninsula are much narrower and less continuous than those of western Malaya. The major expanses of flat land are the Kelantan and the Pahang–Rompin–Endau deltas, separated from each other by Trengganu Highlands which come close to the Trengganu coast. The greatest width of the eastern plains is in the Pahang delta where the alluvium extends inland for about 20 miles. Elsewhere the plains are much less developed and limited to narrow localized areas such as that along the Sedeli coast of Johore. In the Kuantan riverine area the coastal alluvium goes down to a depth of 169 feet. It consists of sandy deposits near the coast, and of alternating beds of peaty clay, silt and sand in the inland areas. Along the Trengganu coast between Kuala Trengganu and Kemaman and along most of the Johore coast south of Mersing there are only narrow bands of coarse beach sands between the foothills and the sea.

The coastal landscape of eastern Malaya is distinctly different from that of the west. The mud flats and mangrove swamps so characteristic of the west coast are here limited in their distribution to some parts of the tidal reaches of sheltered river mouths, such as those of the Mersing, Endau, Pahang, Pahang Tua, Trengganu and Kelantan Rivers. Instead, long sandy beaches dominate the coasts of eastern Malaya. The entire length of the coast faces the great expanse of the South China Sea. There is no protective land barrier between the coast and the South China Sea, unlike the position in western Malaya where the land mass of Sumatra stands between the Indian Ocean and the coast. During the north-east monsoon the winds and waves that beat along the eastern shores of the Peninsula are therefore fiercer and rougher than those normally encountered along the western shores at all times of the year. These, together with the strong currents which flow off the east coast, combine to prevent the forma-

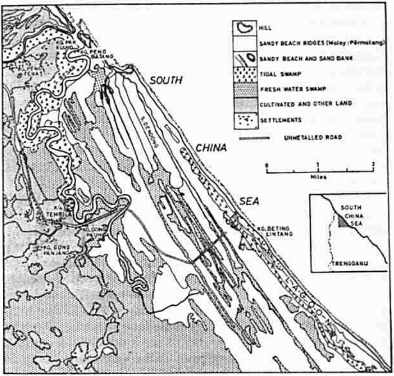


FIG. 4. Beach ridges in Trengganu

tion of mud flats. The beaches are sandy. Sand banks and sand bars have been built up across the mouths of most rivers. These sand banks and bars constantly shift and alter their positions, especially after a flood or a storm, and their presence forms a major obstacle to navigation in these areas.

A characteristic and prominent feature of the coastal landscape of eastern Johore, Pahang, Trengganu and Kelantan is the series of long, low ridges which are aligned more or less parallel to the shoreline, sometimes extending several miles inland (Fig. 4). These beach ridges are known locally as *permatang*. They are composed mainly of sand, and support only a very poor growth of coastal vegetation—sea-side grasses, low bushes of Cape rhododendron, and a few scattered trees. The swales or depressions between the *permatang* are often seasonally or permanently flooded, and are covered with swamp vegetation except where they have been cleared for cultivation.

A number of theories involving tectonic uplift of the land and eustatic changes in sea-level have been put forward to explain the formation of these *permatang*. Fitch recognizes two main series of *permatang* between Kuantan and Kemaman, the older series located 1–4 miles inland and standing up to 36 feet above present sea-level, and the younger series located between 2½ miles inland and the present coast, with a maximum height of 15 feet. He states that they were formed as a result of the post-Pleistocene uplift of the land. The older series were formed when the land emerged 20 feet relative to the sea, and the younger series when the land emerged a further 10 feet relative to the sea.

Nossin found no evidence of recent tectonic uplift of the land in north-eastern Johore. The *permatang* in the Mersing–Endau area extend more than 4½ miles inland from the coast. Their elevation increases with distance from the coast, and reaches a maximum of 25 feet above sea-level at the furthest point inland. Nossin postulates that the present inland *permatang* were formed at a period when the sea-level was about 20 feet higher than it is now. The subsequent fall in sea-level (in recent or subrecent times) resulted in the formation of a succession of beach ridges as the sea withdrew to its present position.

Permatang also occur along parts of the west coast. Along the coast of north Perak and Province Wellesley, for example, these beach ridges rise to heights of between 17 and 30 feet above mean sea-level.

DRAINAGE

The constant and heavy rainfall of the Malay Peninsula gives rise to a dense network of rivers and streams, though there is no one single large river dominating the drainage pattern as, for example, the Menam Chao Praya dominates the drainage pattern of Thailand. The largest river in Malaya, the Sungei Pahang, has a length of only slightly over 270 miles. The Sungei Perak, which drains a large part of north-western Malaya, is only 170 miles long.

The year-round precipitation ensures perennial stream flow, but although no river course is ever completely dry at any time of the year, the torrential and localized nature of the rainfall causes rapid fluctuations in the volume of water transported by the rivers. Very heavy falls may occur within the space of a few minutes or a few hours at any period of the year in western Malaya. The maximum intensity recorded at Alor Star for a twelve-hour period was 5·97 inches. In eastern Malaya such very intense falls are more likely to occur during the north-east monsoon. The maximum intensity recorded for Kota Bharu (12·63 inches for a twelve-hour period) is more than twice that for Alor Star. When such exceptionally heavy rainfall occurs in a catchment area, the volume of water that enters the river channels will be beyond their capacity to transport, so that the excess water runs over the banks and floods the surrounding plain. While most Malayan rivers and streams are subject to occasional flooding, those in eastern Malaya flood more or less regularly during the north-east monsoon when very heavy rainfall occurs over a period of about four months (November to February). In the Pahang delta, for example, floods now occur annually, though the older peasants living there still remember the time when floods were only of occasional incidence and the bed of the Sungei Pahang was very much deeper than it is now. Sometimes, as in 1926, 1947 and 1954, there are Peninsula-wide floods which may paralyze normal work for days or even for weeks at a time. The most destructive flood in Malaya within living memory occurred in 1926 when river levels rose in places from 60 to 80 feet above normal. The tendency of Malayan rivers to flood has been seriously aggravated as a consequence of the uncontrolled forest clearing and mining activities of earlier years which have disrupted the natural regimes of the rivers, especially those in western Malaya, and made them incapable of draining surplus water from the land efficiently.

Stream flow in the upper reaches of Malayan rivers and streams is usually swift and strong, but slow and sluggish in the middle and lower courses. Waterfalls and rapids are common features in streams which have their headwaters in hilly country. Falls are often caused by streams encountering some highly resistant rocks (e.g. igneous dykes) while deepening their valleys. They also develop where the streams cut their valleys through rocks of very unequal hardness, as at the contacts between granite and sedimentary rocks. The waterfalls vary considerably in height, form and volume of water. Most of them are small, but exceptionally large falls occur in places as, for example, those on the Sungei Pelepak Kanan, a tributary of the Sungei Johore, and those on the Sungei Pandan, a tributary of the Sungei Kuantan. Rapids are caused in many cases by the recession of the waterfalls. Others occur where streams are eroding rocks of unequal hardness.

While the headwaters of most Malayan rivers exhibit such indications of youthfulness as steep gradients, waterfalls and rapids, the lower courses in contrast, characteristically show signs of maturity such as braided channels, meanders, ox-bows and levees (Plate 2). The river profiles thus present a typically flattened appearance, and have been influenced by Quaternary changes in sea-level and progressive sedimentation by the overloaded rivers. During periods of rising sea-level in the Quaternary the base-levels of rivers and streams in the Peninsula were raised. The effect of this has been to reduce the downcutting power of the rivers and streams, encourage the formation of meanders, extend the area of impeded drainage far inland, and induce progressive sedimentation along the coasts on both sides of the Peninsula.

The rivers and streams all flow into the surrounding seas; there are no areas of internal drainage in Malaya. There is only one large natural lake—Lake Chini, located some 50 miles from the mouth of the Sungei Pahang (Fig. 5). Chenderoh Lake has been created as a result of the damming of the upper course of the Sungei Perak for the generation of hydroelectric power. Tasek Bera, which takes its name from the Sungei Bera, a tributary of the Sungei Pahang, is an elongated swamp whose boundaries are considerably extended during the rainy north-east monsoon. The junctions of many tributaries of rivers flowing in granite country are often blocked by landslide debris, damming the flow of water and creating long, shallow lakes, which, however, are only temporary features on the landscape, disappearing as soon as the natural dams have been breached. These temporary lakes are more commonly found in eastern Malaya because of the greater frequency with which landslides occur in this part of the Peninsula, especially after the heavy rains of the north-east monsoon. Small, shallow lagoons are also common along the east coast where drainage has been impeded by the sea banking up sand.

The very gentle gradients of the rivers flowing along the western alluvial plains have resulted in the formation of large expanses of both tidal and freshwater swamps. Roe attributes the swamps of western Malaya to subsidence of the west coast. Although extensive areas of

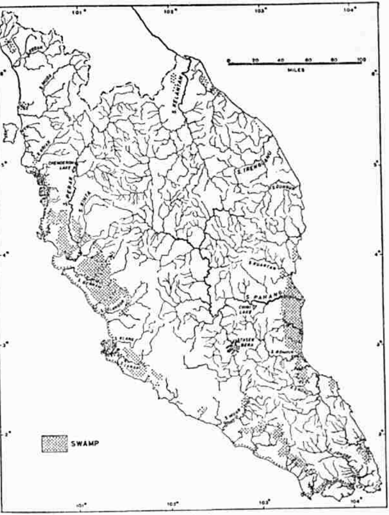


FIG. 5. The drainage pattern

swamps in western Malaya have been drained for agriculture, especially in Perlis, Kedah, Province Wellesley, Krian, the Sungei Manik area of Perak and along the Selangor and Johore coasts, swamps still cover large parts of the alluvial plains (Fig. 5). Freshwater swamps in eastern Malaya have developed where drainage has been impeded by beach ridges. Most of these swamps are being filled in with heavy clay carried down by rivers. Such in-filling has resulted in many instances in fully impeding drainage and has led to the formation of permanently flooded swamps. Many of the smaller rivers of eastern Malaya, particularly those of the Pahang–Rompin–Endau deltaic regions, disappear into the freshwater swamps, emerging only where they debouch into the sea. Much of the drainage of the coastal plains and freshwater swamps on both sides of the Peninsula is under control for padi cultivation.

The main factor which sets the drainage pattern of north and central Malaya (Fig. 5) is the series of mountain ranges aligned in a roughly north–south direction and running with the grain of the Peninsula from the north to end in a number of outliers in Malacca and Johore (Fig. 3, inset). In general the tributaries flow east and west at right angles to the mountain ranges, whereas the main rivers follow a longitudinal course along the strike of the rocks before making a right-angled turn, usually at the break of slope between the mountains and the plains, and meandering out to sea on either side of the Peninsula. The two major rivers—the Perak and the Pahang—both exhibit such a pattern of flow, the one debouching into the Straits of Malacca and the other into the South China Sea. The Sungei Kelantan, however, rising in the Trengganu Highlands and the eastern flanks of the Main Range, flows in a northerly direction straight out into the South China Sea. The overall result is a more or less rectangular pattern of drainage, with longitudinal, often subsequent lines predominating in the middle courses of the rivers, and latitudinal lines in the upper and lower courses.

Advanced erosion and the absence of any pronounced relief features in south Malaya are responsible for the dendritic drainage pattern in this section of the Peninsula. There is irregular branching in all directions, and the tributaries join the main streams at all angles. Marshes and swamps extend far inland from the coasts, and the rivers are generally slow-moving, with ill-defined channels.

CHAPTER 2

CLIMATE

The Malay Peninsula has an equatorial climate, though insularity and exposure to monsoonal effects result in its climate being slightly different in detail from that of say, the equatorial areas of the Congo and Amazon Basins. The differences are not so much in temperature as in rainfall, and again not so much in its total volume as in its annual distribution. The other characteristic features of the climate of the Peninsula are the constantly high temperatures and the absence of a cold season. Seasonality in the Peninsula, as in other parts of the tropics, is a function of rainfall rather than of temperature.

The narrowness of the Peninsula and the central location of the mountain ranges with flanking flat coastal plains facilitate the inland penetration of maritime influences. Although Malaya is a mountainous country, none of the mountains attains any great altitude, and only two of them—Gunong Tahan and Gunong Korbu—rise to just over 7,000 feet above sea-level. They are therefore well below the snowline, which in the equatorial zone is about 16,000 feet, and snow and frost are never encountered in the Peninsula. The lowest absolute minimum temperature recorded at Cameron Highlands (4,750 feet above sea-level) was 36° F (in January 1937).

Climate is the chief control of vegetation type, and the rain forest of the Malay Peninsula is the climax vegetation of the equatorial climate. The rain forest in its turn has a modifying influence on the climate. Three-quarters of the total land area of Malaya is still forested, and the transpiration from the dense vegetative cover increases the humidity of the air and the potentiality for rain to fall. The forest cover also affects the climate near the ground, moderating temperatures by absorbing heat in the process of evaporation from the foliage and by casting shade.

PRESSURE

During the northern winter the air overlying the Asian continent increases in density as temperatures fall. High pressure areas are built up over Siberia (the 'Siberian High') and the Indian sub-continent. At this period the Southern Hemisphere is experiencing its summer. The air overlying the Australian continent becomes lighter as temperatures rise. A low-pressure area develops over the continent. There is therefore, in these months, a continuous pressure gradient across the equatorial regions from the high pressure over Asia to the low pressure over Australia. North of the equator this gradient is associated with north-easterly winds of the north-east monsoon. During the northern summer a reversal of circulation takes place as pressures fall over Asia and a high pressure area develops over Australia.

Over equatorial South-East Asia seasonal pressure changes are very small, the maximum range being less than 2 millibars. Over the Malay Peninsula these seasonal variations are masked by the daily variations in pressure which are more pronounced and range between 3 and 4·3 millibars. At Temerloh, for instance, the atmospheric pressure may vary from 1011 millibars at 0900 hours to 1006·7 millibars at 1500 hours. Such a great daily variation of pressure is typical of these equatorial latitudes and stands in marked contrast to the 1 millibar diurnal variation common in the middle latitudes.

WINDS

The Malay Peninsula and the other parts of South-East Asia come under the influence of eight or nine major air-streams which have their sources in north-east and central Siberia, north India, Tibet, the North Pacific, Australia, the South Indian Ocean and the South Pacific. They converge over South-East Asia from three main directions during the course of a year, to form a pattern of air-stream boundaries as illustrated in Fig. 6. The boundary AB is the Northern Equatorial Air-stream Boundary; BC is the Southern Equatorial Air-stream Boundary, while BD is the Combined Air-stream Boundary. Figure 6 shows a pattern which obtains only in October, April and May. At other times of the year, only two main boundaries—the Northern and Southern Equatorial Air-stream Boundaries (AB and BC)—prevail over South-East Asia.

The boundaries are constantly shifting with changes in the speed and direction of the air-streams. The winds that blow over Malaya and the other parts of South-East Asia are related to the air-streams. It is the wind with its accompanying rains which, more than any other climatic element, gives the climate of Malaya a seasonal rhythm. The advance and retreat of the air-streams that cross the Peninsula follow a recognizable pattern, and are responsible for the division of the year into four seasons: (1) the north-east monsoon,

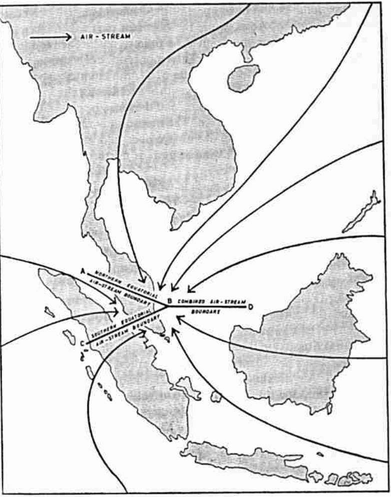


FIG. 6. Principal air-streams affecting Malaya and air-stream boundaries

(2) the south-west monsoon, and (3) and (4) the transitional periods between the monsoons. The north-east monsoon arrives in November or early December, and lasts until March. During this period

air-streams from the north-east sweep over the Peninsula. The north-east monsoon gives way to a transitional period of five to seven weeks' duration, when winds are weak and variable. The north-east monsoon retreats from southern Malaya earlier in the year, so that the transitional period in this part of the Peninsula usually coincides with the month of April, while the northern part experiences it in May. The south-west monsoon then follows, lasting from June to September or early October. This monsoon only prevails over northern Malaya. South of latitude 5° N. the country experiences light southerly winds. Neither the south-westerlies nor the southerlies are as strong as the north-easterlies, and they may be masked by land and sea breezes in coastal areas. The monsoon is then followed by another transitional period during October and early November. This general pattern of the wind seasons is mirrored in the rainfall regime of the Peninsula.

Figures 7 to 12 show the surface winds which blow over South-East Asia, the position of the air-stream boundaries and the percentage frequencies of the surface winds in four stations in Malaya for each month of the year. October is selected as the starting point of the month by month analysis of surface wind conditions as it marks the retreat of the south-west monsoon and the advance of the north-east monsoon over the region.

October (Fig. 7). This is the transitional month between the south-west and the north-east monsoons. The pattern of the air-stream boundaries is similar to that depicted in Fig. 6. The Northern Equatorial Air-stream Boundary (AB) separates the retreating south-westerlies from the advancing north-easterlies, while the Southern Equatorial Air-stream Boundary (BC) divides the same south-westerlies from the southerlies. At about latitude 10° N. and east of longitude 110° E. the two boundaries merge to form the Combined Boundary (BD). Surface winds in the Malay Peninsula are weak and variable, with speeds seldom exceeding 12 m.p.h. In north Malaya a high percentage—39 per cent at Penang and 23 per cent at Kota Bharu—of the days of this month experience calms. At Kota Bharu 50 per cent of the days of the month experience winds from the west, south-west and south. In south Malaya a very small percentage of the wind observations show a calm—only 3 per cent at Kuala Pahang and 1 per cent at Malacca. For 33 per cent of the time, winds at Kuala Pahang are from the west, while westerly winds also attain a high frequency at Malacca (20 per cent).

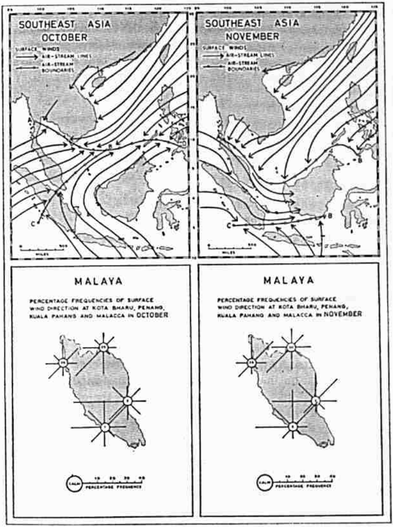
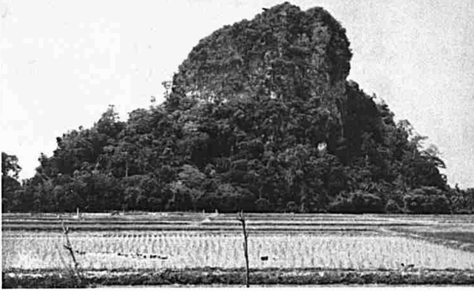


FIG. 7. Surface winds and air-stream boundaries over South-East Asia (*top*), and percentage frequencies of surface winds over the Malay Peninsula (*bottom*), October and November

November (Fig. 7). During this month the air-streams originating from north-east and central Siberia and the North Pacific advance southwards, pushing the Northern Equatorial Air-stream Boundary (AB) across the South China Sea to a position parallel with the east coast of Malaya, while the Southern Equatorial Air-stream Boundary (BC), separating the westerlies from the southerlies, is located at latitude 5° S. Surface winds over northern Malaya are light and variable. Penang experiences a calm on 36 per cent of the days of this month, with winds reaching speeds of less than 8 m.p.h. from the north and north-east for 23 per cent of the time. Kota Bharu has calm weather on 20 per cent of the days of the month, and light winds from the south-west quadrant for 43 per cent of the time. Southern Malaya, again, has very few days of calm. Malacca has light winds from four directions: west (22 per cent frequency), north-west (15 per cent), north (21 per cent) and north-east (20 per cent). Kuala Pahang also receives most of its winds from these four directions, with occasional gusts from the north and north-east reaching speeds of 13 to 24 m.p.h.

December (Fig. 8). The Northern Equatorial Air-stream Boundary (AB) now advances to a position parallel to the equator. The north-east monsoon is now established over the Malay Peninsula, as is apparent from the decrease in the percentage of calms throughout the country and the high proportion of the winds blowing from the north and north-east. Penang has the lowest percentage of calms (25 per cent) for the year during this month. Thirty-two per cent of the days of the month have winds from the north and north-east. Kota Bharu has a 15 per cent frequency of calms, and a 35 per cent frequency of winds from the north-east and east. The pattern of winds in southern Malaya reflects to a more pronounced extent the advance of the north-east monsoon. At Kuala Pahang 63 per cent of the days have winds from the north and north-east, 40 per cent reaching speeds of 13–24 m.p.h. At Malacca 71 per cent of the days have winds from these two directions, though only 13 per cent reach speeds of 13–24 m.p.h.

January (Fig. 8). The Northern Equatorial Air-stream Boundary (AB) advances to its most southerly position, astride the Java Sea. The pattern of winds in north Malaya is similar to that in December, with Kota Bharu recording a higher frequency (54 per cent) of winds from the north-east and east. Both the frequencies and the average speeds of the northerlies and the north-easterlies in south Malaya increase considerably. At Kuala Pahang the frequency of the winds from these two directions increases to 90 per cent, with 64 per cent attaining speeds of 13–24 m.p.h. At Malacca their frequency increases to 83 per cent, and 27 per cent blow with speeds of 13–24 m.p.h.



1. A limestone outcrop rising abruptly from the flat alluvial plain of north Kedah. Its precipitous sides are bare, an unusual phenomenon in a country where the slopes of most mountains and hills are smooth and rounded and characteristically covered with a thick mantle of forest. The local solution of limestone has enlarged the joints and cracks of the outcrop, and has resulted in the formation of several small cavities and one large cave. The vegetation in such limestone areas differs from lowland rainforest, being made up of species which are adapted to semi-drought conditions caused by the rapid run-off and percolation of rainwater, and to the thin, calcareous, alkaline soils.

2. Meanders along the lower course of the Rompin River. The river has its outlet in the South China Sea. Much of this area is inundated during the north-east monsoon and is covered with dense freshwater swamp forest. The higher ground along the seaward face has soils with a high sand content and is occupied by beach forest. Nipah palms (*Nipa fruticans*) line the banks of the river.

3. Cumulonimbus with typical fibrous top and anvil seen from Kota Bharu airport at 3.45 p.m. on 25 August 1961, centred over the east coast of south Thailand, about 30 miles away from the airport. The height of the cloud is over 35,000 ft., and the breadth of the anvil about 40,000 ft.

4. The south bank of the Pahang River mouth showing beach forest on the seaward face with a fringe of casuarina trees (*Casuarina equisetifolia*) along the shore, and dense mangrove forest on the inner curve of the river mouth.

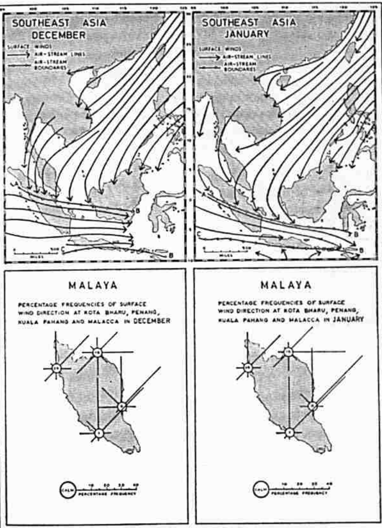


FIG. 8. Surface winds and air-stream boundaries over South-East Asia (*top*), and percentage frequencies of surface winds over the Malay Peninsula (*bottom*), December and January

February (Fig. 9). With the retreat of the north-east monsoon the Northern Equatorial Air-stream Boundary (AB) moves northwards, its mean position for the month being similar to that of December. The wind pattern in Malaya is also basically similar to that in

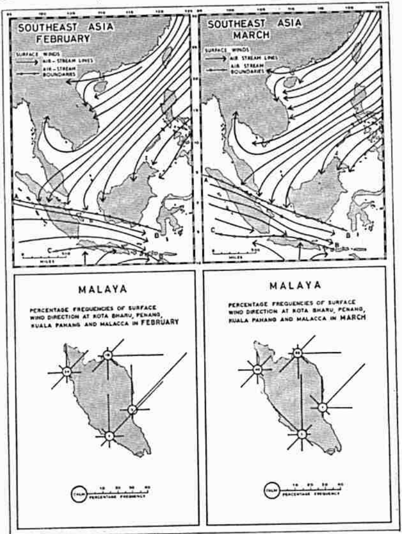


FIG. 9. Surface winds and air-stream boundaries over South-East Asia (*top*), and percentage frequencies of surface winds over the Malay Peninsula (*bottom*), February and March

December, with the exception that Penang records a higher frequency (34 per cent) of calms.

March (Fig. 9). The retreat of the monsoon is marked by a further slight northward shift of the Northern Equatorial Air-stream Boundary (AB). A higher frequency of calms is observed in north Malaya —40 per cent at Penang and 22 per cent at Kota Bharu. The prevailing surface winds along the east coast of Malaya are still from the north-eastern quadrant—40 per cent of the days at Kota Bharu and 70 per cent at Kuala Pahang. But the wind patterns along the west coast do not indicate the presence of the north-east monsoon. At Malacca the prevailing surface winds are from the north and north-west (59 per cent frequency), while at Penang winds from the western quadrant are more frequent (28 per cent) than from the north-eastern quadrant (24 per cent).

April (Fig. 10). The pattern of the air-stream boundaries in this month is similar to that of October, but the position of the boundaries is south of Singapore. April is the transitional period between monsoons in southern Malaya. Wind patterns are indeterminate in this part of the Peninsula. At Kuala Pahang 38 per cent of the days of the month experience winds from the north-east and east. At Malacca winds blow with a 43 per cent frequency from the north and north-east, and a 36 per cent frequency from the western quadrant. Wind conditions in north Malaya are much the same as those recorded for March, except that at Kota Bharu the frequency of winds from the north-east and east drops to 27 per cent.

May (Fig. 10). The pattern of the air-stream boundaries is similar to that for April, but the position of the boundaries is now north of the Malay Peninsula. The withdrawal of the north-easterlies is reflected in the wind patterns in Malaya. North Malaya continues to have a high incidence of calms—48 per cent at Penang and 15 per cent at Kota Bharu. Sixty-five per cent of the days at Kota Bharu have winds from the south-west quadrant. At Kuala Pahang winds also blow with the greatest frequency (64 per cent) from the south-west quadrant.

June (Fig. 11). With the onset of the south-west monsoon air-streams from the south-west prevail over northern Malaya, while southerlies prevail over south Malaya. The Southern Equatorial Air-stream Boundary (BC) marks the meeting zone of these air-streams. Wind conditions throughout Malaya differ very little from those in May.

July (Fig. 11). The Southern Equatorial Air-stream Boundary (BC) now advances slightly northwards. Wind patterns in north Malaya remain remarkably similar to those in May and June. At

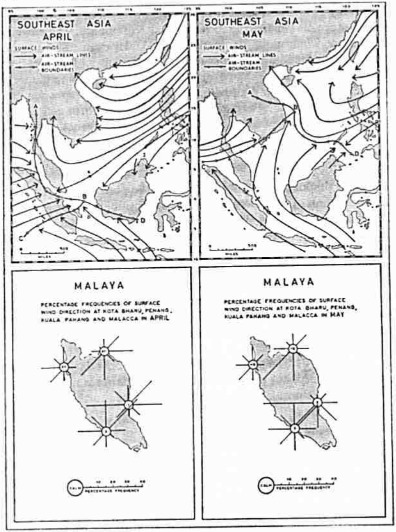


FIG. 10. Surface winds and air-stream boundaries over South-East Asia (*top*), and percentage frequencies of surface winds over the Malay Peninsula (*bottom*), April and May

Kuala Pahang most of the winds are light (less than 13 m.p.h.) and blow from the south-west quadrant. At Malacca, however, 55 per cent of the days have winds from the south-east quadrant.

August (Fig. 12). There is little change in the mean position of the

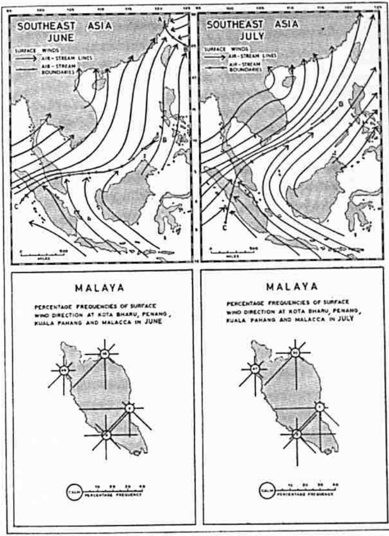


FIG. 11. Surface winds and air-stream boundaries over South-East Asia (*top*), and percentage frequencies of surface winds over the Malay Peninsula (*bottom*), June and July

Southern Equatorial Air-stream Boundary (BC), and wind conditions throughout Malaya are much similar to those for July.

September (Fig. 12). The south-west monsoon begins to retreat. The Northern Equatorial Air-stream Boundary (AB) advances to a

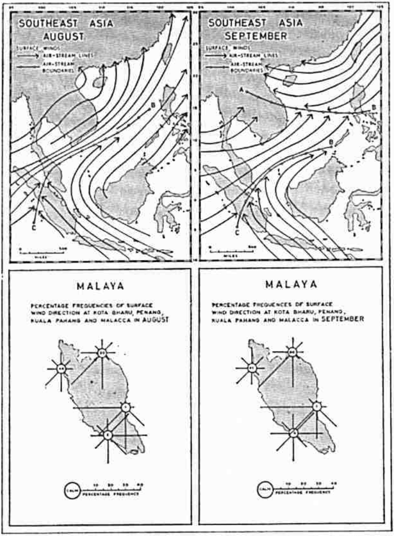


FIG. 12. Surface winds and air-stream boundaries over South-East Asia (*top*), and percentage frequencies of surface winds over the Malay Peninsula (*bottom*), August and September

position between the centre of the Indo-Chinese peninsula and the Philippines, while the Southern Equatorial Air-stream Boundary (BC) now lies between Singapore and Palawan Island. Surface winds in north Malaya are light and are often reduced to a calm. Penang has 41 per cent of the days with calm weather, while Kota Bharu has 20 per cent. Winds at the latter station are predominantly from the south-west quadrant. Kuala Pahang has 75 per cent of the days with winds from the same quadrant, but Malacca has winds as frequently from the north-east (41 per cent) as from the south-west (40 per cent). Wind speeds throughout Malaya remain less than 13 m.p.h.

Land and Sea Breezes. These diurnal winds are caused by differential heating and cooling over land and sea. The sea breeze generally sets in about ten in the morning, steadily gathering strength until it blows with greatest force in the early afternoon, and finally dies away at sunset. There is a short interim period before the land breeze begins to blow in the late evening and night. The land breeze is seldom as strong as the sea breeze. The breezes are only felt for a distance of about 10 miles from the shore, and inland areas do not have these diurnal winds.

The regularity of the breezes varies with the season of the year, and the location of the area in relation to the monsoons. In general the breezes are best developed during the intermonsoon periods and when the monsoons are weak. At Kuala Trengganu, during these periods, the sea breeze reaches maximum speed at about two or three in the afternoon. The breeze at its maximum averages 7–8 m.p.h. The land breeze reaches maximum force at about six in the morning. At its maximum it averages 4–5 m.p.h.

In the Straits of Malacca, during these periods, the sea breeze usually sets in between ten and eleven in the morning, and attains maximum force at about four in the afternoon. The average speed of the breeze at its maximum is 11·5 m.p.h. The land breeze sets in between eight and nine at night and blows until about nine in the morning. At its maximum the land breeze seldom exceeds 8 m.p.h.

The position is different during the monsoons. During the north-east monsoon the prevailing north-easterlies attain sufficient force to mask and even entirely prevent the development of the land breeze along the east coast and the sea breeze along the west coast of the Peninsula. Conversely, the north-easterlies during this period reinforce the sea breeze along the east coast, and the land breeze along the west coast. A reversal of this pattern occurs during the south-west monsoon.

Squalls. Surface winds over the Peninsula are generally light, their speeds seldom exceeding 18 m.p.h., with gusts of less than 30 m.p.h.

Occasionally, however, gusts may exceed 30 m.p.h. A squall is defined by Watts as a storm with gusts of over 30 m.p.h. accompanied by marked changes in wind direction and sudden increases of wind-speed. Such storms can sometimes be quite violent and cause considerable damage to shipping, buildings and other structures which lie in their paths. The torrential rain which accompanies them may cause local floods, destroy crops[1] and impede normal traffic flow. Winds may reach speeds of 40 or more miles per hour within a few minutes. Local squalls may occur as a result of some local configuration of the land disturbing the smooth passage of an air-stream. Other local squalls may occur in association with isolated cumulonimbus.

Line-squalls are usually, though not necessarily, accompanied by continuous lines of cumulonimbus clouds with equally strong winds at every point along them. Line-squalls may accompany a moving air-stream boundary. Sometimes the seaward flow of an air-stream at an upper level may retard the development of a sea breeze so that when the breeze does set in, the air over the land has had time to warm up to such an extent that its temperature is several degrees higher than the sea breeze. The colder sea breeze thereby undercuts the warm air over the land, resulting in the formation of convective cloud and a line-squall parallel to the coast. Similarly, the land breeze may on occasion begin as a line-squall because of an air flow from sea to land delaying the development of the land breeze sufficiently to cause the air over the land to cool considerably. When the land breeze eventually moves out to sea, it undercuts the warmer air over the sea, and a line-squall may then develop.

The incidence of squalls in the Malay Peninsula varies from place to place and according to the period of the year. Table 1 shows that squalls occur with the greatest frequency along the coastal parts of southern Malaya: Mersing had a total of 218 squalls and 72 line-squalls over a two-year period, while Kuala Pahang, at the mouth of the Pahang River, recorded a total of 155 squalls and 52 line-squalls. A similar pattern obtains along the coasts of western Malaya: Malacca recorded a total of 182 squalls and 90 line-squalls while Bukit Jeram, on the Selangor coast, had a total of 146 squalls and 90 line-squalls.

[1] It has been found, for example, that high yielding rubber trees derived from Clone 501 are distinctively susceptible to wind damage and are liable to be blown down during a squall.

The incidence of squalls and line-squalls is highest over all parts of the Peninsula during May to August, as Table 1 reveals clearly. The line-squalls which occur along the coast between Port Swettenham and Singapore during this period are known locally as 'sumatras'. These 'sumatras' have the following characteristic features: (i) they are not associated with a moving air-stream boundary but lie entirely within a single air-stream, (ii) they almost always occur at night or in the early morning, and (iii) they are accompanied by strong cold squalls with gusts of over 50 m.p.h. where the 'sumatras' are well-developed. In most cases these 'sumatras' are accompanied by a continuous line (which may be up to 200 miles long) of huge cumulus or cumulonimbus. Their cause is not yet fully understood.

The incidence of squalls in Malaya is low during November to February, in marked contrast to the high incidence during May to August. Most of the squalls during November to February occur in the early afternoon as local convective storms. Except at Malacca, line-squalls are rare in Malaya at this period. Table 1 also shows that the frequency of occurrence of squalls and line-squalls during the months of September–October is higher than that during the months of March–April, and even higher than that during November to February.

TEMPERATURE

The Malay Peninsula, with its southernmost extremity just north of latitude 1° N. and its northern boundaries at about latitude 7° N., lies within a zone where the sun's angular elevation above the horizon is high for all the year. But insularity, heavy rainfall, high relative humidities, and a constant heavy cloud-cover considerably moderate temperature, so that the excessive summer temperatures which occur at the higher tropical latitudes are never recorded here. Temperatures remain uniformly high throughout the Peninsula and throughout the year. Figure 13 shows that the mean annual temperature is strikingly similar for all places in lowland Malaya. Kluang in central Johore has the lowest (78° F) mean annual temperature of the nine lowland stations, whilst Grik, some 50 miles inland from the Province Wellesley coast, has the highest—80·5° F. The other seven lowland stations have mean annual temperatures between 78° and 80° F. Cameron Highlands, 4,750 feet above mean sea-level, has a mean of 64° F, but altitudinal lowering of the temperature is of little

TABLE 1. *Number of Squalls and Line-squalls in Malaya over a Two-year Period (1936 and 1937)*

	Period of the Year								Total over the Two-year Period	
	Nov.–Feb.		Mar.–Apr.		May–Aug.		Sept.–Oct.			
	Squalls	Line-Squalls	Squalls	Line-Squalls	Squalls	Line-Squalls	Squalls	Line-Squalls	Squalls	Line-Squalls
Western Malaya										
Penang (Bayan Lepas)	6	4	10	6	54	36	24	18	94	64
Sitiawan	6	6	Nil	Nil	16	16	2	Nil	24	22
Kuala Lumpur	26	6	14	2	42	18	30	14	112	40
Bukit Jeram	28	8	18	12	74	52	26	18	146	90
Malacca	46	20	14	6	78	46	44	18	182	90
Eastern Malaya										
Kota Bharu	8	Nil	4	Nil	68	22	26	14	106	36
Kuala Pahang	42	8	11	2	66	30	36	12	155	52
Kuala Lipis	8	2	20	6	36	28	28	8	92	44
Mersing	54	8	24	10	90	34	50	20	218	72

human significance in a country where the population is concentrated in the lowlands.

Figure 13 also illustrates the monotonous uniformity of the mean

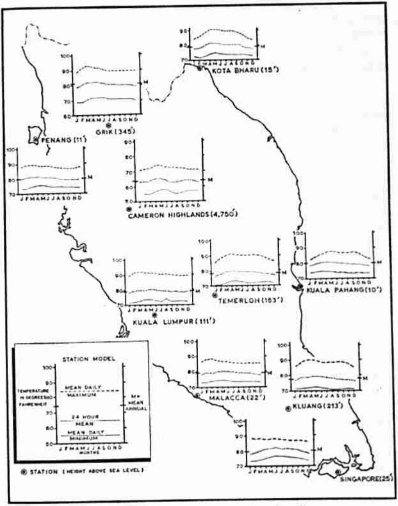


FIG. 13. Mean temperatures at selected stations

monthly temperatures throughout the Peninsula. Temperatures for most of the months of the year for most places in lowland Malaya are between 78° and 82° F. However, there is a small but noticeable drop in mean monthly temperatures in eastern Malaya during the north-east monsoon. Kota Bharu, for example, has mean monthly temperatures of 77–78° F for the monsoon months of November to February, while Temerloh, about 70 miles upstream from the mouth of the Pahang River, experiences a similar drop in temperature during this period. This fall in the average values in eastern Malaya is probably due to the low day temperatures brought about by the overcast skies and heavy rainfall of the monsoons. It is also possible that the fall in average temperature values may be due to the fact that eastern Malaya is under the influence of air-streams from higher, and cooler, latitudes at this time of the year. Cameron Highlands experiences temperatures of between 63° and 65° F for all the months of the year.

The mean annual range is consequently very small everywhere in Malaya, along the coasts as well as in the interior, in the lowlands and the uplands (Table 2). Penang (Bayan Lepas aerodrome), Kuala Pahang at the mouth of the Pahang River, Kuala Lumpur in the Klang Valley, Malacca on the south-western coast, and Kluang in central Johore, all record a mean annual range of only 2° F, while Cameron Highlands has a range of 2·5° F. Kota Bharu and Singapore both have a slightly higher range of 4° F.

As is typical of the equatorial latitudes, the mean diurnal range (that is, the difference between the mean of the daily maxima and the mean of the daily minima observed over a long period) is greater than the mean annual range, although the diurnal range is still very small when compared with that of the dry tropics. For this reason, the 'winter' of equatorial and tropical areas may be said to fall at night when the lowest temperatures are experienced. Mean daily minima for places throughout the lowlands fall between 69° and 76° F (Fig. 13). Most areas record minima of 71–74° F. Mean daily maxima, however, show greater variation. Places in eastern Malaya experience a drop in maximum temperatures during the north-east monsoon. Thus the mean daily maxima at Kota Bharu are 83–86° F for the months of November to February, and 87–90° F for the rest of the year. A similar pattern obtains for Kuala Pahang. At Temerloh the fall in daily maximum temperatures is confined only to the months of December and January when mean daily maxima are 85–86° F. For the remainder of the year the maxima are between 88° and 91° F (Fig. 13).

The mean daily maxima are generally higher in the interior of the Peninsula (e.g. 89–93° F at Grik) than along the coast (e.g. 86–89° F at Penang). The mean daily minima are also lower in the interior (e.g. 69–72° F at Grik) than along the coast (e.g. 73–75° F at Penang). The result is that interior locations have a more pronounced diurnal range of temperatures than places along the coast. Thus Kuala Lumpur, Temerloh, Grik and Kluang all have a diurnal range of 16–19° F, while the coastal stations of Kota Bharu, Kuala Pahang, Malacca and Penang have a range of 11–14° F (Table 2). At Cameron Highlands the range is 16° F (mean maxima of 72° F and mean minima of 56° F).

TABLE 2. *Temperature Ranges and Extremes of Temperature at Selected Stations (in ° F)*

LOWLAND STATIONS	Mean Annual Range	Mean Diurnal Range	Absolute Maximum	Absolute Minimum	Extreme Range
Kota Bharu	4	14	96	62	34
Penang (Bayan Lepas)	2	13	94	65	29
Kuala Pahang	2	11·5	93	65	28
Temerloh	3	17	97	64	33
Kuala Lumpur	2	18	98	64	34
Malacca	2	13	95	66	29
Kluang	2	16	96	64	32
Grik	3	19	99	60	39
Singapore	4	12	95	67	28
Cameron Highlands (4,750 feet)	2·5	16	80	36	44

In Malaya extreme temperatures show the same constancy and the same small range as mean temperatures. The thermometer seldom rises above 100° F or falls below 60° F (Table 2). The highest temperature recorded in the Peninsula was 103° F, at Pulau Langkawi on a day in March 1931. The lowest temperature recorded in the lowlands was 60° F, at Grik on several occasions, at Lenggong on a day in 1937 and again in 1939, and at Kulim on a day in 1937. The extreme range in the lowlands seldom exceeds 40° F (Table 2). At Cameron Highlands the extreme range is greater as an absolute maximum of 80° F and an absolute minimum of 36° F have been recorded. Such a range, however, has not been observed for the other highland stations in the Peninsula.

RELATIVE HUMIDITY

Relative humidity is persistently high in all parts of the Malay Peninsula. The average values recorded for a large number of stations in different locations show remarkable uniformity. Most of the stations have a mean relative humidity of 82 to 86 per cent, rising to nearly 90 per cent in the highland areas. The constantly high temperature and high relative humidity which are characteristic features of the Malayan climate are far from the optimum for comfort, health and sustained physical work.

Over the Peninsula relative humidities vary to some extent with changes in the monsoons, but these variations are not great, and the mean values in the months of highest and lowest relative humidity do not exceed 13 per cent in any part of the country. Figure 14 shows the average monthly variation of relative humidity for each of the main rainfall regions of Malaya: the north-west (Alor Star), the east (Kota Bharu), the west (Kuala Lumpur), the south-west (Kluang), and the Port Dickson–Muar coast (Malacca), as well as the highlands (Cameron Highlands). In all cases the monthly variations are the result of variations in the mean daily minima as the mean daily maxima lie between 95 and 100 per cent for all stations. The greatest variation (nearly 13 per cent) of the average monthly values of relative humidity is recorded at Alor Star. Mean monthly relative humidity reaches a peak of about 88 per cent in October, and decreases during the north-east monsoon to a low of 76 per cent in February. It then increases to a secondary peak of 85 per cent in May, and remains around that level during the south-west monsoon. Mean monthly relative humidity at Kota Bharu is between 82 and 84 per cent for most of the year except in October, November and December when the onset of the north-east monsoon causes it to rise to 86, 88 and 87 per cent respectively. Kuala Lumpur has a wave pattern of relative humidity, with crests of 85–86 per cent occurring in April and May and again in November, and troughs of 81–82 per cent in February and July–August. The same pattern is recorded at Malacca, Kluang and Cameron Highlands.

Figure 15 shows the hourly values of relative humidity in relation to temperature for the same selected stations from the main rainfall regions. The diurnal cycle is the same for all stations throughout Malaya: during the night and the early hours of the morning temperatures fall gradually until they reach a minimum of 72–75° F

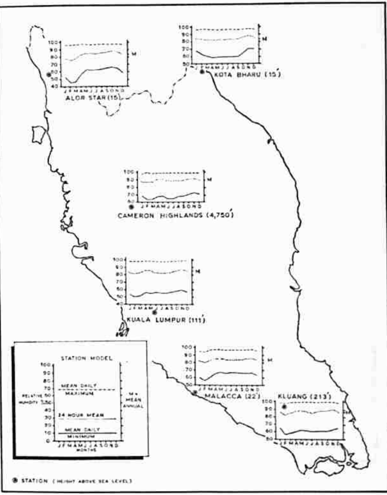


FIG. 14. Mean relative humidities at selected stations

at about 6 and 7 a.m. in the lowlands, and 58° F in the highlands. As temperatures fall, relative humidity increases progressively until it reaches a maximum of 93–98 per cent during the hours of lowest temperatures. A state of near saturation now exists. Temperatures are still in the seventies in the lowlands at eight in the morning, but climb abruptly to 82–83° between 9 and 10 o'clock, and to 66–68° F in the highlands. As a result there is a sudden decrease in relative

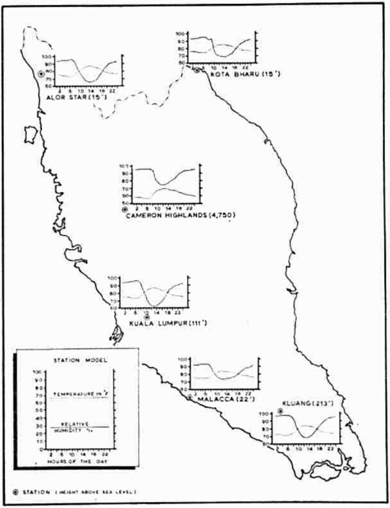


FIG. 15. Hourly values of temperature and relative humidity at selected stations

humidity during this period, values falling by 7 per cent in the case of Malacca (from 89 per cent at 8 a.m. to 82 per cent at 9 a.m.) to as much as 17 per cent at Kota Bharu (from 93 per cent at 9 a.m. to 76 per cent at 10 a.m.). Thereafter temperatures rise steadily to a maximum of 84–87° at one in the afternoon in the lowlands and 70° in the highlands, and relative humidities drop to their lowest levels for the twenty-four-hour period: to 62–74 per cent in the lowlands and 75 per cent in the highlands. There is a slow but steady fall in temperatures and a rise in relative humidities as the afternoon advances, gives away to evening and then to night. However, the relative humidity of a place may increase suddenly when a shower or thunderstorm occurs.

The diurnal range of relative humidity is much greater than the annual range, and is greater for inland areas than for coastal or highland. Thus the coastal stations of Kota Bharu and Malacca have a range of 26 and 19 per cent respectively, while the inland stations of Kuala Lumpur and Kluang have a range of 34 and 29 per cent. Cameron Highlands has a diurnal range of 21 per cent.

RAINFALL

In the tropics, the seasons are marked by changes in rainfall rather than changes in temperature. Wet and dry seasons take the place of winter and summer. While there is no real 'dry' season in the Malay Peninsula, the rainfall does vary sufficiently at different periods in the year to justify a classification of the rainfall regime into seasons of lesser or greater rainfall. Then again, because of the size of the Peninsula, its position in relation to the main air-streams and the mountain ranges which lie athwart these air-streams, there is a great difference in the amount of rain which falls in any one region in the Peninsula at any one season.

Rainfall Types. The rainfall regime of a place is affected, to a varying extent (depending upon local conditions of position and relief) by the type of rainfall that is experienced in that place. Precipitation in the Peninsula at any one time may derive from one or a combination of these four types of rainfall:

(1) Orographic rainfall. Orographic ascent causes some of the moisture that the air-streams have picked up from the surrounding tropical seas to be precipitated in the form of heavy falls of rain. Such rainfall is particularly important during the monsoons when the prevailing winds are stronger and more regular, and consequently capable of greater uplift when they encounter land barriers such as mountain ranges, plateau escarpments and even moderately high hills. Cooling, condensation and precipitation then occur, usually on the windward slopes. The Main Range and the other subsidiary

ranges which are aligned transversely to the path of both the monsoons receive considerable rain on the western flanks during the south-west monsoon and the eastern flanks during the north-east monsoon.

(2) Convectional rainfall. Differential heating and cooling of the earth's surface may result in the formation of huge cumulonimbus clouds which attain a vertical depth of several miles. In Malaya the rain which falls from such clouds is usually of great intensity, but of limited duration and affecting only a small area. Such showers last for periods of from one to six hours, but the rate of precipitation may be as much as 2–3 inches per hour. A single cumulonimbus cloud may bring rain to an area of less than 1 square mile or as much as 24 square miles. Much of the rain which falls in the Peninsula is of this type.

(3) Boundary rainfall. As has been described in the section on winds, eight or nine major air-streams blow across the Peninsula in the course of a year. Where two or more of them converge to form an air-stream boundary up-currents are initiated, followed by cloud formation and heavy precipitation. Such boundary rain commonly marks the onset of the monsoons, and may persist for several days in areas because of the slow rate of movement of the air-stream boundary.

(4) Squall rainfall. Squalls, including line-squalls and 'sumatras' are important sources of rain in the Malay Peninsula. Very intense falls of rain lasting for only a few minutes but occasionally up to two hours may be experienced during a squall.

Annual Rainfall. The areal distribution of annual rainfall reflects the interplay of the seasonal winds and orography on precipitation. The main differences in the regional distribution of rainfall arise from changes in the major air-streams and from the positional factor relative to the rain-inducing barrier of the main mountain ranges of the Peninsula.

Figure 16 shows the distribution of annual rainfall in the Peninsula. There are two exceptionally wet belts where rainfall totals more than 110 inches a year. The first and major belt covers the entire length of eastern Malaya, and is broad in the mountainous north and narrow in the southern half. Within this eastern wet belt is a smaller belt running from the Kelantan delta to the vicinity of Kuantan and including most of Trengganu State where rainfall totals are still higher, being between 130 and 170 inches a year. Between one-third and one-half of the annual total rainfall of eastern Malaya falls during the north-east monsoon. The heaviest falls are experienced along the foothills of Trengganu where an average of 160 inches is received a year.

The other wet belt lies along the north-western Malaya and runs from the coastal parts of central Kedah in a south-easterly direction

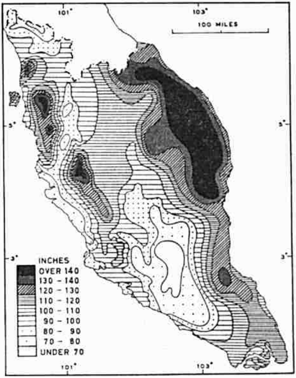


FIG. 16. Mean annual rainfall

to the vicinity of Tanjong Malim, the continuity of the belt being interrupted by the Perak River valley which receives less than 90 inches a year. In contrast to the eastern wet belt the western belt is narrow and confined to the northern half of western Malaya. Heavy falls of rain are not experienced along the southern half of western Malaya probably because of the sheltering effect of the Sumatran mountains.

There are three 'dry' belts where rainfall totals are less than 90 inches a year. All are in western Malaya. The first small belt includes Perlis and north-western Kedah. The second covers the coastal districts of Perak and Selangor and extends inland along the Perak River valley. The third and largest belt runs from the Muar–Malacca coast northwards to the vicinity of Temerloh, and includes north-western Johore, most of Malacca State, the inland districts of Negri Sembilan and the south-western parts of Pahang.

All the other parts of the Peninsula receive between 90 and 110 inches of rain a year.

These are the broad trends. The distribution over local areas, however, shows wide variations, even over comparatively short distances. As would be expected, the heaviest falls and the highest totals occur on the windward slopes of the main mountain ranges. Maxwell's Hill (3,400 feet) has an annual rainfall of 201 inches, while Taiping, at the foot of the Hill, has 166 inches. Hill stations higher than Maxwell's Hill but exposed to winds robbed of much of their rain-load when passing over the Sumatran mountains receive considerably less rain: Cameron Highlands (4,750 feet) has a total of 107 inches, and Fraser's Hill (4,289 feet) has 109 inches. The relatively low total received by Cameron Highlands is also due to its being in a sheltered highland valley.

At the other end of the scale, the lowest annual total occurs in Jelebu District, which receives 65 inches. This is again due to its protected location, being ringed in on all sides by mountains.

Monthly Rainfall. Figures 17, 18 and 19 show the monthly rainfall distribution as worked out by Dale. They should be consulted in conjunction with Figs. 7 to 12 which show the surface winds and the position of the air-stream boundaries from month to month. October is again selected as the starting point of the month to month analysis of monthly rainfall, being the transitional month between the retreating south-west monsoon and the advancing north-east monsoon.

October (Fig. 17) is the transitional month between the monsoons. The highest rainfall (18–22 inches) is experienced in north-western Malaya. This is also the wettest month of the year for this part of the Peninsula. Western Malaya in general receives heavier rain than eastern Malaya.

November (Fig. 17) marks the onset of the north-east monsoon. The heaviest rainfall occurs in a belt running from the Kelantan

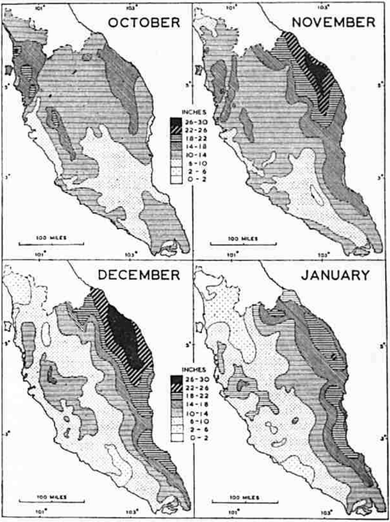


FIG. 17. Mean monthly rainfall, October to January

delta to southern Trengganu, with totals of 18–30 inches. The rest of Malaya, except the extreme north-west and a large part of the western half of south Malaya, receives fairly heavy falls of between 10–18 inches.

December (Fig. 17) brings very heavy boundary and orographic rain to the entire length of eastern Malaya as the Northern Equatorial Air-stream Boundary (Fig. 8) passes slowly across the Peninsula from the north-east to the south-west. It is the rainiest month of the year in Malaya, but with most of the rain distinctly localized to the east coast. A broad belt along this part of the Peninsula receives 14–30 inches.

January (Fig. 17) has a rainfall pattern similar to that of December, but totals are lower and eastern Malaya receives between 10 and 22 inches. The rest of the country, apart from a small area in west-central Malaya, receives less than 10 inches of rain. This is the wettest month of the year for southern Johore.

February (Fig. 18) is a month of low rainfall for all of Malaya, with totals amounting to less than half those for December. Although the north-east monsoon is still blowing with undiminished strength, it brings little rain to the east coast. Kota Bharu, for example, has only 5 inches, Dungun 6 inches, Temerloh 4 inches, and Mersing 9 inches of rain during the month. Most of the Pensinula north of latitude 5° N. receives less rain in this month than for any other month of the year.

March (Fig. 18) is a month of slightly heavier rainfall, with most parts of the Peninsula receiving between 6 and 10 inches. There are two narrow wetter belts, one running along the foothills and plains of west central Malaya, and the other a coastal zone running from southern Trengganu to the southern extremity of Johore. Both belts have totals of between 10 and 14 inches.

April (Fig. 18) is the transitional period between the retreating north-east monsoon and the advancing south-west monsoon. Calm conditions prevail for much of the time, and convectional rainfall is important. The western wetter belt of March has extended to include a considerably larger area of country, with some parts receiving 18–22 inches of rain. However, this is a month of low rainfall for eastern Malaya, with totals of 6–10 inches, except for a slightly wetter zone astride the southern Trengganu–Pahang border. North-eastern Malaya is the driest part of the Peninsula, with totals of less than 6 inches.

May (Fig. 18) marks the onset of the south-west monsoon over northern Malaya, but there is no significant increase in rainfall in western Malaya during this month. Most of the country receives between 6 and 10 inches of rain, with belts and zones of slightly higher and slightly lower rainfall.

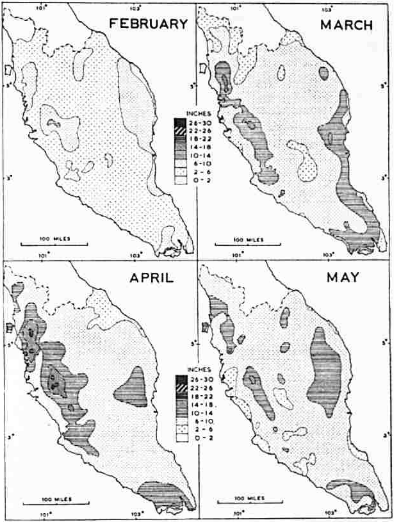


FIG. 18. Mean monthly rainfall, February to May

June (Fig. 19) is a month of still lower rainfall for most of Malaya, with totals of between 6 and 10 inches for the northern half of the Peninsula, and between 2 and 6 inches for most of the southern half, except southern Johore.

July (Fig. 19) is the driest month of the year for most of Malaya,

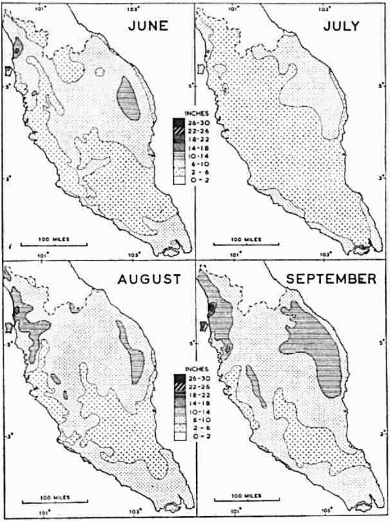


FIG. 19. Mean monthly rainfall, June to September

with totals of less than 6 inches everywhere except in the Kelantan delta and most of Trengganu where totals are between 6 and 10 inches.

August (Fig. 19) is a period of slightly heavier rain for most places except in the Pahang–Rompin–Endau deltas and along the Perak-Selangor coast where totals remain less than 6 inches.

September (Fig. 19) sees a further increase in rainfall throughout the country, particularly in north-western Malaya and Trengganu. Although the period from May to September sees the south-west monsoon established over northern Malaya, the monsoon does not bring heavy rain to the Peninsula. In fact, one of the months of the monsoon—July—is the driest for most of Malaya. The monsoon does, however, bring more rain to northern than to southern Malaya.

The Daily Rain Cycle. The daily rain cycle varies with the time of the year and the location of the station (whether coastal, inland, eastern or western). For example, half of the total amount of rain which falls during the north-east monsoon at Kuala Lumpur,

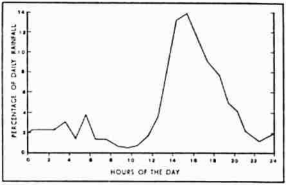


FIG. 20. The daily rain cycle at Kuala Lumpur

located some 25 miles inland from the Selangor coast, falls between the hours of two and six in the afternoon, whilst Bukit Jeram, on the Selangor coast, receives its rain spread more evenly over the hours of the day during this period. During the south-west monsoon, however, Bukit Jeram receives one-quarter of its rain during the hours of two and six in the morning, whilst Kuala Lumpur has a more even distribution pattern, though there is still a pronounced afternoon maximum.

Figure 20 shows the daily cycle of rain according to the time of the day at Kuala Lumpur. The very low incidence of rain during the morning hours (only 3½ per cent between 8 a.m. and noon), and the very high incidence during the afternoon and early evening (71 per cent between noon and 8 p.m.) are strikingly illustrated in the graph. The chances of rain falling in the afternoon or early evening are therefore very high as compared with the chances of such rain falling in the morning, especially during the north-east monsoon and the intermonsoon months.

This situation holds true for many inland areas in Malaya. However, the commonly held idea that most of the rainfall in the Peninsula falls during the afternoon must be viewed with some caution. The position is generally more complicated, and depends on many factors. For example, recent research by Watts has indicated that the diurnal variation of frequency of rainfall in Singapore varies to a great extent throughout the year. Rain in Singapore is most frequent from three to four in the afternoon from December to March. There is also a small secondary maximum at about six in the morning in December and January. After April, rain in the afternoon begins to decline in frequency and importance, while early morning rain becomes increasingly frequent. By September and October, most of the rain falls between six and eight in the morning. Such a pattern has also been found to be common along the west coast of Malaya south of Sitiawan.

Another different diurnal regime occurs along the east coast. During the south-west monsoon and the intermonsoon months most of the rain along the east coast falls between the hours of 2 and 6 p.m. But during the north-east monsoon rain is most frequent at night and in the early morning.

Rain-Days. Figure 21 shows the average number of rain-days[1] per year in Malaya as worked out by Dale. There is no simple correlation between the number of rain-days and the annual amount of rainfall. An area may have a great number of rain-days and yet receive a lesser amount of rain in a year than another area with a smaller number of rain-days but which receives its rain in long, sustained spells. The oustanding example is eastern Johore which has the greatest number of rain-days in the eastern wet belt but yet receives the lowest rainfall in the belt. The number of rain-days in any station in Malaya may vary considerably from year to year. Georgetown, for example, had 119 rain-days in 1894 and 229 in 1949.

In general there is a close and direct relationship between relief and the number of days in which rain falls. Thus the Main Range between Fraser's Hill and Cameron Highlands receives more than 200 rain-days in a year. But the mountains of eastern Malaya have

[1] A rain-day is defined as a twenty-four-hour period beginning at 0730 hours local time, in which 0·01 inch or more of rain is recorded.

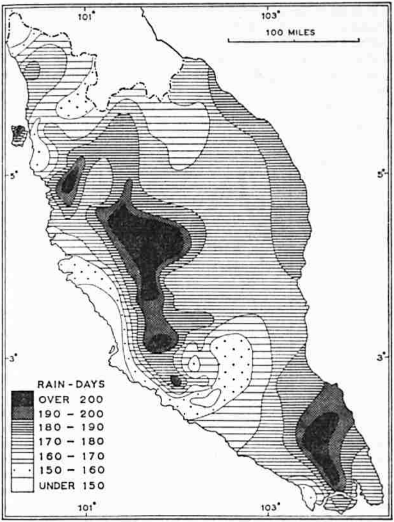


FIG. 21. Average number of rain-days per year

fewer rain-days than those in western Malaya because they lie in the rain-shadow of the Main Range during the south-west monsoon and also because much of the rainfall in this region is concentrated within the relatively brief period of the north-east monsoon. The eastern lowlands, however, have more rain-days than the western lowlands.

The range in the eastern lowlands is from 174 rain-days per year at Pekan to 198 at Mersing, while that in the western lowlands is from 134 at Kuala Selangor to 223 at Taiping.

Rainfall Regions. Dale has divided Malaya into five rainfall regions, each with its distinctive pattern of rainfall distribution (Fig. 22).

(1) North-west. This region includes that part of Malaya lying north of about 5° N. latitude and west of 101° E. longitude. Its rain-

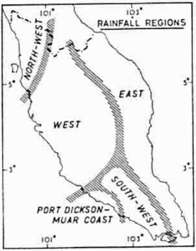


FIG. 22. Rainfall regions

fall regime is typically equatorial, with two maxima occurring during the transitional periods between the monsoons, and two minima during the monsoons. The distinguishing feature of the rainfall pattern in this region is the low amount received during the months of December, January and February, when the other parts of the Peninsula, especially eastern Malaya, have heavy rainfall.

(2) West. This region covers that part of the western lowlands between 2° 40′ and 5° N. latitude, and that part of interior Malaya west of a line drawn from the Thai border running between the Main Range and the Trengganu Highlands and running southwards in a wide curve to end at the west coast north of Port Dickson. The pattern of distribution is similar to that of the north-west region, with two maxima occurring in April and October–November, and

two minima in February and July. Places along the coast may receive as much as half of the total annual rainfall during the north-east monsoon, but, in general, the rainfall is more evenly distributed throughout the year than in the north-west region, and dry spells do not last for more than a week or two, and only very occasionally for as long as a month. Within this region is the southerly extension of the western wet belt where rainfall totals are between 110 and 140 inches a year.

(3) Port Dickson–Muar Coast. This region covers that part of the coast roughly between Port Dickson and Muar, and extending up to 15 miles inland. The pattern of distribution is different from that of the rest of Malaya in that there is only one maximum and one minimum a year. In contrast to the west region, 45 per cent of the annual rainfall is received during the south-west monsoon, and only 36 per cent during the north-east monsoon. Much of the rainfall during the south-west monsoon is from the heavy falls associated with 'sumatras' and boundary rain during the 'summer' months.

(4) South-west. This region extends from the south-western coast of Johore to cover the inland areas of Negri Sembilan and south-west Pahang. Rainfall in this region ranges from less than 70 inches to 110 inches a year, and is distributed evenly throughout the year. The north-east monsoon brings only slightly heavier rain than the south-west monsoon.

(5) East. This region covers the whole of eastern Malaya, from Kelantan to eastern Johore. It receives only one primary maximum and one primary minimum during the year, the maximum occurring in November and December in the north and later in the south. The minimum varies from place to place and from year to year, and may fall in April, June or July. The rainfall pattern in this region is more markedly seasonal than in the rest of Malaya, as much as 60 per cent of the annual total falling during the north-east monsoon, 26 per cent during the south-west monsoon, and only 14 per cent during the transitional months of April and October.

Rainfall Intensity and Soil Erosion. Much of the precipitation in the Malay Peninsula occurs as thunderstorms, when high intensities of rainfall are recorded. The intensity with which the rain falls has an important bearing on soil erosion and soil conservation in tropical agriculture. In exposed localities such as cultivation clearings, heavy falls of rain concentrated within a short spell may wash away valuable top-soil. The direct impact of falling raindrops has considerable eroding effect on exposed soil, as can be seen in any railway cutting or embankment or the exposed face of a fresh landslip in Malaya. Here one often finds little earth pillars, each with a small pebble, leaf or twig on the top acting as a resistant or protective shield while the rest of the surface soil around it is cut away by the falling drops of rain.

Every particular type of soil absorbs rain by percolation up to a certain limit; rain which falls in excess of this limit accumulates,

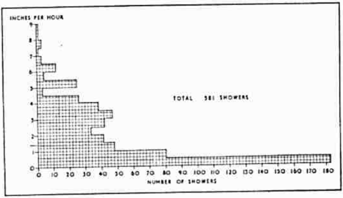


FIG. 23. Rainfall intensity at Kuala Lumpur

runs over the surface and erodes the soil. The maximum amount of moisture which a soil can absorb depends on its mechanical composition (whether clay, sand, silt, etc.) and on the amount of moisture already present in it. In Malaya it has been calculated that for an average open soil the maximum absorptive rate is about 3 inches of water per hour; in very sandy soils the rate may be twice this figure but most Malayan soils have a rate of less than 3 inches.

Local downpours in the Peninsula may occasionally reach intensities of 6 inches or more per hour. At Kuala Lumpur 2 inches of rain fell in only 15 minutes on 24 February 1951. Steady continuous rain falling for long periods has much the same erosive effect as short intense falls because the soil has little chance to dry out in-between falls. At Johore Bahru, for example, heavy rain fell almost without ceasing for nearly a week in February 1925. This is an exceptional occurrence, and the normal pattern is one of heavy falls within short periods.

Records have been kept at Kuala Lumpur of the maximum intensity reached during each shower of rain for 581 consecutive showers. The results are shown in Fig. 23. It will be seen that 26½ per cent (154 showers) of the 581 showers fell with a maximum intensity of more than 3 inches per hour. In effect this meant that an average of one in four showers fell with an intensity greater than the absorptive rate for an average open soil in Malaya, with consequent erosive effect on the soil.

The need, therefore, for keeping the soil covered is clear—in heavy forest the thick vegetation and the forest canopy absorb the heaviest impact of the raindrops, but wherever the forest is felled for cultivation, especially on hill slopes, its protective function is lost. The amount of top-soil which will be removed by subsequent water erosion depends on three factors: (i) the interval between the time of exposure of the soil and the establishment of a new protective cover of planted crops; (ii) the type of crop planted—in general perennial tree crops with thick foliage such as rubber are better for soil conservation than short-term crops such as tapioca, hill padi, or maize; and (iii) the slope of the land: for example, it has been found that a rubber plantation on a 30° slope and without the additional protection of ground cover-crops lost an average of 17 tons of top soil per acre per annum. The significance of this loss is apparent when it is realized that Malayan soils have, with few exceptions, a low content of organic matter and humus, and that this organic matter is concentrated in the top few inches of the soil.

CLOUDS AND SUNSHINE

All the ten international cloud types occur over the Peninsula at various times: the high clouds (cirrus, cirrostratus and cirrocumulus), the middle clouds (altocumulus, and altostratus), the low clouds (nimbostratus, stratus and stratocumulus), and the heap clouds or clouds with vertical development (cumulus and cumulonimbus). But the most characteristic and common clouds in Malaya are cumulus and cumulonimbus. These convection clouds may be formed not only as a result of direct solar heating of the ground, but by any process which causes uplift to occur. The equatorial atmosphere is nearly always conditionally unstable, and strong upward currents arising from a variety of causes favour cumuliform development.

The life cycle of a tropical convective cloud is made up of three stages (Frost): (1) the cumulus or building stage, when a general up-draught prevails, and the cloud tops build up to a height of less than 30,000 feet. This stage lasts for thirty to sixty minutes. (2) The active cumulonimbus stage. In the low latitudes of the Malay Peninsula the transition from cumulus to cumulonimbus cloud occurs at a height of between 30,000 and 33,000 feet. During this stage, which also lasts for thirty to sixty minutes, the cloud continues to build up

TABLE 3. *The Mean Daily Amount of Cloud at Selected Stations*

	AMOUNT OF CLOUD (in tenths)												
	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Alor Star	6	6	6	7	7	7	8	8	8	8	8	7	7
Kota Bharu	7	5	5	5	7	7	7	7	7	7	7	7	6·5
Temerloh	8	7	7	8	7	8	8	8	8	9	9	8	8
Kuala Lumpur	7	7	7	8	7	8	7	8	8	8	8	8	8
Bukit Jeram	7	6	7	7	7	7	7	7	7	8	8	7	7
Mersing	7	6	6	6	6	7	7	7	7	8	8	8	7
Malacca	7	7	7	7	7	7	7	7	7	8	8	8	7
Kluang	7	6	7	7	7	7	7	8	8	8	8	8	7
Singapore	7	7	7	7	7	7	6	7	7	7	7	7	7
Cameron Highlands (4,750 feet)	7	7	7	8	8	8	8	8	8	9	8	8	8

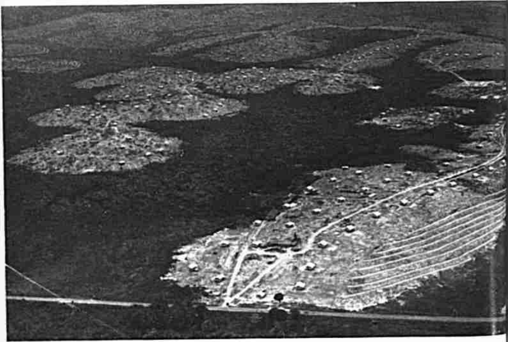
vertically, and may on occasion reach the level of the tropopause, about 55,000 feet. The edges of the cloud have a characteristic fibrous appearance when it is at this active stage (Plate 3). (3) The dissipating cumulonimbus stage, which lasts for less than thirty minutes, and recognizable by the formation of the anvil.

Cloudiness is one of the characteristic features of an equatorial maritime climate such as is experienced in Malaya. It is partly responsible for keeping temperatures in these latitudes uniform, by checking solar radiation by day and terrestrial radiation by night. Table 3 shows the mean daily amount of cloud (in tenths of the sky covered) at representative stations in the Malay Peninsula. High

5. Canopy of lowland tropical rain forest as seen from Kedah Peak. Variety in species and unevenness in height are evident. The silvery-green canopy of the *seraya* (*Shorea curtisii*) stands out from the darker green of the other species.

6. Dwarf sub-montane forest on peat, Kedah Peak (3,992 ft.).

7. An aboriginal (Senoi) family; part of a community occupying only six huts in a *ladang* at the foot of Bukit Chintamani, near Kuala Lipis, Pahang. Besides maize, the main crops cultivated by these shifting cultivators are hill padi, tapioca, banana and sweet potato.



8. The Endau Scheme, a colonization project of the Federal Land Development Authority. The total area to be developed is 2,400 acres. Each settler is provided with a house within a half acre of land in which he can grow subsistence crops such as banana, tapioca and maize, and a six-acre holding of high-yielding rubber. The photograph shows the community settlement area in the foreground, and young rubber on the terraced hillsides in the background. The main road leads, right and north, to Endau and, left and south, to Mersing.

cloud amounts are recorded for all places, the mean annual cloudiness ranging from six-and-a-half-tenths at Kota Bharu to eight-tenths at Kuala Lumpur, Temerloh and Cameron Highlands. The monthly distribution of cloud cover shows only slight variations from place to place. Singapore has a uniform pattern, with seven-tenths of the sky covered for all the months of the year except June, when the amount of cloud is one-tenth less. All the other stations show a slight increase in cloudiness in the last quarter of the year,

TABLE 4. *The Average Number of Overcast*[1] *Days at Selected Stations*

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Alor Star	8	7	8	10	16	14	17	16	18	20	18	18	170
Kota Bharu	12	8	7	6	11	11	13	12	13	15	16	16	140
Temerloh	17	11	12	14	14	15	13	14	14	18	20	19	181
Kuala Lumpur	13	10	12	14	13	14	14	14	16	21	21	18	180
Bukit Jeram	10	5	9	7	8	5	10	9	12	15	14	12	116
Mersing	16	10	8	8	10	11	11	11	10	16	17	18	146
Malacca	13	11	13	13	13	12	13	12	15	19	18	18	170
Kluang	14	9	11	13	12	10	12	11	13	19	20	16	160
Singapore	16	12	11	11	12	12	12	13	13	17	18	19	166
Cameron Highlands	16	10	13	16	18	15	18	20	22	23	22	21	214

[1] On an overcast day the mean amount of cloud at hours of observation covers more than six-tenths of the sky. It should be noted that the British Meteorological Office defines 'overcast' as a sky completely obscured by clouds. When seven-eighths of the sky is obscured the official term is 'overcast with openings'.

coinciding with the end of the south-west monsoon, the transitional period, and the onset of the north-east monsoon.

The general high cloudiness is also seen in the high average number of overcast days in the Malay Peninsula (Table 4). In lowland Malaya the annual average varies from 116 days at Bukit Jeram, on the Selangor coast, to 180 and 181 at Kuala Lumpur and Temerloh, while at Cameron Highlands the average is 214 days per year. There is a general increase in the number of overcast days per month during the last quarter of the year. But these average conditions do not reveal the great fluctuations in the number of overcast days in individual years at each station. For example, Bukit Jeram had only 27 overcast days in 1930 and 207 in 1937, while Singapore had a low of 83 days in 1933 and a high of 225 days in 1952 and Mersing a low of 53 days in 1930 and a high of 209 days in 1947. Cameron Highlands recorded a low of 135 overcast days in 1931, and a record total of 338 overcast days in 1951.

TABLE 5. *The Average Duration of Bright Sunshine at Selected Stations*

	Hours of Bright Sunshine												
	J	F	M	A	M	J	J	A	S	O	N	D	Year
Alor Star	8·0	8·5	8·3	7·9	7·0	6·5	6·3	6·5	5·7	5·5	5·5	6·7	6·8
Kota Bharu	6·1	8·0	8·3	8·4	6·8	6·9	6·8	7·3	6·3	5·8	4·9	4·9	6·7
Temerloh	5·2	6·6	6·6	6·5	6·4	6·3	6·4	6·5	5·8	5·3	4·8	4·7	5·9
Kuala Lumpur	5·4	6·8	5·8	5·7	5·6	5·9	5·6	5·6	5·0	4·6	4·2	4·7	5·4
Bukit Jeram	6·7	8·5	7·3	7·0	7·1	7·5	6·9	6·9	6·3	5·7	5·8	6·1	6·8
Mersing	5·2	7·3	7·3	7·1	6·9	6·7	6·6	6·7	6·1	5·3	4·9	4·7	6·2
Malacca	6·0	7·5	7·2	6·8	6·7	6·8	6·6	6·4	5·9	5·8	5·6	5·8	6·4
Kluang	5·3	7·2	6·0	5·8	5·9	5·6	6·1	5·6	4·9	4·6	4·5	4·5	5·5
Singapore	5·0	6·6	6·2	5·9	6·1	6·4	6·6	6·2	5·8	5·2	4·8	4·7	5·8
Cameron Highlands	4·3	5·5	5·1	4·8	4·7	5·4	5·1	4·8	4·1	3·7	3·4	3·7	4·5

Clear cloudless days are rare in the southern part of the Peninsula. Singapore, for example, had only 33 days of blue sky (when the mean amount of cloud covers less than two-tenths of the sky) over a sixteen-year period, the maximum number recorded in a year being 8 (in 1933). The number of clear days increases slightly with increase in latitude, and the northernmost parts of the Peninsula—Alor Star and Kota Bharu—receive on an average 10 days of blue sky in a year. Cloudiness in highland areas is very marked, and Cameron Highlands had only 27 days of blue sky over a sixteen-year period, of which 10 occurred in the year 1931.

Daylight in the Malay Peninsula lasts for about 12 hours, the length of day varying only slightly throughout the year because of the low latitude of the Peninsula and its small latitudinal extent.

The difference between the longest and shortest days at Singapore is only 9 minutes, at Kuala Lumpur 20 minutes, and at Alor Star, in the north, 37 minutes. The duration of bright sunshine (Table 5) is therefore only affected to a small extent by differences in day lengths due to latitudinal differences. It is, however, greatly affected by the amount of cloud cover. At Singapore, where the cloud cover is high throughout the year (Table 3), the average duration of bright sunshine is only 5·8 hours a day, with little variation from month to month. The average duration is still less at Kluang and Kuala Lumpur, with 5·5 and 5·4 hours per day respectively. At both these places the cloud cover increases towards the end of the year, and the average duration of bright sunshine falls correspondingly. A similar pattern obtains for the other lowland areas of Malaya. At Cameron Highlands cloudiness is higher than in the lowlands, and the average duration of bright sunshine is only 4·5 hours a day.

CHAPTER 3

VEGETATION

About three-quarters of the land area of Malaya is still covered with dense evergreen forest, the characteristic vegetation of the hot, wet tropics. This forest, which is usually referred to as tropical rain forest, has developed as a result of the uniformly high temperatures and heavy, evenly distributed rainfall of the Peninsula; it is the climax vegetation of the equatorial climate. Within this general term, the rain forest shows different aspects and floristic composition according to locality. It is modified locally by the nature of the soil, whether lateritic or sandy, dry and well-drained, or swampy and liable to flooding. For example, the forest which is established on the steep limestone hills of Perlis and the Kinta Valley is different in composition from the ordinary lowland forest in that the plant species are those which can adapt themselves to a calcareous soil as well as dry conditions. The mangrove swamp forests and the peat swamp forests are two special edaphic types of forest which occupy large areas in the Peninsula. The tropical rain forest is also modified locally by altitude; with increasing altitude the lowland rain forest gives way to submontane and montane rain forest, a result of temperature changes rather than of rainfall. In the Peninsula the altitude of 2,500 feet is roughly the transitional zone between lowland rain forest and submontane forest, and the altitude of 4,000 feet that between submontane and montane forest. Both these altitudes are approximations only, for the transition between one forest type and another is always gradual and nearly imperceptible. At the same time it must be realized that, apart from temperature, other climatic elements such as rainfall, humidity, wind velocity and sunshine also vary with altitude, but not uniformly and consistently as in the case of temperature. Because of this fact, the actual altitudinal limits of the vegetation zones are different on different mountain ranges in the Malay Peninsula, and may vary even on different parts of the same mountain. The zones also tend to be lower on small isolated hills and mountains than on continuous ranges. Thus, for example, the *Dipterocarpaceae*, the dominant family in the lowland tropical rain forests, reach the upper limit of growth at about 4,000 feet in the main mountain ranges, and this altitude is taken as the approximate dividing line between lowland rain forest and mountain forest. But the upper limit of the *Dipterocarpaceae* on the isolated mountains is much less than 4,000 feet; it is, for example, only 2,750 on Gunong Belumut in Johore.

Figure 24 shows the distribution of the main types of vegetation in the Malay Peninsula. Lowland tropical rain forest covers the largest area; the other vegetation types are limited in their distribution by one or more factors—either altitude, as in the case of mountain forests, or soils and location, as in the case of mangrove, beach and freshwater swamp forests.

Mangrove Swamp Forest. Mangroves are species of evergreen trees inhabiting tidal land in the tropics. Mangrove forests occupy some 560 square miles in the Malay Peninsula. More than 95 per cent of these forests are distributed along the west coast, where they form an almost continuous belt stretching from Perlis to Singapore. The belt varies in width from a few yards to 12 miles. The continuity of the belt is broken by numerous tidal creeks which cut off islands of different sizes. Exposure to wave action and other adverse environmental conditions limit the extent of mangroves in the east coast; they are here confined to river mouths and occupy areas seldom exceeding 2–3 square miles. The mangrove forests of the Peninsula are exceptionally luxuriant and consist of at least 17 'principal' species and 23 'subsidiary' species. Associated with these are the nipah palm (*Nipa fruticans*), the nibong palm (*Oncosperma tigillarium*) and various weeds and ferns.

Mangrove trees are adapted to maritime conditions and cannot survive in fresh water or on dry land. The seedlings are unable to withstand strong waves and surf, and for this reason mangrove forests can only develop in sheltered locations, as found along the west coast of the Peninsula. Extensive mud banks are built up in such quiet localities through deposition and silting, and these form favourable sites for mangrove development. Muddy beaches are the rule on the west coast but the exception on the east. The soil requirements vary with the different species of mangrove but the best soil is deep, well aerated mud, rich in humus but with little or no sand. The larger part of the mangrove swamps of the west coast is covered with such soil.

There is a definite relationship between the distribution of the

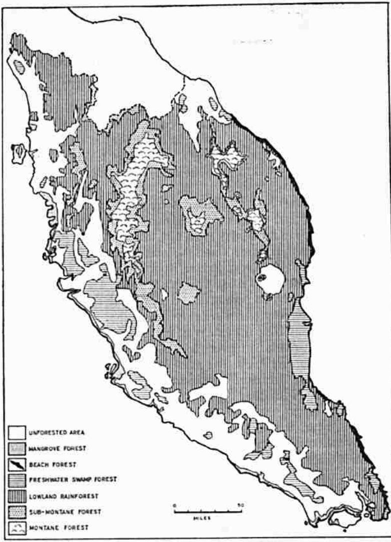


FIG. 24. Vegetation types[1]

major species of mangroves and the frequency of tidal inundation of the land they colonize. Table 6 summarizes this relation-

[1] It has been found necessary from the cartographic point of view to exaggerate the width of the beach forest. In fact, beach forest occupies only a very narrow fringe along the coast of eastern Malaya.

ship as worked out by Watson for mangroves growing in the neighbourhood of Port Swettenham.

The main types of mangrove communities are:

(1) *The Avicennia Sonneratia griffithii type.* The first stage in the formation of a mangrove swamp is the colonization of mud banks or sand banks which are exposed at neap tides. The pioneer species are usually *Avicennia alba* and *A. intermedia.* In the river estuaries, however, the new ground is first colonized by *Sonneratia alba.*

(2) *The Rhizophora type.* The second or middle phase of mangrove swamp formation is usually the replacement of the pioneer species

TABLE 6. *Frequency of Tidal Inundation and Distribution of Main Mangrove Species*

LAND FLOODED BY	NUMBER OF TIMES FLOODED PER MONTH	MAIN MANGROVE SPECIES
All high tides	56–62	None
Medium high tides	45–59	*Avicennia* and *Sonneratia griffithii*
Normal high tides	20–45	Most species, but *Rhizophora* predominates
Spring high tides	2–20	*Bruguiera*
Abnormal or equinoctial tides	0–2	*Bruguiera gymnorhiza*

by *Rhizophora* as the level of the mud bank is built up and the pioneer fringe extends seaward. The land is now inundated by normal high tides but with dry periods of from four to eight days twice each month at neap tides. Other conditions which are necessary for the establishment of *Rhizophora* are soils which have been aerated and enriched by the pioneer species, and which contain little or no sand. The main species of *Rhizophora* are *R. conjugata* and *R. mucronata*. *Rhizophora* forests cover two-thirds or more of the total area of mangrove swamps on the Malay Peninsula, and they provide the bulk of the mangrove products (e.g. firewood, timber, charcoal and tanbark) which are extracted annually. The Malay name for *Rhizophora* is *bakau.* In Perak, where the mangrove forests are best developed, the annual yield per acre is about 3,000 cubic feet, but the yield from the average mangrove forest in the Malay Peninsula is usually much less than this.

(3) *The Bruguiera type.* There are many species of *Bruguiera. B. caryophylloides* forms thick pure stands where the soil is a stiff clay and flooded only by the spring tides. It is confined to the sea-face of the mangrove belt and is usually absent in the river estuaries. *B. gymnorhiza* occupies the driest section of the tidal land—subject to inundation only during the spring and the equinoctial tides. It marks the final stage in the development of the mangrove forests and the beginning of the transition to the inland lowland rain forest. The soil has a noticeable sand content, and on the landward side the ground level may be raised above the level of even the highest tides through the deposition of sediments and dead organic matter and the activities of burrowing prawns. *B. gymnorhiza* grows to a great size if left undisturbed; individual stands may have trees up to 120 feet high and 8 feet in girth. The Malay name for this species is *tumu merah*.

The mangrove swamps on the west coast of the Peninsula are continually extending seawards into the Straits of Malacca, and as this process continues, the seaward face is gradually colonized by the pioneer species of mangroves, while the landward side of the swamps is converted into dry land as the ground level is raised and the mangroves give way to inland rain forest. The process is a very slow one, and may be interrupted by uncontrolled felling of the forests.

Along the brackish water zone of estuaries mangroves give way to brackish water palms—nipah (*Nipa fruticans*) and nibong (*Oncosperma*). Nipah is used extensively for thatching, and nibong poles, which can withstand prolonged submersion in sea water, are employed in the construction of fishing stakes.

Beach Forests of the East Coast. The mud banks and mangrove forests which characteristically line the west coast of the Malay Peninsula are absent along the east coast, except in the sheltered river mouths. Instead, sandy beaches dominate the coastal landscape from Johore to Kelantan, their continuity broken only by the mouths of the rivers which debouch into the South China Sea. At intervals along the coast and extending for some distance inland from the shoreline are the old beach ridges known locally as *permatang*. These are usually arranged in a series parallel to the line of the coast, the channels between successive ridges enclosing lagoons in various stages of reclamation by swamp vegetation. In other places the sandy beaches give way inland to sand flats or sandy plains. Beach forests develop on these sandy beaches and flats and, like the mangrove forests, owe their presence and character to special soil and water conditions.

The typical vegetation of the sandy foreshores comprises low-growing herbaceous plants, which occupy a narrow zone immediately above tide level. Many of the plants have a trailing habit, sending long runners over the surface of the sand. The most common of these are the creeper *Ipomoea pes-caprae* and the creeping grass *Ischaemum muticum*. The majority of the species which colonize this zone are capable of withstanding occasional submergence in sea water and are unharmed by the high salt content of the soil. The screw-pine, *Pandanus fascicularis* (Malay: *mengkuang*), with its pineapple-like fruit, may occur scattered or in groups. But the most striking and distinctive species in this foreshore zone is the casuarina tree, *Casuarina equisetifolia* (Malay: *ru* or *aru*). Its area of natural distribution is along the east coast of the Peninsula; elsewhere, the casuarina is planted. It is a quick growing pioneer of the sandy shores, capable of attaining a height of 100 feet in twenty-five years. The seedlings are unable to survive in thick forest or dense shade or even in the carpet of fallen needles under the mature casuarina trees. For this reason the casuarinas can only regenerate themselves naturally if the shore is continually building itself seawards and providing the seedlings with a succession of open sandy beaches in which to establish themselves. At Telok Subong on the east coast of Johore and in several places along the Pahang coast the stands of casuarina attain a width of several hundred yards, but the normal pattern is a very narrow strip or even a single line of such trees along the sea front (Plate 4). Many of the casuarina stands along the east coast have been cut down for firewood or, in places, to make way for coconut holdings.

Inland from the fringe of casuarina and the narrow zone of low growing herbaceous plants, shrubs and trees become increasingly common. The trees may form a dense belt of woodland or may be scattered in groups with open spaces between. The sandy ridges of the *permatang* support forest of a xerophytic type. The soils here are almost pure sand below the top few inches, and some of the profiles may contain a lateritic iron pan close to the surface. In such locations the characteristic trees are various species of *Eugenia*, particularly *E. grandis* (Malay: *jambu laut* or *jambu jembar*) and small trees such as *Garcinia hombroniana* (Malay: *beruas*), *Vaccinium malaccense* (Malay: *setumbar*), and *Glochidion* (Malay: *membatu*). In parts of the south Pahang and the Kuantan coasts the sandy ridges carry almost pure stands of *Hopea mutans* (Malay: *giam*) and *Shorea materialis* (Malay: *balau pasir*).

The channels and low-lying ground between the *permatang* are usually swampy and support trees adapted to growing in waterlogged soils. In swamps that are not more than a few feet deep, the typical tree is *Melaleuca leucadendron* (Malay: *gelam*). It is very abundant in the stretch of low ground between Kuala Trengganu and Besut. The timber is used by the Malays for firewood and the papery bark for caulking their boats. The deep swamps which contain thick layers of peat carry forests which are similar to the inland peat swamp forests of other parts of the Peninsula.

Freshwater Swamp Forest. Freshwater swamps develop in locations characterized by an abundance of water on or near the surface of the ground. They occupy an estimated 10 per cent of the total area of the Malay Peninsula. Much of the 868,000 acres of wet padi land in Malaya today was once freshwater swamp. The swamps vary considerably in character and in the level of standing water. There are all gradations from *lopak*, which is a special type of swamp subject to only occasional inundation, to the deep swamp covered with water all the year round. The freshwater swamps occupy the zone between the mangrove swamps and the dry land of the foothills of the interior mountain ranges; they are found at intervals along the entire stretch of western Malaya, but are restricted in the east to the southern half of the Peninsula from Kuantan to the southernmost tip of Johore (Plate 2). North of Kuantan the Trengganu Highlands come close to the coast with no intervening stretch of swampy flat land between foothill and coast. Most of the freshwater swamps of the Kelantan delta have been cleared for cultivation, and only patches of such swamps remain in this part of the Peninsula.

The soils of the freshwater swamps are formed under conditions of restricted drainage. The swamp soils are of two types: soils which develop under oligotrophic (extremely mineral deficient) conditions and which contain a surface layer of peat; and soils which develop where the water supply is eutrophic (rich in bases) and which contain little or no organic matter or humus. The plants that grow in swamps are specialized and adapted to conditions in which the soil is waterlogged. For this reason in many of the swamp forests the number of tree species is restricted. There is also a tendency for one or a small number of species to be dominant; for example *Melaleuca leucaden-*

dron (Malay: *gelam*) is dominant in many of the swamps of Kedah and Perlis, and forms pure stands over large areas. The level of water is also important in determining the type of vegetation in the swamps. Swamps with very great permanent depth of water have few or no tree species. The floristic composition of swamps gradually changes from the edge of the swamp where there is little or no peat towards the centre where the peat layer may be up to thirty feet thick.

The vegetation of the peaty swamps includes species of *Pandanus* and palms as well as representatives of the chief families normally present in the rain forest. The undergrowth is thin where the trees are large and close-grown, but dense and thick where the trees are widely spaced. In general, however, the undergrowth is thicker than that in inland rain forest.

The swamp forests may contain commercial timber trees such as *Campnosperma* (Malay: *terentang*) and *Cratoxylon arborescens* (Malay: *geronggang*). A careful enumeration of 6,000 acres of swamp forest in Sungei Bernam showed that there was an average of thirteen trees per acre which were of commercial size; of these, the most important was *Shorea rugosa* (Malay: *meranti bakau*). Other trees of commercial importance are *Koompassia malaccensis* (Malay: *kempas*), *Fragaea crenutata* (Malay: *malabera*), and *Tetramerista glabra* (Malay: *punah*). The latter is sometimes the most abundant tree in freshwater swamp, usually growing in the shallower parts where the soil is very soft and peaty. The exploitation of timber from freshwater swamps is always difficult because of inaccessibility, but in recent years has become a practicable proposition through the use of light diesel locomotives running on tramways laid over the swampy ground from the nearest road or river. Costs, however, remain higher than in the case of timber extraction from dryland forest, and labourers as a rule dislike the living conditions in the swampy environment. In spite of these disadvantages the swamp forests of Malaya are assuming a greater importance yearly as a source of timber and forest products.

Lowland Rain Forest. Tropical rain forest covers all parts of the Malay Peninsula from sea-level to about 2,500 feet elevation, except for the littoral (mangrove and beach) forests and freshwater swamp forests described above. About 30,000 square miles or 60 per cent of the total area of the Peninsula are still occupied by lowland rain forest. The area under such forest was considerably larger less than a century ago, but the large-scale clearing of forested land for mining and agriculture, particularly in western Malaya, has reduced the total to the present figure.

The most important characteristic of the lowland rain forest of the Malay Peninsula is the remarkable wealth of species. There are no less than 8,000 species of flowering plants, and at least 2,500 of these are trees. A typical acre of forest has about 200 trees of about 100 different species, besides a great number of shrubs, herbs, lianes and epiphytes. In fact, the floristic composition of the lowland rain forest of the Malay Peninsula is probably the richest in the world. The other outstanding feature of the rain forest is that the large majority of the plants are woody and attain the size and dimensions of trees. Not only do trees predominate in the forest, but the undergrowth consists mainly of woody plants, and most of the climbing plants as well as a few of the epiphytes are also woody. The continuous growing season in the Peninsula favours the growth of woody plants as against herbaceous and other smaller plants, while the very long period over which the flora of Malaya has been evolving probably explains the extraordinary number of different species of forest trees in this part of the tropics.

Although the lowland rain forest consists of an extremely rich flora, the different species of plants are distributed in the greatest disorder and only occasionally are one or two species dominant within the forest community. The different species vary in the space they occupy, some being restricted to localized sectors of the forest and others distributed over very large expanses. This lack of order in distribution of species and the general heterogeneity of the rain forest stand in contrast to the uniform external appearance of the forest, especially when viewed from the air (Plate 5). The rain forest is evergreen, and its general appearance remains the same throughout the year. A few trees may lose their leaves at different times of the year, but these are too scattered and insignificant in number to have any effect on the green of the forest canopy.

The rain forest trees of the Malay Peninsula as a whole have several physiognomic features in common, a result of the adaptation of different species to similar ecological conditions. The tree trunks are usually tall and straight, and are branchless except near the top; the crowns of these trees interlock with each other to form a continuous canopy. Many of the trees have buttresses at the base to provide additional support as their roots do not penetrate far into the soil. Other trees support themselves by the aid of adventitious roots which originate at the lower part of the trunk; these roots hold up the trees much in the same way as wires hold up a telegraph pole. The bark is usually smooth and thin, commonly light grey in colour but sometimes reddish brown. The leaves are generally large, leathery and dark green in colour. The flowers are small and inconspicuously coloured; large and colourful flowers are rare.

The undergrowth of the Malayan rain forest consists of shrubs, small palms, herbaceous plants, gingers of varying sizes, ferns, and large numbers of sapling and seedling trees. Contrary to popular belief, the undergrowth in mature rain forest is not impenetrable. It is only on river banks or in forest clearings where sunlight reaches the ground that the undergrowth becomes dense enough to make progress extremely difficult if not impossible. The ground of the forest is not everywhere covered with a thick carpet of dead vegetation, but is often quite bare beneath a thin layer of fallen leaves and branches. The herbaceous ground plants are sparse and grow best on slopes where the light is slightly stronger.

Apart from trees, shrubs and ground herbs, all of which are strong enough to support themselves, the rain forest includes also two types of plants which are dependent on others for support, namely, the climbers which grow from the soil but support themselves on trees up to the upper level of the forest where there is better light; and secondly the epiphytes which do not grow from the soil but perch themselves on the branches and trunks of the trees. Most of the climbers are woody (lianes) and grow to very great lengths, hanging down from the forest canopy in great loops and festoons. They belong to a great many families, and there is a good proportion of economic plants among the lianes, of which the rattans are perhaps the best known. A rattan cane may grow to a length of 200 feet or more. There are more than a hundred species of rattans in the Malay Peninsula, the majority of them belonging to genus *Calamus*.

The epiphytes are a very abundant plant community in the rain forest. They include large numbers of orchids and other flowering plants and many ferns. They are adapted to an arboreal existence where the most pressing problem is water supply. Many epiphytes have fleshy leaves, or leaves which minimize water loss from transpiration. Orchids have pseudo-bulbs which act as reservoirs for water; other epiphytes have long aerial roots which absorb water from the atmosphere.

It is apparent that the lowland rain forest is extremely complex in character and is composed of numerous plant types, mostly woody in structure. The forest as a whole is arranged in several storeys or strata—layers of trees whose crowns are more or less of the same average height. In the Malay Peninsula, as in other tropical regions of the world, the primary rain forest communities are arranged in three main tree storeys. In addition, there are also two layers of undergrowth, so that there are five storeys in all between the forest floor and the crowns of the highest trees. The topmost storey is made up of very large trees most of which are valuable as timber trees; the most important of them are species of *Dipterocarpus* (Malay: *keruing*), *Dryobalanops aromatica* (Malay: *kapur*), *Shorea* (Malay: *meranti*), *Dyera costulata* (Malay: *jelutong*), and occasionally some other species. Most of the species in this storey are light-demanders. Their crowns do not start until 80 or 100 feet above ground and may rise to 130–180 feet. Very occasionally some trees may reach heights of over 200 feet; the tallest tree recorded in Malaya measured 265 feet. It is common to discover three or more top storey trees growing together and separated from the neighbouring groups by fairly pronounced gaps.

The second storey is, in fact, the main storey, in that the crowns of the trees here interlock with each other to form a continuous closed canopy, sometimes referred to as the 'roof' of the forest. The tree crowns are usually smaller and more compact than those of the top storey trees, and they begin from 50 feet above ground level, rising to 80–100 feet.

The third storey is composed of trees which do not reach above 50 or 60 feet in height. This storey is composed of a very large number of species, especially members of the families *Annonaceae*, *Euphorbiaceae*, and *Flacourtiaceae*. However, few of the species here are of economic importance.

Beneath these three main tree strata is a layer composed of shrubs, palms, and herbaceous plants, and under this is the last and fifth layer comprising the ground flora of ferns, herbs, low-growing palms such as the bertam palm (*Eugeissonia tristis*) and the pinang palm (*Pinanga spp.*), and also seedlings of the species making up the tree strata. It must be remembered that this stratification of the forest vegetation into five storeys is not a rigid one, and the spaces between the storeys may be occupied by species growing gradually from a lower stratum to a higher one.

The lowland rain forest contains more than 350 species of trees which yield timber, excluding the timber trees of the seashores, fresh-water swamps and mountains. The most important species from the commercial point of view are those of the family *Dipterocarpaceae*; these collectively provide three-quarters or more of the timber output of Malaya. Most of the species of this family require a hot, wet climate for optimum growth, and few of them are found in the Peninsula north of the 7° N. latitude. They are distributed throughout the Peninsula from sea-level to more than 4,000 feet altitude. They grow in a variety of situations, on poorly drained land as well as steep slopes, but seem to attain their best development in undulating or hilly country. The trees are large and generally belong to the first two storeys of the rain forest. A characteristic feature is the presence of wings on the fruit of most species, a mechanism that aids the dispersal of the seeds. The principal species of the family are the heavy hardwoods, *Balanocarpus heimii* (Malay: *chengal*), *Shorea* (*meranti*), *Hopea* (*giam*), *Eushora* (*balua*), and *Vatica* (*resak*); the medium hardwoods, *Dipterocarpus* (*keruing*) and *Dryobalanops* (*kapur* and *keladan*); and the light hardwoods *Shorea* (red, white and yellow *meranti*), most species of *Hopea* (*merawan*) and *Anisoptera* (*mersawa*). Many of the species are gregarious to some extent; *Dryobalanops aromatica* (*kapur*) for instance, is abundant in forests near the east coast. The most abundant of the groups is the *meranti*, and they constitute about 17 per cent of the number of trees of commercial size in Malaya. There are usually between three to five trees of commercial size per acre. The next most abundant group is *keruing*, usually making up about 9 per cent of the total number of trees of commercial size, with about two trees of such size per acre of forest. The heavy hardwoods are more restricted in distribution; patches of forest of 20 to 100 acres in extent in the east coast may have two or three trees of commercial size in them.

Apart from the *Dipterocarpaceae*, four other main species also produce valuable timber—*Intsia palembanica* (*merbau*), *Koompassia malaccensis* (*kempas*), *Dyera costulata* (*jelutong*), and *Tarrietia* (*mengkulang*). In addition, there are many other species which yield timber, some of which are used for special purposes such as boat-building, tool handles and fence posts. Among these are species of the families *Lauraceae*, *Sapotaceae*, *Burseraceae*, and *Myristicaceae*, as well as species of *Eugenia*, *Calophyllum*, *Dillenia*, and *Durio*.

Submontane Rain Forest. This is sometimes known as *Hill Dipterocarp Forest.* The transition between lowland rain forest and submontane forest occurs roughly between 2,000 and 2,500 feet above sea-level. The forests lying above the 2,000 foot contour line cover roughly one-tenth of the total land area of the Peninsula. They are of little value as sources of timber, but are of considerable importance as water catchment areas and as a protective cover, minimizing soil erosion on the steep slopes of the uplands. Submontane forest occupies the area lying between the 2,000–2,500 and the 4,000 feet contours. The forest at the lower levels does not differ markedly in appearance from lowland rain forest. The difference is rather in the floristic composition—the lowland dipterocarp species being replaced by highland species such as *Shorea platyclados* and *S. ovata* and certain species of *Dipterocarpus.* One of the few indigenous conifers in the Peninsula, and also one of the largest hill forest trees, is *Agathis alba* (Malay: *damar minyak*). The undergrowth is generally denser than in the lowland rain forest, and the ground is often carpeted with a thick layer of plant remains. A dwarf form of submontane forest develops where the soil is peaty, as in some parts of Kedah Peak (Plate 6). Towards the higher levels of the forest the trees decrease markedly in height, and around 4,000 feet most species of dipterocarps disappear, and the floristic composition of the forest undergoes an almost complete change from lowland and hill species to mountain species.

Montane Forest. Apart from floristic composition, mountain forests also differ from hill and lowland rain forests in external appearance, the trees being not as tall as the dipterocarps. Such forests occur above the 4,000 feet contour and extend to the peaks of the highest mountains of the Peninsula. The tallest trees are usually oaks, particularly species of *Pasania* and *Castanopsis.* Members of the *Laurel* family are also abundant and, in fact, the term *Oak-Laurel* forest is sometimes given to the vegetation of the mountains.

A characteristic feature of the mountain landscape is the prevalence of clouds and mist. The perpetually moist atmosphere provides ideal conditions for epiphytes, and mountain forest is especially rich in such plants. The undergrowth is dense as the lower canopy allows for better light penetration to the ground, and the forest floor is generally covered with a profusion of small trees, climbing plants such as rattan palms, species of tree ferns belonging to the family

Cyatheaceae, pitcher plants, ferns and orchids. The ridges and summits of the high mountains have only a thin soil impoverished by constant washing-out, and on these locations the forest is stunted and may be covered with mosses. The upper part of Kedah Peak, for example, has such a dwarf forest in which the moss *Sphagnum* is prominent.

Secondary Forest or Belukar. The area covered by primary (or climax) rain forest is continually decreasing in the Federation of Malaya, and has been reduced to practically nothing in the island of Singapore. Its retreat can be traced a very long way back when the first cultivators reached the Malay Peninsula and started to clear the forest in small patches in order to grow their crops. The process was accelerated as the population of cultivators (including the Malays, who practised permanent or sedentary agriculture based on wet padi, and the aborigines and occasional Malay who practised shifting or *ladang* cultivation) increased with later migrations as well as natural growth. But the greatest encroachment was made during the last hundred years when large areas of forested land were cleared for mining and especially for cash-crop cultivation. At the same time other forested land was cleared in order to grow some of the food crops needed to support the large number of immigrants who poured into the country from China and India. It is inevitable that further encroachments will be made on the remaining areas of forested land for either mining or agriculture as the need arises and the population increases.

But all the land that was cleared of its primary forest is not under agriculture or some other form of productive land use; a part of it, covering some thousands of square miles, is abandoned land under stands of grasses or other secondary growth and in the process of reverting to climax rain forest. These secondary plant communities are known throughout Malaya as *belukar* or sometimes as *utan muda* (young forest). Unlike the other types of natural vegetation, already described, the distribution of *belukar* is not determined by soil, climate, or other natural agencies, but by man, who in deciding to choose a particular piece of land, clears it of its forest growth, and later abandons it, determines by his actions the location of that area of secondary forest. For this reason, the distribution of *belukar* does not follow a definite natural pattern as in the case of the other types.

The area under secondary growth of one type or another is larger than is generally realized. Perhaps the most important cause of the destruction of primary rain forest which gives rise to *belukar* is the system of shifting cultivation which is practised by the aboriginal tribes (the Sakai or Senoi and the Jakun or Proto-Malay) and also by a few Malays living in the more remote and inaccessible areas of the Peninsula. The system depends on the felling of a patch of forest, the burning of the fallen trees, and the cultivation of a few food crops on the patch so cleared. After one or more crops have been harvested, the plot is abandoned and a new one started elsewhere. The old plot meanwhile is colonized by secondary plant communities. The extent of abandoned land once under shifting cultivation (*ladang*) and now under various stages of regeneration to climax rain forest is much wider than previously estimated. That this should be so is due to earlier underestimates of the aboriginal population and to the tendency of the aborigines to avoid recultivating an abandoned plot. Thus, the number of aborigines in the Malay Peninsula is now known to be around 100,000 or three times the number estimated in the 1947 census. Assuming that each family of four cultivates a two acre *ladang*, the total area under shifting cultivation in any one year would be approximately 50,000 acres. Further, these groups seldom recultivate an old holding which has reverted to secondary forest, but prefer to clear a new patch of forest because it is likely to yield better crops and to suffer less from the depredations of pests. Since it takes up to several hundred years for an abandoned clearing to re-establish itself as climax rain forest, it is unlikely that the area of fully regenerated forest is keeping pace with the area being cut down or newly abandoned, more so in view of the very long history of *ladang* cultivation in the Peninsula.

Apart from *ladang*, there are also large areas of land once under some form of agriculture or mining and now abandoned because of loss of soil fertility or of mineral exhaustion. In the western Tin Belt, and particularly in the Kinta Valley, the Larut tin fields of Taiping and the Selangor tin fields, the mined-over land covers some thousands of acres. Still larger areas have been devastated as a result of indiscriminate agricultural practices in the past. Thousands of square miles of protected Forest Reserves were cut down for short-term food crops during the Japanese occupation and subsequently abandoned. In Penang, Malacca and Johore the 'soil-mining' methods of agriculture used by the early pioneers in growing such crops as pepper, gambier, tapioca, and pineapple, have left their mark on the landscape in the shape of rolling acres of *lalang*—the ubiquitous and obnoxious weed *Imperata cylindrica*. The area of seriously degraded land in Malaya has been estimated to cover 2,000–4,000 square miles (or 4–8 per cent of the total land area of the Federation); this estimate does not include the less seriously degraded land. All such land is either under *lalang* or *belukar* in different stages of regeneration to primary rain forest.

The *belukar* which appears on a site which has been abandoned varies according to the previous history of the site. Where the forest has been completely cleared and the area cultivated for three or more years, abandonment soon leads to an invasion by *lalang* grass. *Lalang* burns easily but because of its underground rhizomes it recovers quickly from a fire which may totally kill off other plants. Repeated firing results in the area being dominated by *lalang*, thus seriously delaying regeneration by forest species. If left undisturbed, however, the *lalang* patch will, in the course of time, be invaded by pioneer plant species such as *Melastoma malabathricum* and *Eupatorium odoratum*. Later woody species such as *Macaranga*, *Mallotus*, *Glochidion* and *Bridelia* take possession of the area; they form a close canopy up to 30 feet high. Under their shelter seedlings of forest trees take root and gradually the original type of rain forest is re-established. The transformation from *belukar* to primary rain forest may take up to 250 years or more.

Where the period of cultivation before abandonment is less than two years and the soil is less seriously degraded, a dense secondary forest is quickly established. The dormant seeds and coppice shoots of jungle trees, as well as the pioneer species of plants, rapidly invade the site and compete with each other for living space. The secondary species which are light-demanding and short-lived in any case, eventually succumb to the shade of the jungle species.

The character of *belukar* varies not only with the degree of felling and the period of cultivation or other forms of land use but also with the physical nature of the soil. *Belukar* is a portmanteau term which covers all stages of natural succession from light scrub to high forest difficult to distinguish from primary rain forest. 'Typical' *belukar* consists of a large number of herbs, herbaceous creepers and climbers and light-demanding shrubs and tree species which are not characteristic of primary rain forest. They grow in haphazard profusion, but a few species are often gregarious in a patch-like manner. The thick undergrowth is very difficult to penetrate. The general appearance and floristic composition of *belukar* are also different from that of primary rain forest. The trees are smaller in size and the canopy lower, though when viewed from above it has a more level surface than primary forest.

CHAPTER 4

SOILS

Soil may be defined as the superficial layer of fairly loose earth which results from the weathering, decomposition and transformation of the underlying parent-rock through the action of physico-chemical and biological agents. It is a medium in which live a very large number of plants, animals and micro-organisms.

The type of soil which develops in any area depends on the parent material, climate and organisms in that area. Time is also classed as a soil-forming factor because soils undergo a process of evolution from patent material into mature soils. Surface relief, which influences the water relationships in soils and also partly determines the extent of soil erosion, is generally regarded as another formative factor. The major soil-forming factor in the Malay Peninsula is the climate. The soil-differentiating factor is the parent material, and Malayan soils have been classified provisionally according to their parent material, and on a geological basis. The influence of the parent rocks in determining soil types is thought to be greater than that of climate. Climate in a relatively small area such as the Malay Peninsula is regarded from the pedological point of view as being fairly uniform. Figure 25 shows the distribution of the main soil types of Malaya. There are four main parent rock formations from which they are derived:

(1) *The Granites.* These are believed to be of Jurassic-Cretaceous age and occur extensively throughout the Peninsula. Mineralization in Malaya is usually associated with the granite, in particular with the contacts between the granite and the different sedimentary rock formations. The solid granite is normally blanketed by a cover of weathered material which has developed *in situ* and which consists of unsorted medium and coarse sand embedded in clay. This regolith may be as much as 500 feet thick.

(2) *The Arenaceous Series.* Lithologically these consist mainly of quartzite, conglomerate, chert and shale, but stratigraphically they are of two ages: the 'younger' series of Triassic age, and the 'older' series of Carboniferous age. Recently, however, two other major

groups of these sedimentary rocks have been identified as belonging to the Upper Cambrian and Jurassic-Cretaceous ages. Most of the

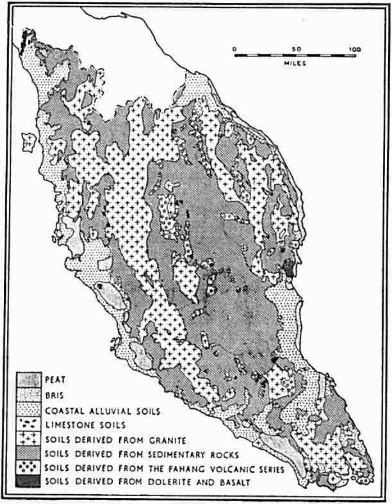


FIG. 25. Soil types

sedimentaries were folded during the orogenic period when the granite was intruded.

(3) *The Calcareous Series.* These are believed to be of Carbo-Permian age, and consist mainly of limestone, calcareous shale, and

shale. Limestone occurs extensively over large parts of the Peninsula north of Johore, but it is usually blanketed by a non-calcareous overburden. The limestone in Perlis and Perak is as much as 2,000 feet thick. The marble that is found in the quarries of Pulau Langkawi and Perak is the result of contact-metamorphism during the intrusion of granite. Limestone outcrops, appearing characteristically as steep-sided hills with forested tops and whitish-grey sides, are a common landscape feature in Perlis, the Kinta Valley of Perak, along the Pahang–Kelantan border near the headwaters of the Galas, in Pulau Langkawi, and at Batu and Kanching in Selangor.

(4) *The Pahang Volcanic Series.* These are mainly of Permian age, and are remnants of volcanic activity during late Paleozoic and early Mesozoic times. They consist of pyroclastic and extrusive rocks, tuffs and lavas, and occur chiefly in the interior of Malaya east of the Main Range.

In addition to these main formations, coastal and valley alluvial deposits, the result of weathering, erosion and fluvial and marine deposition, cover large parts of the Peninsula, especially along the western side. They vary in thickness from a few feet to over 500 feet, as indicated by borings near Telok Anson.

All Malayan soils that have developed *in situ* from the parent rock formations are pedologically mature, and have been subjected to a very long period of intensive tropical weathering. As a general rule, such soils are infertile in spite of the fact that they may have been derived from different parent rocks. In a humid tropical climate where the annual precipitation exceeds the annual evaporation, water continually percolates downwards through the soil and in the process chemically breaks down all but the very resistant minerals and leaches the organic matter that is present in the upper layers, so that the soil is eventually exhausted of most of its plant food. The soluble bases are removed early and the soil becomes highly acid. In the Malay Peninsula where there is no distinct dry season, leaching goes on continuously without a break. The rocks of the Peninsula have been exposed to such tropical weathering for a very long period of time. The end-product of intensive and prolonged weathering is a reddish-brown to yellowish material, commonly seen exposed in road-cuttings, construction sites, erosion gullies, and other places where the vegetation and top-soil have been removed to reveal the underlying layers. The colour of these red and yellow soils is derived from the iron and aluminium oxides which remain after the other constituents (the bases, magnesia, calcium oxide and silica) have been leached out. These soils, which may attain great depths (30 feet or more), are common not only in the Malay Peninsula but also in the other tropical areas of the world where similar climatic conditions prevail. The term *laterite* was once used to describe such soils, but in recent years an alternative name—*latosols*—has been suggested by Kellogg as being more suitable.

Continuous leaching has eliminated a large number of the valuable chemical constituents of Malayan soils and they are usually very poor in inorganic plant nutrients such as phosphorus and nitrogen. For this reason the fertility of the soils is largely determined by the amount of organic matter[1] present, which in turn depends on vegetation factors, climatic factors and on the previous history of the soil. The amount of organic matter in Malayan soils has been found to be very low compared with that of soils in temperate countries, so that soil fertility is correspondingly low. Yet it has often been maintained that the lushness of the vegetation which covers three-quarters of the total area of the Peninsula and once covered the entire area is visible proof that the soils of Malaya are rich rather than poor. The apparent paradox can be explained thus:

The high uniform heat and humidity of the Malay Peninsula favour the rapid destruction of humus and nitrogen in the soil. The destructive process can be slowed down or countered in two ways: (i) through the addition of large quantities of organic material to replace those that have been destroyed or used up; and (ii) through keeping the soil temperatures at or below about 77° F, the level at which the process of humus formation gives place to humus breakdown. Both of these requirements are fulfilled in the rain forest. The soil temperature at or near the surface in the undisturbed forested plains of the Peninsula is about 77° F, with only slight daily variations, and at this temperature humus formation and decomposition are at equilibrium. Such relatively low temperatures are due to the heavy shade provided by the dense foliage and the transpiration of the trees. The direct rays of the sun do not fall on the soil surface, and it has been calculated that the intensity of light at ground level in the Malayan rain forest is only one-hundredth that of direct sun-

[1] Organic matter consists of dead matter, including fallen leaves, branches, fruit and other dead vegetation which fall upon and are subsequently taken up by the soil. It also includes living organic matter, i.e. soil flora and fauna which are composed of innumerable micro-organisms (E. C. J. Mohr).

light. The air is very still at this level and nearly always saturated; there is thus little variation in temperature due to the movement of the air.

The organic matter which is lost through leaching, erosion or through being taken up by plants is replaced in this manner: the decomposition of the parent rock through chemical weathering releases plant nutrients which are absorbed in dilute solution by deep-rooted plants. These plants shed leaves, flowers, fruit, and branches which fall on to the forest floor. Occasionally whole tree-trunks may also fall down. All these are immediately set upon by termites, ants and other insects. Rainwater also partially dissolves the vegetation remains, which are subsequently attacked by soil micro-organisms—fungi, bacteria and protozoa. The activities of the micro-organisms transform the plant remains into various gases and acids, leaving a dark-coloured residue (humus) from which plant nutrients are set free. The nutrients are quickly absorbed again by the plants, especially those shallow rooted ones which are only capable of taking up their food from the surface layers of the soil. The stock of organic matter (the raw material of humus) is replenished by a constant rain of dead vegetable matter falling on to the forest floor.

A closed cycle is thus set up, in which the plant food is circulated from the top-soil, taken up by the plants, and then returned to the soil again in the form of dead matter to start the process anew. The resources of the parent rock underlying the top-soil are tapped to make good the losses due to drainage and erosion. The entire process takes place many times faster than in temperate forests, and a small amount of nutrients circulating rapidly suffices to maintain the dense vegetation of the tropical rain forest. To put it in the words of Ramann, 'The tropical forest works with a small capital of nutrients and a rapid turnover.'

The luxuriance of the Malayan rain forest then is not due to inherent soil fertility, but rather to the special conditions of shade and temperature, and the abundance of vegetative raw material from which the small capital of plant nutrients is built up, expended and rebuilt. The cycle continues as long as conditions remain stable, that is, as long as the forest stands.

When the forest is cut down the cycle is broken, the nutrient capital is rapidly exhausted, and the soil reduced to a low level of fertility. The initial effect of forest clearing is to expose the soil surface to the direct rays of the sun, thereby raising the soil temperatures to such a degree that the rate of humus decomposition is greatly accelerated. At the same time the flow of plant waste from the forest is arrested and the small store of plant nutrients in the top layers of the soil rapidly depleted. What follows after depends on the subsequent course of events. If the forest is allowed to regenerate itself immediately the process of soil impoverishment is arrested before much harm can be done. But if there is a long period of cultivation after the forest is cleared, and especially if the crops do not provide a good permanent foliage cover, the soil structure, humus content and nutrient status of the soil are radically altered and will progressively deteriorate.

Apart from fertility, the productivity of Malayan soils depends also on their physical structure. The structure of forest soils is usually good, being porous and resistant to erosion, due to the activities of micro-organisms which bind loose particles of soil into friable crumbs. Under stable conditions of forest growth the number of micro-organisms remains in equilibrium, but when the forest is cut down microbial activity is reduced and the soil structure consequently breaks down. It becomes massive, compacted and very hard, and may deteriorate to the state of 'excessive granulation' when the soil provides too few contacts for plants to take in water and nutrients. One of the major problems of agriculture in Malaya and in other tropical areas is how to preserve a good soil structure on soils which have been cleared of their original vegetation and cultivated continuously over a period of years.

The process of soil degradation of forested soils following forest clearing is shown diagrammatically in Fig. 26. Profile A shows a typical soil profile under undisturbed forest. The trees tend to obtain their food more and more from the organic layers of the first 3 inches of soil (which are replenished from dead vegetative matter) and on the mineral layer immediately below which is enriched by organic matter washed down. Below the 1-foot layer is a highly acid, infertile dead layer of soil almost totally leached of nutrients. Below this, the soil grades gradually to undecomposed parent rock. Profile B shows the result after the forest has been cleared, burnt and cultivated. The humus top layer has disappeared, including the litter crumb, and the profile is said to be 'truncated'. The soil fertility now largely depends upon the amount of nutrients left in the original parent rock; this is usually low. The process of degradation and leaching following crop cultivation leads first to a deficiency in nitrogen, and later to phosphorus deficiency, and then to a shortage of bases like magnesium, calcium and potassium, and finally to certain essential trace elements losses. As well as losing its original fertility, the physical structure of the soil also breaks down and becomes an unfavourable medium for plant growth.

While it is apparent that, as a general rule, Malayan soils are of low inherent fertility, closer examination of the local soil types will reveal enormous variations in their fertility status, from soils which are practically sterile to soils which are of above average productiveness. The soils described below are classified according to the parent

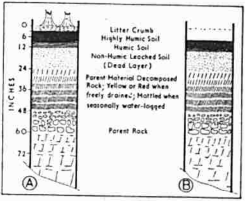


FIG. 26. Soil profiles under (A) forest, and (B) field crops

material from which they have been derived (Fig. 25). The soils of Malaya have not yet been thoroughly surveyed and mapped, and large parts of the Peninsula remain unknown to soil scientists.

Coastal Alluvial Soils. Alluvium blankets about 8,500 square miles of the Malayan land mass, the cover of alluvium varying from a few feet to 500 feet in thickness. The coastal alluvial soils are derived from marine sandy deposits and fluvial sediments which have been carried down from the uplands of the interior. They are therefore quite different in content from the rest of Malayan soils which have developed *in situ*, and they also vary considerably within themselves as regards their agricultural value and fertility status, especially the coastal soils of eastern Malaya. The agricultural value of such soils also depends upon the level of the permanent water table—the soils which are waterlogged being generally poor and excessively acid.

The alluvial soils are distributed along western Malaya in a nearly continuous belt from Perlis to Selangor. The continuity of this belt is interrupted at Negri Sembilan and Malacca where outliers of the mountain ranges come close to the coastline. From south Malacca and all along the west coast of Johore stretches another large belt of alluvium. The width of the alluvial belt in western Malaya varies from about 5 to 40 miles. The distribution of such soils in eastern Malaya is more limited. The largest expanse lies between Kuantan and Mersing, and includes the deltas and estuarine plains of the Kuantan, Pahang, Rompin, Endau and Mersing Rivers. Most of this area is still undeveloped. The other major stretch of alluvial soils is located in the north-east—the Kelantan delta with a narrow south-easterly extension to Kuala Trengganu. Patches of such soils also occur in localized areas elsewhere along the east coast.

The coastal alluvial soils of Malaya are divided into two main types: coastal clays and peat soils, with an intermediate or transitional type called 'organic' soils. A local soil type—'*bris*'—is also found extensively along the east coast. Coastal clays vary considerably in their texture and structure depending upon the quantity of fine sand present. The colour of such soils depends to a great extent upon the drainage condition. The surface layer of undrained soils is usually grey while the underlying layers which are permanently waterlogged are blue or blue-green in colour. The soils that have been drained for cultivation are a mottled red and yellow. Some of the coastal clays may contain layers of peat a few inches thick at depths of 1 to 3 feet below the surface. The presence of peat layers can be detected through the strong smell of sulphuretted hydrogen which permeates the soils. The coastal clays are generally highly acid[1] but they are also one of the most fertile of Malayan soils with a nitrogen content very much greater than the other soils. Their fertility is, however, lowered where drainage is restricted. The main crop grown on these soils is padi, but besides padi other major crops such as coconut, rubber, oil-palm and pineapple grow well on them provided the land is well drained before cultivation.

Peat soils of varying thickness are common not only in the Malay Peninsula but are found everywhere in lowland South-East Asia

[1] The method of denoting the acidity of soils is by their pH value. Soils with a pH value of 7 are absolutely neutral; acid soils have a pH value below 7, while alkaline soils have a pH value above 7.

where rainfall is heavy and well distributed. Peat is an accumulation of plant residues which have decomposed in the absence of adequate supplies of oxygen. Peat can only form in areas where there is constant standing water to inhibit the activities of those micro-organisms which live on free oxygen from the air, whilst encouraging decomposition by anaerobic micro-organisms. For this reason peat normally occurs in areas with restricted drainage such as swamps. The type of peat which is formed depends mainly on the vegetation from which it originates.

In Malaya the area covered by peat has been estimated at 1,160,000 acres distributed mainly on coastal locations, though deposits of peat have been discovered at some hilly areas in the Peninsula, notably Gunong Batu Brinchang (elevation 5,000–5,500 feet). The largest areas of peat are found in the Bruas–Sitiawan area of Perak, the middle course of the Sungei Bernam, the Kuala Selangor stretch of the Selangor coast (including Tanjong Karang), the Klang–Kuala Langat stretch of the Selangor coast, the Pontian area of south Johore (a pineapple-growing area), and on eastern Malaya, mainly along the lower course of the Endau River and in scattered pockets along the east coast (Fig. 25).

The depth of peat varies from 1 to 40 feet. Due to the low content of mineral matter, peat soils are generally infertile. There is a marked deficiency of nitrogen, and the content of lime varies from 0·14 per cent to 0·5 per cent, of phosphate from 0·01 to 0·09 per cent and of potash from 0·02 to 0·2 per cent. Peat soils are also very acid, with pH values of 4 and less than 4. They are brownish black at the surface and a reddish black below. When cultivated for some years there is a marked deterioration in the fertility of such soils, and minor element deficiencies become evident. Some of the *masam kelat* (very sour) soils associated with *gelam* vegetation (*Melaleuca leucadendron*) found in Malacca, Kelantan and Trengganu are extremely infertile, and useless from the agricultural point of view.

The agricultural value of peat soils depends upon the depth of the peat layer. Where it is 1–2 feet deep, a good soil can be obtained by mixing it with the underlying clay, but where it is more than 2 feet thick, deep drainage is essential before cultivation is possible. The draining of peat is difficult since it contains a considerable proportion of water which must be extracted gradually. Too rapid drainage reduces the peat to a brown dry powder which is impossible to recondition. Drainage and the progressive lowering of the water table lead to a marked shrinkage and a consequent drop in the level of the soil as the peat dries out. Tree crops such as rubber and coconut when planted on peat soils often tend to lean and fall over as their roots become exposed with the lowering of the soil surface. Little padi is grown on peat as it is believed that the plant will not do well on such soils. The crops that can be cultivated on peat are pineapple and vegetables, both shallow-rooted plants. Tree crops, besides being unable to establish a firm hold on peat soils, also tend to become sickly when grown on such soils as their roots encounter the permanent water table in the later stages of their growth. For these reasons rubber grown on peat gives low yields. No crop can be cultivated on land where the peat layer is very deep. The better peat soils are those which are contiguous with the inland quartzite soils and intermixed with them.

'Organic' soils are intermediate in quality between coastal clays and peat. In fact they are coastal clays containing over 20 per cent of undecomposed organic matter (peat may contain as much as 80 per cent undecomposed organic matter). *Bris*[1] is a white sandy soil composed of more than 80 per cent sand. The total area of *bris* has been estimated at 438,000 acres. The largest continuous stretch of *bris* occurs along the coast from Kota Bharu in Kelantan to the southern Trengganu border, covering an area of over a quarter of a million acres. These soils are very deficient in plant nutrients and consequently they are of very little agricultural value. The only plant of economic importance that will grow on *bris* is the coconut palm. The coast road from Kuantan to Kota Bharu runs through *bris* country for much of the way.

The usual sequence from coast to interior in western Malaya is coastal clays which grade into 'organic' soils and then into peat soils. In eastern Malaya the usual sequence is slightly different: there is first a narrow band of *bris* interspersed with occasional stretches of peat; inland from the *bris* and occurring mainly in the Kelantan, Pahang and Rompin–Endau river deltas is a broad belt of coastal clays and 'organic' soils.

Inland Alluvial Soils. Inland alluvial soils are derived from material which has been washed down and deposited on the floors of the

[1] *Bris* is a Kelantan word used to describe the series of old beach ridges that run parallel to the coast. These ridges are characteristic features of the coastal landscape of eastern Malaya, and are known as 'permatang' in Pahang and elsewhere.

interior valleys of the Peninsula. There are two main types of inland valleys—the broad open valley such as those of Kinta or Klang, and the narrow valley typified by the Kuala Pilah or the Inas valley of Negri Sembilan. The agricultural value of the valley soils varies with the fertility of the material from which they are derived and with their structure and drainage conditions. The reddish yellow clay loams of good drainage are extensively cultivated under rubber, but the silty clay loams which are poorly drained have to be carefully reconditioned and aerated before cultivation under tree crops is possible. The clayey soils of the narrow inland valleys are commonly used for padi cultivation by the Malays of Negri Sembilan and Malacca. Some of the valley soils are composed predominantly of sand and are of little value from the agricultural point of view because of their excessive permeability.

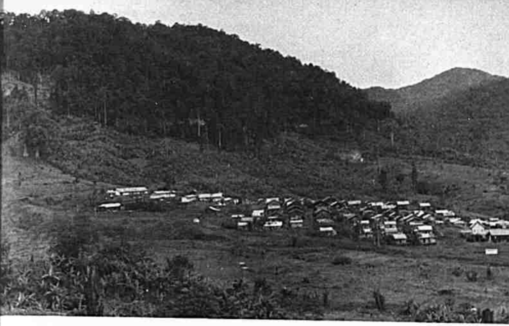
Valley soils derived from quartzite parent material are infertile and require careful drainage and heavy manuring with farmyard manure before they are capable of supporting crops of tapioca, derris and fibre plants. They are not responsive to artificial fertilizers. Those Chinese squatters who settle on the inland valleys with quartzite soils use pig droppings to manure the vegetable plots. Yields, however, remain low.

Soils derived from Acid Igneous Rocks. Granite and other non-volcanic igneous rocks cover half the total area of the Peninsula. Most of the high mountain ranges are of granite. Granite in Malaya generally weathers to great depths, the average is about 30 feet. The product of weathering is a soft mass of material which may be red, orange or yellow in colour, and within which may be large numbers of 'core-boulders' which have resisted decomposition. The soils derived from such acidic granite are clayey owing to the presence of kaolinite. These residual soils are fairly uniform in their characteristics and have a low nutrient content although capable of supporting good stands of rubber. The quality of such soils appears, however, to vary with the grain of the parent rock. As a rule the soils derived from the finer-grained granites are of better quality than those from the coarser-grained rocks. But where the decomposing coarser-grained rocks do not lie deep below the surface, the quality of the soils derived from them is not far inferior to that of the best residual soils of Malaya. The nutrient level of granite-derived soils may be maintained by the continual decomposition of the parent rock. The soil texture under forest is good, being friable, deep and permeable.

But if cleared and planted to food crops the texture deteriorates, and the soil tends to pack and form a hard impermeable crust. Though granite-derived soils probably cover a larger area than any other type of soils in Malaya, they are found mainly on mountain sides and locations either too steep or too inaccessible for large-scale agricultural development. Where they occur on undulating land or lowland, as in the stretch from Negri Sembilan to Malacca, in the Perak River valley and in the Kemaman area of the eastern coast, such soils are extensively cultivated.

Soils derived from Basic Igneous Rocks. Of the basic igneous rocks found in the Peninsula, the series of volcanic rocks known as the Pahang Volcanic Series cover the largest area and are the most important agriculturally. They are the remains of volcanic activity in late Palaeozoic and Mesozoic times, when lavas composed mostly of rhyolite and andesite were laid down not only in Malaya but also in Sumatra and Borneo. They are distributed almost entirely in eastern Malaya (Fig. 25). In Johore they occur scattered in the south-eastern tip of the Peninsula, the headwaters of the Endau River near the Johore–Pahang border, in small pockets near Kota Tinggi, Kluang, Labis and Segamat, in a stretch between Mersing and Endau, and in the larger islands off the east coast of the State. In Pahang are located the most extensive areas of such rocks, occurring mainly on both sides of the railway line from Mentakab to Mentara Halt on the Pahang–Kelantan border. In Kelantan they are found in two parallel stretches, the larger one running in a line joining Tanah Merah and Manek Urai on the railway and extending southwards to near the Kelantan–Pahang border, and the other lying to the west of this stretch and running between Kampong Rawa and Kampong Lulut. In Trengganu the rocks occur around the headwaters of the Trengganu River.

Not all the rocks in the Pahang Volcanic Series are basic in composition, and not all of them weather down into good soils, though the soils derived from the Series are, in general, the most fertile of the inland residual soils of Malaya. The best of them have a high potash and phosphate content, are deep and very friable, and are considered to be suitable for most crops. Their fertility is attested by the high yields from rubber planted on them. Although the estimated area of the Pahang Volcanic Series is one million acres, the actual acreage of fertile soils is considered to be much less than this because of the variable composition of the Series. They are of particular



9. A New Village in the Gombak valley in the Bentong area of Pahang, photographed in 1956. The area has undergone considerable development since then. In 1961, with the Emergency over, there has been some dispersion of the settlements. Most of the surrounding land has been converted into Chinese market-gardens.

10. Malay settlements at Kaki Bukit, Perlis, with young padi in the foreground, backed by kampong land.

11. Kuala Pahang, a fishing village on the north bank of the Pahang River. Most of the catch has to be dried or salted because of distance from markets. The long racks used for sun-curing are clearly visible. The sandy, gently shelving beach is typical of the east coast. A straggly stand of coconuts occupies a narrow coastal strip north of the village. The dense canopy of the mangrove swamp west of the village stands in contrast to the more open aspect of the coconut grove.

12. A Chinese fishing village at Pontian Kechil, west Johore. The stilts and attap roofs are cultural adaptations from the Malays, but the boats, some with 'eyes' painted on the bows, are distinctively Chinese.

interest to planters today as they are the most suitable of all the inland soils for cocoa growing.

Basic rocks are not extensive in the Peninsula. Dolerite occurs as intrusions in granite in several localities, for example, in a quarry near Bukit Timah in Singapore. The largest intrusion of dolerite occurs north of Kuantan. This outcrop covers several square miles. Dolerite weathers into a soil which contains a large proportion of free alumina.

Soils derived from Sedimentary Rocks. The sedimentary rocks cover about one-third of the total area of the Malay Peninsula. The most important of these rocks are quartzites, shales and coarse conglomerate which are of Triassic age (Fig. 25). The other sedimentaries are chert and associated shales. The Triassic quartzites have generally been weathered back into sandstone at the surface. The shales are grey to greenish in colour in their unweathered form, but on weathering become reddish or orange, or may be bleached white. Some of the shales have a high carbon content (up to 54 per cent). The coarse conglomerates contain pebbles of granite, rhyolite or quartz porphyry, and carbonaceous shale and chert, and weather down into loose sands and pebbly gravels. Chert is characteristically flinty in appearance, and breaks down into angular fragments. Good examples of these sedimentaries may be seen exposed in the cliffs of Pulau Blakang Mati, the 'Gap' at Singapore, and in the vicinity of Raub and Bentong in Pahang.

The soils derived from sedimentary rocks are distributed over the major portion of the foothill and undulating lowland regions of the Peninsula where the greatest commercial agricultural development has taken place, though this development has been confined mainly to western Malaya. The soils being derived from such a heterogeneous series of rocks are, as would be expected, extremely variable in composition and nutrient status. On the whole, however, most of them are of low inherent fertility and their agricultural value lies not so much in the amount of nutrients in them as in their soil structure. The latter again varies considerably with the age and degree of weathering as well as with the nature of the parent material. Quartzites, for example, weather into soils that have little crumb structure, that pack easily on exposure, becoming hard and concrete-like so that they resist root penetration and favour erosion.

The nature of the parent material determines the depth to which weathering can take place. Where the parent material is hard sandstone or schists, the resultant soil is shallow and gravelly, but where the bedrock is shaly, weathering may be up to 30 feet deep. Soils derived from schists, shales and phyllites contain varying amounts of ferruginous concretions usually deposited in a pan which hardens into a slag-like mass on exposure. Where the pan is near the surface, rubber trees do not grow well because the hardpan resists root penetration and prevents normal root development. As a rule the soil structure deteriorates on exposure, and such soils are unsuitable for crops which do not provide adequate cover to the soil surface. They are, however, capable of supporting good growths of tree crops such as rubber, and many of the rubber areas of the Peninsula have been established on these soils.

Soils derived from Limestone. Such soils are very limited in area. Although calcareous shales and limestones cover large stretches in the Malay Peninsula they are generally overlain by a non-calcareous overburden, and it is only in a few localities where the limestone occurs as outcrops rising abruptly from the plains—in Perlis, Perak (the Kinta Valley), Selangor, and Pulau Langkawi—that limestone soils are found. They usually cover an area of only a few hundred yards around the base of the limestone hills, and are therefore too limited in extent to be of significance to agriculture other than locally. But they are fertile soils having no concretionary layer and differing from the usual acid soils by having a pH value of 6 to 8·5.

Laterite. The term 'laterite' has in the past been used to cover that group of tropical red or orange soils now known as 'latosols'. The word was used originally by Dr F. Buchanan for describing a type of soil found in the Malabar coast. The soil was an indurated clay which was covered with pores and cavities and which contained a very large amount of iron in the form of red and yellow ochre. Land which had such soils was agriculturally useless, but the laterite was used extensively by the local inhabitants, who cut the soft, slag-like mass into bricks and hardened them by exposure before using them for building.

Laterite is found in localized areas in the Malay Peninsula, notably in Malacca, where it occurs over phyllites, in Selangor (near Rawang) and in the Kinta Valley. It has been quarried for bricks for many hundreds of years in Malacca. St Paul's Church built by the Portuguese in the sixteenth century is evidence of the durability of laterite. The Malays use laterite blocks as ground supports for their houses.

There is a difference of views on the formation of laterite, mainly on whether it develops more readily in a constantly wet climate, or in a wet and dry climate with a fluctuating water table. But there are no doubts about its infertility. The weathering and other pedological processes involved in the formation of laterite remove or make inaccessible all the nutrients which are essential for plant growth. The lateritic hardpan, especially where it forms near the surface, hardens on exposure and becomes highly resistant to root penetration. Forest clearing over some of the sedimentary rocks of the Peninsula enhances the rate of laterization by destroying the soil structure and accelerating the leaching process, and with indiscriminate cultivation methods the upper layers of the soil are eroded away to reveal the concretionary layer which otherwise would remain covered. This layer soon hardens to form a resistant pan.

Laterite is widespread enough in the tropics to constitute a serious hindrance to agriculture, especially in those areas where cultivable land is limited. In Malaya the purest form of laterite is found in Malacca, where lateritic concretions, with ironstones up to 1·5 inches in diameter, form a hardpan seldom more than 12 inches below the soil surface. They are mostly developed on flat or very gently undulating land, and are sometimes exposed as a hardened slag-like mass. Because of the very low fertility and the impermeability of laterite, agriculture is almost impossible.

PART II
THE PEOPLE

CHAPTER 5

THE EVOLUTION OF THE POPULATION PATTERN

The population of Malaya[1] has changed considerably in numbers as well as composition over the years since the British first obtained a foothold in the Malay Peninsula with the founding of Penang (or Prince of Wales Island as it was then called) in 1786. Most of these changes occurred as a result of the large-scale migration of Chinese and Indians into the country during the period following the establishment of British rule in the Malay States up to the beginning of the Second World War. But in order to obtain a clearer picture of the evolution of the population pattern it is necessary to go back further in time and trace the pattern as it was in the days immediately prior to the advent of the British.

The Population Pattern in the Pre-British Period. The pattern of population distribution in the period immediately preceding the founding of Penang was fairly simple. On the coastal swamps flanking the central mountainous core and on the jungle covered slopes of the mountain ranges lived small wandering groups of aborigines whose economies covered the hunting, gathering and shifting cultivation stages. Towards the northern parts of the Peninsula were several distinct tribes of Negritoes, small woolly-headed nomads known locally as Semang in Kedah and Perak and as Pangan in Kelantan. Their traditional habitat was the coastal forests and swamps bordering the mountain ranges of upper Perak, Kelantan and Trengganu, but their wanderings sometimes led them to the jungles of Pahang. With the invasion of the lowland Malays and later of other immigrant races, the Negritoes in the course of time were pushed into the interior towards the remote mountain slopes. The Negritoes were hunters and gatherers, practising no agriculture but entirely dependent on the jungle and rivers for their food. They built no permanent houses but only crude shelters constructed from sticks and leaves.

[1] In this chapter all references to Malaya up to 1946 refer to both West Malaysia and Singapore. After 1946, the term Malaya does *not* cover the Republic of Singapore.

The largest of the aboriginal groups collectively known as the Senoi (or more popularly but erroneously as the Sakai) were distributed on the mountains and foot-hills of the central mountain ranges, seldom venturing on to the plains. The Senoi had a more advanced economy than the Negritoes, and practised some form of *ladang* or shifting cultivation in addition to hunting and food-gathering. Their houses were more substantial than the crude leaf-shelters of the Negritoes (Plate 7). As the feature of shifting cultivation is movement and impermanency, the pattern of population distribution of the Senoi was also constantly changing, although movements of these hill tribes were generally limited to the mountains and slopes of central Malaya.

The third group of aborigines were the Jakuns (or Proto-Malays), primarily of Mongoloid stock. The chief subgroups were the Mantera and the Biduanda of Negri Sembilan and Malacca, and the Orang Ulu, Orang Kanak and Orang Laut of Johore. They were distributed in the southern lowlands of the Peninsula and had a culture akin to that of the lowland Malays, their dialects especially showing recognizable traces of several centuries of contact with the historical Malay tongue. Many of them practised shifting cultivation while some tribes, such as the Orang Laut, settled in fishing villages on the west coast of Johore. Many of them were assimilated into the Malay groups, the rest being distributed in the remoter swamps and jungles of southern Malaya.

The numbers of the aboriginal population of the Malay Peninsula cannot be fixed with any degree of accuracy. Newbold, writing in 1839, estimated that there were some 9,000 aborigines around that period, but it is likely that there may have been more. The population density of all these aboriginal groups varied considerably. Small pockets of settlement in the *ladang* might have a density of anything from five to twenty persons per square mile, while large tracts of the surrounding jungle were entirely uninhabited.

Apart from the aborigines, the other major population group in the Malay Peninsula was formed by the lowland Malays (sometimes also known as Deutero-Malays or Coastal Malays). Ethnically resembling the Malays of Indonesia, the Malay in the Peninsula is descended from the 'Proto-Malay plus many foreign strains derived from intermarriage with Chinese from the Chou period onwards, with Indians from Bengal and the Deccan, with Thais and Arabs' (Winstedt). The distribution of the Malays followed a definite pattern set by the physical geography of the country. The heavy and uniform rainfall gives rise to a multiplicity of rivers which are narrow and swift in their upper courses and slow and meandering where they flow along the broad flat plains flanking the mountainous core. These rivers in their turn set the original pattern of Malay settlement on the lowlands and coastal areas. The easiest lines of movement in the landscape of mangrove and freshwater swamp and forest were along the rivers. Wet padi cultivation, the basis of Malay agriculture, also tended to draw the Malays towards flat irrigable land near a convenient source of water. The sea and rivers were the natural sources of fish, and the rivers served as bathing places and provided potable water as well as water for the padi fields. All these considerations served to attract settlement to sites located near to sea and river, the most frequently settled sites being riverine, deltaic and estuarine areas. When the Malays first found their way to the Peninsula, overland and later by sea from Indonesia, the river mouths were always the foci of settlement. From these central locations offshoots of the original settlement expanded either coastwise or up the river or, more usually, in both directions. Malay settlements, in contrast to the amorphous nature of the aboriginal groupings, thus assumed a definite form and shape derived from ribbon development along the coast and along river banks.

The mouth of a river was a strategic location, commanding lines of movement both along the coast and along the rivers. The old Malay political units were sited at these focal points for military as well as economic reasons. The head of each riverine state was the Raja or Sultan, who wielded absolute power. Each sultanate was separated from the next by forested interfluves which acted as a no-man's land, but there were no well-defined boundaries to indicate where one ruler's control ended and the next began. There was a large number of these isolated petty kingdoms during the eighteenth century, and it was by a slow process of absorption of weaker sultanates by stronger ones that the nine Malay States which exist today came into being.

The Malays followed a simple subsistence economy founded on padi cultivation, with fish as the main supplement. There was no pressure on the land. The economy had a flexibility which solved increases in population numbers by bringing more land under cultivation. There are no reliable figures on the total Malay population in the Peninsula at this period. Newbold estimated the population of the States in 1835–36 to be 280,680 (Table 7).

The total does not include the population in the islands of Penang and Singapore, or that of Malacca. Purcell estimated the total Malay population in the Malay States in 1830 to be about 200,000 and diminishing.

Population Changes in the Early and Middle Nineteenth Century. The period between the founding of the Straits Settlements of Penang and Province Wellesley, Singapore and Malacca and the extension of British rule to the Malay States saw only minor changes in the basic population pattern of the Peninsula. These changes were mainly the result of the influx of Chinese and Indians into the Straits Settlements as they came under British rule, and of some Chinese miners and traders into the Malay States. In addition there were also small numbers of Europeans consisting chiefly of British administrators and military personnel.

TABLE 7. *Estimated Population in Malaya, 1835–36*

STATE	TOTAL POPULATION	STATE	TOTAL POPULATION
Perak	35,000	Johore	25,000
Selangor	12,000	Kedah & Ligor	50,000
Rembau	9,000	Kelantan	50,000
Sungei Ujong	3,600	Trengganu	30,000
Johol	3,080	Kemaman	1,000
Jempol	2,000	Patani	10,000
Jelebu	2,000		
Sri Menanti	8,000		
Pahang	40,000	Total	280,680

Penang was occupied by the British East India Company in 1786. A strip of land on the mainland named Province Wellesley was added to it in 1800. There were no Chinese or Indians in the Settlement at that date, but within a very few years substantial numbers of them began to settle in both the island and Province Wellesley. The Chinese were engaged in a variety of occupations. Many were traders and shopkeepers, others were labourers, while some took to their traditional occupation of farming, not cultivating padi but the more remunerative cash crops like vegetables, clove, nutmeg and sugar-cane. The Indians migrated to Penang as merchants, petty traders and domestic and agricultural labourers. A number of them were *sepoys* responsible, under their British officers, for maintaining law and order in the Settlement. By 1812 there were 7,000 Indians in a total population of 26,000 in Penang and Province Wellesley, and by 1820 some 8,500 Indians were enumerated in Penang Island alone. In the same year there were 8,300 Chinese in the island. After 1825 the immigrant population of the Straits Settlements was swelled by the arrival of convicts from India. Singapore, Penang and Malacca were then being used as convict stations, the flow averaging over 900 convicts per annum during the years 1832 to 1837.

Singapore, founded in 1819, had only a few Malay fishermen and no immigrant population. Within three years there were some 4,700 people on the island, of whom 1,150 were Chinese. The different immigrant races at first settled wherever they liked, but later the Chinese, Indians, Bugis and Malays were allotted settlement areas on a plan worked out by Raffles. The immigrant population followed much the same occupations as those in Penang, the class of people most encouraged in the early years being merchants and traders. There were also a number of agriculturists working in the European plantations of clove, nutmeg and sugarcane. The Chinese farmers were more interested in growing gambier and pepper and in market-gardening. The Bugis farmers were principally engaged in pineapple cultivation. The population continued to grow rapidly and by 1850 there were about 53,000 people in Singapore, 28,000 of them Chinese.

Malacca had already had a long history of foreign domination by the Portuguese and the Dutch before it finally passed into British hands in 1825. Although Indian influence had been dominant in the Peninsula until the advent of Islam in the fifteenth century, the Indians did not settle in the country, and until the era of modern immigration which began in the nineteenth century, the number of Indians in Malaya was insignificant. Malacca had a total population of nearly 25,000 in 1826, of whom only 2,300 were Indians. Similarly the Chinese, although they had trade and diplomatic relations with the Malay kingdoms from an early period, did not settle permanently in the country until after Malacca was founded. There were some 2,160 Chinese in a total population of 9,630 in Malacca in 1750. The number of Chinese increased to 4,100 in 1826. They were the principal traders in the Settlement, but were also engaged in a great variety of other occupations including farming.

Thus the basic population pattern of aborigines in the interior highlands and lowland Malays around the coasts was altered to some extent in the nineteenth century by the addition of an immigrant group composed largely of Chinese and Indians distributed in the three British possessions—Penang, Singapore and Malacca. By 1871 the immigrant element of the population in the Straits Settlements had become numerically almost as important as the Malays, as shown in Table 8.

The population pattern in the Malay States remained much the same until the latter half of the nineteenth century when Chinese

TABLE 8. *The Immigrant and Malay Population in the Straits Settlements, 1871*

RACE	Penang	Singapore	Malacca	Total
Chinese	36,561	54,572	13,482	104,615
Indians	18,611	11,501	3,278	33,390
Europeans	433	1,946	50	2,429
Eurasions and others	2,409	2,951	2,850	8,210
Total immigrant population	58,014	70,970	19,660	148,644
Total Malay population	75,216	26,141[1]	58,096	159,453
GRAND TOTAL	133,230	97,111	77,756	308,097

[1] The Malays in Singapore included a large number of immigrant Malays from Indonesia.

miners began to enter in increasingly large numbers. In 1830 there were already about 15,000 to 20,000 Chinese, mainly miners and traders.

In addition there were some Chinese squatters cultivating pepper and gambier in south Johore. But it was not agriculture but tin-mining which was responsible for the influx of Chinese into the Peninsula. The discovery of rich deposits of tin in the Larut district in 1850 turned it from a little-known and almost uninhabited area to a busy and densely populated mining camp swarming with thousands of Chinese miners (40,000 in 1872). A similar discovery in the Klang Valley saw the influx of miners in Selangor, their numbers growing to 17,000 by 1871. Chinese miners also penetrated into, and set up camp in, the fabulously rich Kinta Valley, as well as the tin fields of Negri Sembilan where there were 15,000 miners in Sungei Ujong in 1874. The influx of Chinese to these new mining fields was so great that the Malay rulers began to find it difficult to maintain order, and the situation soon got out of hand as rival factions of Chinese quarrelled and fought with each other as well as with the Malay overlords over the possession of mining land, and also over the monopoly of opium, liquor and other supplies to the miners. Chinese secret societies played a prominent part in these internecine quarrels.

The turbulent conditions in the Malay States threatened to spread to the Straits Settlements. Normal economic activities in the Settlements were also hampered. Up to this juncture the British Government was reluctant to interfere in the internal affairs of the Malay States. But in 1873, when conditions were becoming chaotic, the British Government reversed their non-interference policy and decided to step in and try to restore law and order in the Peninsula. Both Perak and Selangor were brought under British protection in 1874. Sungei Ujong, one of the Negri Sembilan ('Nine States') also came under British rule in the same year, and was joined by the other states in subsequent years to form the State of Negri Sembilan. British rule gradually spread to cover the rest of the Peninsula, Pahang accepting protection in 1888, Kelantan, Trengganu, Kedah and Perlis in 1909, and finally Johore in 1914. Malaya was then made up of three major political units—the *Straits Settlements* of Singapore, Malacca, Penang and Province Wellesley; the *Federated Malay States* of Perak, Selangor, Negri Sembilan and Pahang; and the *Unfederated Malay States* of Kedah, Perlis, Kelantan, Trengganu and Johore. (In 1948 all these States and Settlements, with the exception of Singapore, were amalgamated into a federation—the Federation of Malaya. The Federation attained its independence in 1957. Singapore, however, remained a British Colony until 1959, when it became a self-governing State.)

The establishment of the *Pax Britannica* paved the way for economic development in Malaya. Immigration was actively encouraged by the British as a necessary means to development, and the years between 1874 and the beginning of the Second World War saw the influx of Chinese, Indians and immigrant Indonesians in such numbers as to alter the population pattern of the country completely, turning it from a little known country inhabited by a few hundred thousand Malays and some aborigines to a major producer of rubber and tin with a large (5·5 million in 1941) multi-racial population composed of two major groups—the Malays and the Chinese—and an important minority, the Indians and Pakistanis. The next section is devoted to tracing the growth of this immigrant population from 1874 to 1941.

The Growth of the Immigrant Population: The Chinese. The stabilization of conditions in the western Malay States laid the foundation for the large-scale and systematic exploitation of the tin deposits in these areas. Immigration was completely unrestricted until the Great Depression of the 1930s, and the Chinese continued to flow into the Peninsula in great numbers to trade and to work in the tin mines, and, later, in the rubber holdings and other agricultural enterprises. The continual influx of Chinese into Malaya was due to a number of factors. Most of the immigrant Chinese originated from south-eastern China, from the provinces of Fukien, Kwangtung and Kwangsi and the island of Hainan south of Kwangtung. The natural resources of these regions were limited. There was extreme pressure of population on available cultivable land, which eventually forced many to seek a better livelihood overseas. Malaya, among the countries of the *Nanyang*, offered the best prospects to the migrants, not only because of the opportunities for trade and mining, but also because of the policy of active encouragement followed by the British who, having acquired the Malay States, realized that development would be seriously hampered in this sparsely peopled land without cheap and plentiful labour. Indeed the demand for labour was so great that a system of recruitment was established for tapping the south Chinese sources of labour.

There was a considerable expansion in the tin-mining industry in the 1880s which followed on the increased demand for tin and the discovery of further deposits along the western foothills. In 1898 there was a phenomenal rise in the price of tin which was reflected in the abnormally high wages being paid for mining labour. This, in turn, stimulated the flow of labour from south China to such an extent that in the two years 1899 and 1900 an estimated 100,000 adult Chinese arrived in the Federated Malay States. Chinese migration into Selangor and Perak during the period 1881–1900 totalled 1,681,711, while the number which entered the Federated Malay States during the same period came to nearly two million. The overall result was that by 1901 there were more Chinese than Malays in the two States of Perak and Selangor and, in fact, the Chinese nearly equalled the Malays in numbers in the Federated Malay States, there being 301,463 Chinese as compared with 313,205 Malays.

Although the development of the tin-mining industry gave the original impetus to Chinese migration, the interests of later migrants expanded to cover a wide range of other economic activities, in particular rubber growing when the crop began to attract the attention of planters in Malaya. The bulk of the labour in the tin mines continued to be Chinese, but the introduction of labour-saving machinery, especially dredges (in 1912), reduced the need for such labour. The largest number of labourers employed in the mines was 225,000 in 1913. The number gradually declined after that year, and by 1939 only 73,000 were employed, although the output from the mines remained much the same, 51,090 tons in 1939 as compared with 50,126 in 1913.

At the beginning of the twentieth century rubber had come into the agricultural scene, and the end of the first decade saw a phenomenal boom which greatly stimulated the cultivation of the crop. Most of the labour employed in the rubber estates was Indian, but a large number of Chinese were also engaged in this new venture. In 1911 60 per cent of the estate population in the Federated Malay States was Indian, 25 per cent Chinese, and most of the rest Malay. The total Chinese estate population was about 40,000 of which some 10,000 were Hainanese, and the rest Cantonese, Hakka, Hokkien, and Teochew. In 1931 35 per cent of the total population engaged in rubber cultivation in the Federated Malay States was Chinese. The Chinese proportion in the Straits Settlements was 32 per cent, in Johore 49 per cent, in Kedah 16 per cent and in Kelantan 13 per cent. By 1941 the number of Chinese employed in estates of 25 acres and over was 50,000 in the Federated Malay States, 7,500 in the Straits Settlements, 33,000 in Johore and 4,500 in Kedah.

The characteristic feature of Chinese migration to Malaya was that it was motivated entirely by economic reasons. The Chinese came to the country with but one desire—to make their fortunes before returning to their original homes. Few had any intention of settling permanently in the Peninsula. Movements of Chinese to and from south China were therefore extremely fluid, more so as transport was modernized and steamers replaced the old sailing junks. The frequency and directions of these movements were highly geared to the existing state of the Malayan economy, periods of economic boom resulting in a net influx of labour and periods of depression causing a return flow of migrants to China. At most times there was a constant stream of new immigrants from China landing at the Malayan ports and making their way inland to the mines, the estates, and the new towns that were springing up along western Malaya. Thus in 1881 some 89,900 Chinese landed at Penang and Singapore, the number increasing to 224,000 in 1901 and to 278,000 in 1913. The First World War put a temporary halt to immigration, but the postwar years were years of prosperity. The number of immigrants reached its record total of 435,708 during the boom year of 1927. During this year only 303,497 Chinese left Malaya for China, so that there was a net surplus of over 132,000. In contrast, the depression year 1931 saw 304,655 leaving the country as against 191,690 who arrived. In the decade 1921 to 1930 2,317,941 Chinese entered Malaya and 1,937,941 left it, so that the migrational surplus was 380,000.

The export economies of Malaya based on rubber and tin were highly susceptible to price fluctuations in the world markets. In such a situation a flexible labour force was desirable in order to enable quick adjustments to be made to suit the changing market conditions, including a reduction of the labour force to a minimum in a period of low prices. The general world depression of the 1930s greatly affected the Malayan economy, and there was a country-wide retrenchment of labour employed in the rubber estates, tin mines and other enterprises. At the beginning of the depression (1930) 167,903 Chinese left the country for China, including some 13,000 destitutes repatriated at governmental expense. However, the exodus was less than the influx, for during the same year 242,149 Chinese arrived in Malaya, most of whom could not find work and only increased the number of unemployed. It became necessary to prevent more labourers from entering the country, and in August 1930 the Immigration Restriction Ordinance was enforced which stopped direct immigration to the Federated Malay States and imposed a quota upon the number of labourers who could enter the Straits Settlements. More and more Chinese began to leave, and the migrational deficit in 1932 was half a million. The Aliens Ordinance of 1933 further restricted immigration of all adult males of all classes, with the object of regulating 'the admission of aliens in accordance with the political, social and economic needs for the moment of the various administrations in Malaya'. The quota system applied only to male labour. From 1934–38 female immigration was unrestricted, with the result that there was a migrational surplus of 190,000 Chinese women. It became necessary to restrict the entry of women also, and this restriction was consequently imposed shortly before the start of the Second World War. This imposition marked the end of the major phase of Chinese migration to Malaya.

TABLE 9. *Growth of the Chinese Population in Malaya, 1871–1941*

YEAR	TOTAL POPULATION	CHINESE	
		Number	Percentage of Total Population
1871[1]	308,097	104,615	34
1891[2]	910,123	391,418	43
1901	1,227,195	583,396	48
1911	2,644,489	914,143	35
1921	3,338,545	1,170,551	36
1931	4,345,503	1,703,528	39
1941	5,545,173	2,418,615	44

[1] Straits Settlements only.
[2] Straits Settlements and Federated Malay States only.

The net result of Chinese migration from the middle of the nineteenth century to the beginning of the Second World War was to add a major racial component to the population pattern of Malaya. It has been estimated that at least 5 million Chinese entered Malaya during the nineteenth century, and a further 12 million between 1900 and 1940. The large majority of them returned to China, but a significant number decided, for one reason or another, to settle in the Peninsula. Thus the Chinese population in Malaya grew from 104,615 (Straits Settlements only) in 1871 to 2,418,615 or 44 per cent of the total population in 1941 (Table 9).

The Growth of the Immigrant Population: The Indians. While modern Chinese immigration was originally associated with the exploitation of tin, modern Indian immigration was closely linked with the agricultural development of Malaya, in particular with the rise of the rubber industry in the twentieth century. Most of the Indians in Malaya before the establishment of British rule in the Malay States were in the Straits Settlements. The census of 1871 enumerated 33,390 Indians out of a total population of 308,097 in the Straits Settlements. When British rule was extended to cover the Federated Malay States from 1874 onwards, the F.M.S. government vigorously pursued a policy of encouraging commercial agriculture. Up to the turn of the century the agricultural enterprises based on spices, tapioca, sugarcane and coffee met with uneven success because of competition from overseas producers, price fluctuations, plant diseases and lack of agricultural knowledge on the part of the pioneers. Most of the capital invested was Chinese. British and European capital was little committed until the development of coffee and later rubber plantations. By the end of the nineteenth century there were some forty sugarcane plantations covering 50,000 acres and employing 8,000 to 9,000 labourers in Perak, while the Selangor Annual Report for 1896 stated that there were seventy-two European-owned coffee estates covering 47,000 acres and employing 4,000 Indian and Javanese labourers.

In addition to the demand for labour generated by these new agricultural enterprises, there was also a substantial demand for workers to help in the construction of railways and roads. Most of the labourers were immigrants from India, and by 1891 the Indian population had increased to 74,104 in the Straits Settlements and the Federated Malay States. A decade later the total was 115,532. But the greatest influx of Indians did not occur until rubber became the premier export crop of Malaya.

Rubber was an experimental crop during the turn of the century, and up to 1905 only 50,000 acres had been planted. But the growing demand for rubber forced prices to boom levels in 1906, and again in 1909–12. Profits from rubber were far higher than could be obtained from any other revenue crop, and there was a general rush to clear jungle land, and even land under other crops, for rubber. The acreage under rubber leaped to 290,000 in 1909, and continued to expand throughout the next three decades in spite of fluctuating market conditions until, by 1940, the planted acreage was 3,481,000. Natural conditions of soil and climate in the Malay Peninsula were found to be ideal for the growth of rubber, especially on the well-drained soils as found along the western foothills.

By the first decade of the twentieth century the skeleton of an excellent railway and road network had already been laid to serve the mining industry, and was conveniently placed to serve the transport needs of the planters as well, being connected to the deep-water ports of Penang and Port Swettenham as points of entry for labour and supplies, and of exit for rubber. The major problem which the planters had to face was the labour shortage, as the rapidity with which the rubber acreage expanded created an unprecedented demand for workers. The planters could not look to the indigenous population as the Malays were then few in number, and too much tied to their own self-subsistence economy, with its irregular hours of work and variety of occupations, to have either the inclination or the economic incentive to abandon these for hard, sustained and monotonous work in a rubber estate. The other alternative sources of labour were the immigrant Chinese, Javanese and Indians. Although the Chinese were already present in large numbers in the Peninsula, they were very much preoccupied with their mining, trading and other economic activities, and only a few chose to be wage-earners in a rubber estate. Moreover, the planters were reluctant to employ Chinese labourers as they were 'inclined to be disorderly, cost more in police supervision and gave more trouble'.[1] Javanese labour was difficult to recruit, and was also difficult to manage. In the circumstances the South Indian labourer was the logical choice, being well-behaved, hardworking, and willing to accept low wages. The demand for South Indian labourers came at a time when there was widespread unemployment and under-employment in India due to the rapidly increasing population. Large numbers of labourers were therefore easily persuaded to emigrate to Malaya.

Unlike the flow of Chinese into Malaya, the migration of Indians was an organized movement from the start. Until the imposition of quotas on all immigration into Malaya in the 1930s, most Indian labour immigration was of the assisted type, that is, the labourer was paid his passage to Malaya by his employer or, later, by the Indian Immigration Committee. The average length of service was three years, so that there was a constant return flow to India as those labourers who did not renew their contracts returned to their original homes. Indian labour migration continued until 1938 when the

[1] *Report of the Commissioners of Enquiry into the State of Labour in the Straits Settlements and the Protected Malay States, 1890* (Singapore, 1890), para. 451.

Indian Government put a ban on the emigration of all unskilled workers to Malaya. In addition to this labour migration was the migration of Indians from the higher economic classes—professional people, merchants, petty contractors, moneylenders, shopkeepers and pedlars—all of whom were attracted by the good prospects in Malaya. Most of these were from North India.

The number of Indian labourers and other Indians who arrived in Malaya and the number who returned to India during the period 1881–1940 are shown in Table 10.

TABLE 10. *Arrivals and Departures of Indians in/from Malaya, 1881–1940*

Period	Arrivals	Departures	Migrational Balance
1881–1889	137,898	n.a.	n.a.
1891–1900	n.a.	n.a.	n.a.
1901–1910	421,038	245,298	+ 175,740
1911–1920	908,100	561,913	+ 346,187
1921–1930	887,751	703,809	+ 183,942
1931–1940	764,449	720,374	+ 44,075
		TOTAL	+ 749,944

n.a. = Information not available.

Between 1901–40 there was a migrational surplus of three-quarters of a million Indians, most of them labourers. The greatest influx of Indians took place between 1910 and the Great Depression. The period 1931–40 recorded a migrational surplus of only 44,000 mainly because of the depression which led to the imposition of immigration control and the Indian Government's action in banning emigration in 1938.

The net result of Indian immigration into Malaya was to increase the Indian component of the Malayan population until by 1941 it constituted 14 per cent of the total population (Table 11).

The Growth of the Immigrant Population: The Indonesians. The large-scale migration of Chinese and Indians to the Malay Peninsula has been well documented and well publicized. Not so well known is the equally important but less spectacular migration of Indonesians to Malaya during the same period. There were two main reasons for this: in the first place there was a general lack of accurate statistics on Indonesian migration. While the Chinese and Indian migrants came in through the main ports, the Indonesians trickled in at various points in the country and, except in the case of Javanese indentured

TABLE 11. *Growth of the Indian Population in Malaya, 1871–1941*

Year	Total Population	Indians	
		Number	Percentage of Total Population
1871[1]	308,097	33,390	11
1891[2]	910,123	74,081	8
1901	1,227,195	115,536	9
1911	2,644,489	267,159	10
1921	3,338,545	471,536	15
1931	4,345,503	621,774	14
1941	5,545,173	767,693	14

[1] Straits Settlements only.
[2] Straits Settlements and Federated Malay States only.

labourers, no record of their number was kept. Secondly the distinction between the local Malays and Indonesians, especially those from Sumatra, is not very obvious, and indeed has been ignored in the compilation of Malayan vital statistics. The 1931 Census of Population, for example, showed all Sumatrans born in Malaya as Malays, thereby increasing the proportion of indigenous Malays to immigrant Indonesians.

The migration of peoples of Malay stock from Indonesia to the Malay Peninsula has been going on for centuries. Most of them were from the neighbouring islands of Java, Sumatra and Celebes as well as the lesser islands such as tiny Bawean. Most of the settlers came across in a series of insignificant waves which at times assumed substantial proportions, as, for example, the movement of the Minangkabau from Sumatra to Negri Sembilan in the fourteenth century, and that of the Bugis to Selangor in the eighteenth century. Such immigration has continued to recent times but has been overshadowed by the more spectacular movements of Chinese and Indians to the Peninsula. The immigrants from Sumatra intermarried freely with the Malays already settled in Malaya, while the Boyanese from Bawean, the Bugis from Celebes, and the Javanese might retain their individuality for some time before they were assimilated into the local Malay population. Assimilation has been greatly facilitated by the fact that these immigrants shared a common anthropological origin, a basically similar language, and were Muslims. During the period of British rule and up to the present time, all such people were recognized as 'Malays'.

The Indonesian immigrants came to Malaya with the primary motive of settling on the land as peasant farmers. Unlike the Indians, only a few of the immigrants took to wage-earning in the rubber estates and other large establishments. Most of such labourers were from Java. After the establishment of British rule in the Malay States and towards the end of the nineteenth century when coffee and rubber were introduced as revenue crops, the European planters had to recruit labour from whatever sources were available. In addition to Indian and Chinese labourers, some of the pioneer planters also employed Javanese, although the total number of Javanese labourers never at any time made up a large proportion of the total estate labour force. The Javanese were hard working and, in fact, some planters preferred them to Indians or Chinese as labourers, but recruitment from the former Netherlands East Indies was both difficult and expensive. Javanese immigration was regularized in 1909 with the passing of laws requiring that all Javanese estate labour imported into Malaya be indentured. This regulation remained in force until 1932. The lack of any recruiting machinery in the Netherlands East Indies and the success of the system of free immigration from India both worked against increasing the flow of Javanese labour into Malaya. In consequence the total number of Malaysian estate labourers (Javanese mainly, but also including other Indonesians and indigenous Malays) enumerated in the 1921 census of population was only 37,753, or 10 per cent of the total estate population. By 1931 it had dropped to 28,455 out of a total estate population of 423,851. The total number of Javanese employed as labourers in 1937 was only 15,603. The restriction on Indian emigration imposed by the Indian Government in 1938 created a shortage of labour in estates, public works and other fields of employment. A move was started by the United Planting Association of Malaya urging the Malayan Government to use the Indian Immigration Fund to assist Javanese labourers to come into the country, but the Japanese invasion prevented anything concrete emerging from the proposal.

In contrast to the limited number of Javanese and other Indonesians who entered the country as labourers and wage-earners, the number of Indonesian immigrants who came to farm and settle in Malaya was quite considerable during the period under discussion. It has been estimated by Vlieland, the superintendent of the 1931 census, that some 244,000 of the 594,000 Malays enumerated in the Federated Malay States in that year were either new Indonesian immigrants or the descendants of immigrants who entered the country between 1891 and 1931. This meant that less than sixty per cent of the Malay population in 1931 had been in Malaya for more than forty years.[1] An indication of the importance of immigration as a factor in swelling the Malaysian population of Malaya is given by the fact that 85 per cent and 83·6 per cent of the Malaysian population were returned as Malays in the censuses of 1921 and 1931 respectively. The percentages were lowest in four areas—Singapore (58 per cent in 1931), Perak (77 per cent), Selangor (52 per cent) and Johore (48 per cent)—a clear indication that immigration from Indonesia had been an important factor in the growth of the Malaysian population of southern Malaya.

The extent of the flow of Indonesian migrants to Malaya in the first four decades of the century can be measured roughly by the official statistics of the number of Indonesians by year of first arrival over the period (Table 12). It will be seen that 88,000 of the immigrant Indonesians who settled in Malaya came over during the first forty years of the century. As pointed out by Vlieland, many of the Malays enumerated in the censuses were, in fact, descendants of recent immigrants, so that 'a very large proportion of the Malay population consists of recent immigrants and . . . a still larger fraction cannot

[1] C. A. VLIELAND, 'The Population of the Malay Peninsula', *Geogr. Rev.*, **24** (1934), 64.

claim pure Peninsular descent for any considerable number of generations.'[1]

The Malay population (that is, the indigenous Malays and other Malaysians)[2] increased from 1,410,105 in 1911 to a total of 2,248,579 in 1941. What proportions of this increase were due to the excesses of births over deaths and what due to immigration cannot be determined exactly because of the lack of migration statistics. It is certain, however, that the flow of Indonesians to Malaya which has been going on for centuries was accelerated in the first three decades of the present century as many Indonesians, attracted by the bright economic prospects in Malaya, crossed the seas and opened up smallholdings of rubber, fruit and coconut. The Javanese, the most numerous of the immigrants, emigrated also because of the growing pressure of population on land in Java.

TABLE 12. *Immigrant Indonesians by Year of First Arrival in Malaya*

STATE/SETTLEMENT	1910 or earlier	1911–20	1921–30	1931–40	TOTAL
Singapore	1,000	2,000	4,000	6,000	13,000
Johore	4,000	10,000	12,000	7,000	33,000
Selangor	3,000	7,000	6,000	4,000	20,000
Perak	3,000	4,000	3,000	2,000	12,000
Other States	2,000	3,000	3,000	2,000	10,000
TOTAL	13,000	26,000	28,000	21,000	88,000

The Stabilization and Post-war Growth of the Malayan Population. By the start of the Pacific War the influx of immigrant Chinese, Indians and Indonesians had completely altered the pattern and character of the population of Malaya. The position is illustrated in Table 13. Within the space of less than a century the Chinese had

[1] VLIELAND, *op. cit.*, p. 64.

[2] The official definition of a Malay is a person belonging to the Malay race or any Malaysian race, who habitually speaks the Malay language or any Malaysian language and professes the Muslim religion. The term therefore covers both the indigenous Malays and immigrant Malaysians. For convenience, further references to Malays will also refer to both these groups.

entered and settled in the Peninsula in such large numbers that they outnumbered the Malays in 1941, while the Indians formed a substantial majority in the now multi-racial society of Malaya.[1] The bulk of the immigrant population was spread along a broad coastal belt in western Malaya running from Kedah southwards to the tip of the Peninsula. The eastern boundary of this belt coincided with the line taken by the western flanks of the Main Range except in the south where the boundary ran roughly along central Johore. Here were found the tin and rubber industries as well as the main ports.

TABLE 13. *The Number and Composition of the Population in Malaya, 1941*

RACE	Number	Percentage of Total
Chinese	2,418,615	44
Malays	2,248,579	40·5
Indians	767,693	14
Europeans	30,251	0·5
Eurasians and others	80,035	1
TOTAL	5,545,173	100·0

The Chinese were distributed largely in the urban and tin-mining areas, and to a lesser extent in the rubber estates. Most of the Indians were dispersed in the rubber estates with two zones of concentration, the Kuala Lumpur to Malacca and the Kinta to Butterworth rubber areas, and the remainder in urban centres. The Malay population was spread along the traditional padi and fishing areas in the north-eastern and north-western parts of the Peninsula, mainly on coastal locations. A further proportion of the Malays were also located in the coastal parts on both sides of the Peninsula, and in riverine areas

[1] With the separation of Singapore, with its large (730,133 in 1947) Chinese population, and the mainland into two separate political units, first by the establishment of the Malayan Union and then by the formation of the Federation of Malaya and the Colony (now the Republic) of Singapore in 1948, the Malays became numerically superior to the Chinese. Malays formed 49·5 per cent of the total population in the Federation in 1947, and the Chinese 38·4 per cent.

in the interior. Broadly speaking there was little overlapping in the distribution of the immigrant peoples and the Malays since the economic interests of the former lay in the urban centres and the tin and rubber areas which were located nearer the foothills than the coast, while those of the Malays were on the coastal and riverine lands associated with their padi and fishing economy.

Up to 1941 the characteristic feature of both Chinese and Indian migration to Malaya was its temporary nature. None of these two groups of people came to the country with a view to permanent settlement, although over the years a substantial number of them did decide to make Malaya their permanent home. The temporary nature of Chinese and Indian migration was reflected in the ill-balanced sex ratio and the low percentage of local-born among both these racial groups. In 1891 there were only 153 Chinese women to every 1,000 Chinese men in the Straits Settlements. The sex ratio among the Indians was even more unbalanced, there being only 18 Indian women to every 1,000 Indian men in the Straits Settlements and the Federated Malay Straits. When the first pan-Malayan census was taken in 1911 the sex ratio of the Chinese was 247 women to every 1,000 men and of the Indians was 308 women to every 1,000 men. The number of women to every 1,000 men increased to 513 in 1931 in the case of the Chinese and to 482 in the case of the Indians. The percentage of local-born Chinese in 1921 was only 22 and of Indians 12. The number of local-born Chinese increased to 31 per cent of the total Chinese population in 1931, while that of the Indians rose to 21 per cent.

The improved sex ratio and the greater number of local-born in 1931 were indicative of a degree of stabilization among the immigrant population of Malaya. But it was not until after the Great Depression of the 1930s that a succession of events occurred which collectively helped further to stabilize the population.

While the Indian Government had made it mandatory that there should be two females for every three males emigrating to Malaya as early as 1922, the character of Chinese immigration did not change, with males predominating, until the Aliens Ordinance of 1933 severely restricted the number of males entering Malaya but allowed the entry of females. The passing of the Ordinance and the subsequent Japanese invasion of China in 1937 caused a flood of Chinese women into the Peninsula which vastly improved the sex ratio of the Chinese population and encouraged the establishment of families in the country of their adoption. It also encouraged the formation of new social links in the country and led to the decay of old ones in China.

When the Indian Government banned emigration of unskilled labour to Malaya in 1938, and the Malayan Government put a ban on the entry of Chinese women shortly before the start of the Pacific War, immigration which up to then had been the prime factor in altering the population pattern of Malaya and increasing its population, ceased to be of major importance in the further development of the social geography of the Peninsula. By this time many of the Chinese had created extensive economic ties and interests, and the guaranteed protection of these by a paternal government naturally made the Chinese reluctant to leave Malaya and abandon the fruits of many years of labour. Life, even for the common labourer, was very much easier in the rapidly developing Peninsula than in the old, over-crowded villages of China. Finally, the immobilization of traffic between South China and Malaya over the long period from the beginning of the Japanese occupation of the South Chinese ports in 1937, to the end of the Pacific War, and the Communist conquest of China in 1949, forced many Chinese who would normally have returned to their homeland to stay on and, at the same time, fostered and strengthened the economic and social bonds holding them to Malaya. A new generation of local-born Chinese who had never seen the country of their fathers and grandfathers came into being. The over-all tendency to permanent settlement is indicated by the improvement in the sex ratio from 513 females to every 1,000 males in 1931 to 815 females to every 1,000 males in 1947, and the increase in the number of local-born Chinese from 31 per cent of the total Chinese to 62·5 per cent. This tendency to permanent settlement was less pronounced in the case of the Indians, whose sex ratio in 1947 was 637 females per 1,000 males. Only 50 per cent of the Indian population was born locally. In contrast, 95 per cent of the Malay population was local-born in 1947.

The total population of the Malay Peninsula increased to 5,848,910 in 1947, made up of 4,908,086 in the Federation of Malaya and 940,824 in Singapore. Most of the increase in the inter-censal years 1931–1947 was due to a natural increase of the population and not to the influence of immigration. The increases were confined to the Chinese and Malay segments of the population. The Indians, on the contrary, declined in numbers from 621,774 in 1931 to 599,616 in

1947 in Malaya and Singapore, due to the deaths from malnutrition of thousands of unemployed estate labourers during the Japanese occupation, the loss of most of the 50,000 Indians forced to work in the notorious Burma–Siam railway project, and the fall in the birth-rate of the Indians as a result of these factors.

The end of the war, the recovery and further development of the Malayan economy and the extension of health and medical facilities to most parts of the country have resulted in a great increase in the

TABLE 14. *Population Growth in the Federation of Malaya, 1947–57*

RACE	Number		Percentage Increase	Percentage of Total Population, 1957
	1947	1957		
Malays[1]	2,427,834	3,126,706	29	49·8 (49·5)
Chinese	1,884,534	2,332,936	24	37·1 (38·4)
Indians[2]	530,638	695,985	31	11·1 (10·8)
Others	65,080	123,136	89	2·0 (1·3)
TOTAL	4,908,086	6,278,763	28	100·0 (100·0)

Figures in brackets refer to the corresponding percentages for 1947.

[1] The term includes Malays, Indonesians and the aboriginal groups.
[2] The term does not include Pakistanis and Ceylonese who are included in 'Others' (1957 census only).

numbers of all the main racial groups as the birth rates remained high and the death rates declined. Table 14 illustrates the position between the two census years 1947–57.

The greater rate of increase of the Malays has improved their position relative to the total population from 49·5 per cent in 1947 to 49·8 per cent in 1957. Conversely, there has been a relative decline in the proportion of Chinese to the total population, from 38·4 per cent in 1947 to 37·1 in 1957. The Indians have recorded the greatest percentage increase of the three main racial groups, in spite of the fact that the 1957 total does not include the Pakistanis and Ceylonese. The near doubling of the Other Races over the inter-censal period was due mainly to the inclusion of the Pakistanis and Ceylonese under this category in the 1957 census.

The decade between the two post-war censuses has seen a further marked tendency on the part of all the peoples in Malaya to settle down permanently in the country. The stabilization of the population is indicated by the larger proportions of the immigrant races born locally. The percentage of Indians born locally increased from 49·8 in 1947 to 62·1 in 1957, while that of the Chinese increased from 62·5 to 74·7, and that of the Malays from 95·4 to 96·9. The 1957 census also showed that 77·9 per cent of the total population of Malaya and Singapore was local-born as compared with 75·4 per cent in 1947. It is evident, therefore, that in time to come the immigrant character of the Malayan population will disappear entirely, and that unless there is a change of governmental policy, large-scale immigration will no longer be of any consequence as a factor in population growth. The population of Malaya is, in fact, approaching 'normality' rapidly, and will soon be made up of peoples born and bred in the country. But there has been little intermarriage over the years between the Malays, the Chinese and the Indians, mainly because of cultural and religious differences. The multi-racial structure of the population is therefore likely to persist for some time.

CHAPTER 6

THE PATTERN OF POPULATION DISTRIBUTION

Malaya, with its six-and-a-quarter million people[1] spread over an area of nearly 51,000 square miles, is not densely populated by Asian standards. The density of population of the country as a whole is only 124 persons per square mile (1957 figures). In direct contrast, the Republic of Singapore with its 1,446,000 inhabitants distributed over an area of only 224·5 square miles, has a density of 6,441 persons to each square mile.[2]

The overall density of population, however, does not convey a true picture of the situation, since it assumes that all the people are distributed evenly over the entire surface area of the political territory of Malaya. In actual fact, the population is distributed in an extremely uneven manner. Extensive areas of land are almost devoid of population or only very thinly peopled, while in contrast, many parts of western and north-eastern Malaya have rural densities approaching those of the Menam or Irrawaddy deltas. Figures 27 and 28 show the distribution and density of population based on 1957 census data. The pattern of population distribution is fairly simple, being made up of the following elements: two zones of high population densities, one extending all the way along western Malaya from Perlis in the north to Pontian (Johore) in the south, and including the crowded islands of Penang and Singapore, and the other located in north-eastern Malaya and centred round the Kelantan and Trengganu deltas. The rest of the Peninsula, consisting of the forested uplands of the interior and other parts of eastern Malaya, is sparsely populated.

The Western Belt of High Densities. Figure 28 shows that there are thirty-six districts in western Malaya with more than 100 persons per square mile. These districts are all located in a continuous belt 25–75 miles wide running the entire length of the Peninsula. The total

[1] The estimated total population in 1965 was 8,157,000, of whom 50% were Malays, 37% Chinese, 11% Indians and Pakistanis, and 2% other races.

[2] The estimated total population in 1965 was 1,864,900, and the density of population 8,326 persons per square mile.

area and the number of people within this belt of high densities is shown in Table 15.

The table shows that three-quarters of the total population of

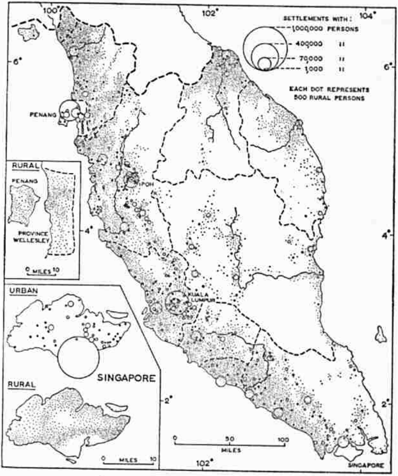


FIG. 27. Distribution of population, 1957

Malaya in 1957 was concentrated in this western belt, the area of which constitutes 30 per cent of the total land area of the Federation. Another 563,322 people or 12 per cent of the total population were found in the Kelantan and Trengganu deltas (Fig. 28) which together make up 1,419 square miles or 3 per cent of the total land area of

Malaya. In contrast, the remaining two-thirds of the country contained only 1,029,931 people or 13 per cent of the total population of Malaya in 1957.

The average density along this western belt was 310 persons per square mile or exactly two-and-a-half times the average for the whole

TABLE 15. *Area and Number of People within the Western Belt, 1957*

STATE	Area (sq. miles)	Number of People
Perlis	310	90,885
Kedah (districts of Kota Star, Kubang Pasu, Yen, Kuala Muda, Baling, Kulim, Bandar Bahru and municipality of Alor Star only)	1,797	651,249
Penang and Province Wellesley	398	572,100
Perak (districts of Krian, Larut & Matang, Selama, Kuala Kangsar, Dindings, Kinta, Lower Perak and municipalities of Ipoh and Kampar only)	4,399	1,079,056
Selangor	3,166	1,012,929
Negri Sembilan (districts of Seremban, Kuala Pilah, Rembau, Port Dickson and municipality of Seremban only)	1,698	313,420
Malacca	640	291,211
Johore (districts of Johore Bahru, Muar, Batu Pahat, Pontian and municipality of Johore Bahru only)	2,681	674,660
TOTAL	15,089	4,685,510

of Malaya in 1957. The boundaries of the belt also delimit the area of maximum economic development in the country. Both the high degree of economic development and high population densities are the result of a combination of circumstances that has made western Malaya specially favourable to settlement. Part of the explanation lies in the better environmental conditions along this belt. Western Malaya, protected from the direct force of the south-west monsoon by the great land mass of Sumatra and from the north-east monsoon

13. Mentakab, a small town in Pahang. As with many such towns in Malaya, Mentakab has grown up on both sides of the main trunk road, which, in this case, is also the main street. The two-storied Chinese shophouses are characteristic features of the urban landscape, not only of the Malay Peninsula, but of nearly every part of South-East Asia.

14. Clearings (*ladang*) made by aboriginal shifting cultivators on the flanks of Tanah Abang, a mall isolated hill in the middle reaches of the Endau River, Johore. The abandoned *ladang* to e right are reverting to *belukar*. The large one to the left is being cultivated. Note the huts in e centre. The monsoon rains have washed away much of the top-soil which has accumulated as hite patches on the lower edges of all the clearings.

15. Rubber and pineapple on peat land, some 10 miles west of Pekan Nanas, west Johore. Drainage of such peat land is necessary before cultivation is possible, but over-rapid drainage has caused the surface layers to dry out and shrink to such an extent that the roots of the young rubber trees are exposed (right). Pineapple is the most suitable crop for peat land, but the pineapple canning industry is undergoing a lean period, and poor prices have led the smallholder to put in rubber as the permanent crop, with pineapple as a temporary catch crop (left).

16. A Tamil woman rubber tapper empties a latex cup into a bucket after the flow of latex from the tree has ceased. She will carry two such buckets on a 'kanda' stick to a central collecting point.

by the central mountain ranges of the Peninsula, has always held greater attractions for the settler than the exposed backwater of the South China Sea that borders the eastern coast. The sheltered waters

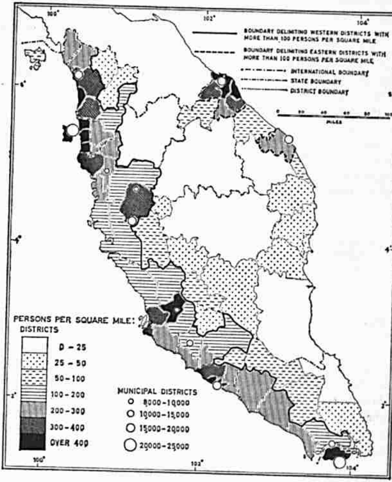


FIG. 28. Density of population, 1957

of the Straits of Malacca and the presence of deep-water harbours along the western coast have served to attract ocean-going vessels to this part of the Peninsula, both in the days of sailing ships and today. Consequently sea-borne traders and sea-borne immigrants have landed and settled along the west coast in far greater number than on the east.

Malayan soils are generally old and poor, being highly leached and suited only to a limited range of crops. The best of these are the alluvial soils deposited by the rivers and constantly enriched by fresh alluvium over the older layers. Here, again, the sheltered west coast provides the better conditions for fluvial deposition. Since the early days of history the first Malay colonists to come to the Peninsula have chosen to settle on the estuarine plains and deltaic plains of the west. With the exception of the Kelantan and Trengganu deltas of the north-east, Malay settlements in eastern Malaya were of little importance.

But perhaps the greatest single factor that has influenced the pattern of population distribution was the presence of large and easily accessible deposits of tin along the western flanks and valleys of the Main Range. As seen in the previous chapter, these rich deposits were the original magnet that drew thousands of Chinese miners to the western foothills. The exploitation of the tin resources was responsible directly or indirectly for the establishment of British rule over the Malay States, the influx of Chinese to mine, trade and later to settle in the country, and the establishment of modern land transport in this part of the Peninsula. When rubber was introduced as a major export crop, the first plantations were started in the western belt not so much because of environmental conditions as because of transport availability and proximity to good ports as points of entry for Indian labour, materials and food, and of exit for rubber. The success of both the tin and rubber industries provided the revenue for the extension of the rail and road networks along western Malaya, which in turn served to concentrate subsequent rubber and other agricultural development in this area. Further thousands of immigrants from South China, South India and neighbouring Indonesia flocked in to share in and contribute to the wealth of the country, and eventually a substantial number decided to settle here permanently. There is thus a juxtaposition of agricultural smallholdings, mining areas, and large plantations, and an admixture of Malays (including immigrant Indonesians), Chinese and Indians settled in a continuous belt of high density along the entire length of western Malaya.

A large proportion of the immigrant population live in towns distributed along this western belt. In 1957 sixty-two of the eighty-four urban centres with a population of over 5,000 each were located here. Altogether there were 1,674,860 people in these sixty-two towns, or 85 per cent of the total urban population of the whole of Malaya. Only three—Kota Bharu, Kuala Trengganu and Kuantan—of the twenty-one towns in Malaya with more than 20,000 inhabitants were situated outside the western belt.

Within the belt of dense settlement are found four main areas of exceptionally high population densities, ranging from 300 to 1,500 persons per square mile (Fig. 28). The first of these includes the districts of Kota Star, Yen and Kuala Muda in Kedah, the entire State of Penang and Province Wellesley and the district of Krian in Perak. Together they make up a continuous belt of thickly peopled country along the north-west coast of the Peninsula. This is a zone of intensive fishing and agricultural activities based on the cultivation of padi, rubber and coconut, and also of trade centred round the port of Penang. The area has experienced a long history of settlement and development. Here, too, is located the second largest town in Malaya, the city of Georgetown which had a population of 234,930 in 1957.

The second area of exceptionally high population densities is the Kinta Valley, lying between two granite ranges—the Kledang Range on the west and part of the Main Range on the east—and since the 1880s associated with the most intensive mining activities. It is still the premier tin-mining region of Malaya, but over the years most of the richest deposits have been worked out. Cash crop cultivation has also become important in the Valley, and there are nearly a hundred thousand acres of rubber occupying non-stanniferous land. The early development of Kinta was characterized by a mushroom growth of mining camps, some of which disappeared but others of which persisted and later grew into permanent towns. One—Ipoh—has grown to become the third largest town in Malaya with a population of 125,776 in 1957.

The third area is the Klang Valley, made up of the districts of Kuala Lumpur and Klang (Fig. 28). The population of this area of 746 square miles was 627,202 in 1957, giving an average density of 841 persons per square mile. The Valley is a region of important agricultural uses of land, mining activities, trade and urban functions. The modern development of the Valley was first associated with the discovery of rich tin deposits at about the same time as the discovery of similar deposits in the Kinta Valley. Klang, and later Port

Swettenham, served as ports and points of entry to the region. Kuala Lumpur grew in a similar way as Ipoh from a small mining village to a major town. When rubber was introduced into Malaya some of the pioneer plantations were established on the old coffee estates in this Valley. From these varied beginnings the economic base has expanded rapidly with the development of the tin and rubber industries, and the expansion of the port functions of Port Swettenham as one of the two major ports of the Federation. Kuala Lumpur, lying midway along the western belt and the focal point of land and air routes, has become not only the administrative heart of the country as the Federal capital, but has also become an important industrial centre. Within the Valley is located the biggest town in Malaya—Kuala Lumpur, with a population of 316,230 in 1957, as well as the fourth biggest town—Klang, which had a population of 75,649 in 1957.

The fourth densely populated area is Malacca or, more correctly, the two districts of Alor Gajah and Malacca Central, including the town of Malacca. This is an old settled region with a long history of trade and agricultural development. The trading activities of the port of Malacca have, however, declined considerably in recent years and are no longer of much significance. The economic foundations of the area rest mainly on cash-cropping based on the cultivation of fruit and coconut in smallholdings and rubber in smallholdings as well as estates. Padi is also grown here as a subsistence crop. Malacca, the sixth largest town in Malaya, had 69,851 inhabitants in 1957.

Historically, economically and culturally associated with the western belt of Malaya, but now politically separate from it, is the Republic of Singapore. Singapore is another very densely populated area with an overall density of 6,441 persons per square mile in 1957. The economic base of the island rests on its activities as an entrepôt port for Malaya and other parts of South-East Asia, and to a small but increasingly important extent, as an industrial and manufacturing centre. Sixty-three per cent of the total population of 1,445,930 lived within the City limits in 1957.

The North-eastern Belt of High Densities. This second belt of high densities is composed of two major nuclei of population centred around the Kelantan and Trengganu deltas and separated by the relatively sparsely peopled district of Besut (Fig. 28). Twelve per cent of the total population of Malaya were distributed in these two nuclei (Table 16).

Both the plains of Kelantan and Kuala Trengganu are fishing and agricultural areas with an overwhelmingly Malay population. They are among the earliest settled areas of Malaya. Isolated from the rest of Malaya by the forbidding barrier of the Main Range and the Trengganu Highlands, the north-eastern belt has remained very much an area of agricultural smallholdings and fishing villages. Except for the urban centres of Kota Bharu and Kuala Trengganu, the landscape of human occupation bears little evidence of the impact of the modern

TABLE 16. *Area and Number of People within the North-eastern Belt, 1957*

STATE	Area (sq. miles)	Number of People
Kelantan (districts of Tumpat, Pasir Mas, Kota Bharu, Machang, Bachok, Pasir Puteh and municipality of Kota Bharu only)	918	438,894
Trengganu (district of Kuala Trengganu only)	501	124,428
TOTAL	1,419	563,322

economy and of the immigrant peoples which has completely altered the face of western Malaya. Padi cultivation still remains the customary occupation inextricably bound up with the Malay farmers' whole way of life. Rubber, that staple of the modern economy, is here a subsidiary crop to padi. There was no sudden rush to plant the crop as happened in many parts of western Malaya, but rather an unobtrusive introduction of the tree into the traditional kampong landscape without upsetting the normal pattern of life.

Within the north-eastern belt is one area with exceptionally high population densities. This is the lower part of the Kelantan delta where rural densities are among the highest in Malaya: 729 persons per square mile in Kota Bharu (excluding the municipality) and 935 persons per square mile in Tumpat in 1957. The high densities in this low-lying coastal plain are mainly a result of natural increase and owe little to immigrational additions except in Kota Bharu town.

The town itself had 38,106 inhabitants in 1957, of which 25,306 were Malays and the rest immigrant Chinese and Indians. The town of Kuala Trengganu had a population of 22,805 Malays out of a total population of 29,466 in 1957.

The Central Uplands and Eastern Areas of Low Densities. The western belt of high densities is bordered on the eastern, interior side by a number of discontiguous districts with densities of between 50 and 100 persons per square mile (Fig. 28). These are, in point of fact, part of the western belt in that they have all the characteristic features of the belt, but because development has been less intensive and population densities relatively lower, they remain outside the boundaries of the belt.

Elsewhere densities vary from nothing over large parts of the mountainous core to 50 per square mile in the coastal districts of Pahang and east Johore. The uplands of the Peninsula are negative areas except in the hill resorts of Cameron Highlands, Fraser's Hill and Maxwell's Hill. Agricultural development in Malaya has remained below the 1,000 foot contour line, while tin-mining has also been focused on the recovery of the alluvial and detrital deposits of the valleys and foothills. The exploitation of timber resources has again been confined to forested land below 1,000 feet. The only people who inhabit the uplands in any number are the aboriginal groups of hunters and gatherers and shifting cultivators, and roving bands of Communist terrorists whose number is estimated to be less than 2,500. Thus there is a close correlation between the districts of less than 25 persons per square mile and the forested uplands of the Peninsula (compare Fig. 3 with Fig. 28).

Another band of exceptionally low densities is that made up of the districts of Pekan and Mersing (Fig. 28), comprising the coastal plains of the lower Pahang, Rompin and Endau Rivers. Much of this area is covered with freshwater peat swamps which so far have not been put to productive use. The swamplands of the Pahang delta are also infested with the mosquito vectors of filariasis, a crippling disease whose characteristic manifestation in the later stages is a grotesque swelling of the lower limbs. Settlements in this area are few and far between, and are confined to Malay fishing villages along the coast, a few riverine kampong and some tin-mining settlements in Mersing. There were only 68,629 people spread over a total area of 4,778 square miles in 1957, and only one small town, Mersing, which had a population of 7,229. However, it is likely that the region will become more densely peopled when the extensive iron-ore resources in the Rompin riverine area are fully developed.

The rest of eastern Malaya has densities of between 25 to 50 persons per square mile. This includes the coastal districts of Dungun and Kemaman in Trengganu, the adjoining district of Kuantan in Pahang, and the district of Kota Tinggi in Johore (Fig. 28). The important iron mine of Bukit Besi is located in Dungun, the only lode tin mine in Sungei Lembing in Kuantan, and the major bauxite mine of Telok Ramunia in Kota Tinggi district. Kuantan town, with a population of 23,034, is also a minor port and is linked to the western belt by the main east–west trunk road as well as by air. Settlements are generally located on coastal and riverine sites, consisting in the main of small fishing villages and riverine agricultural smallholdings.

The Urban Population and Urbanization. Urbanization may be defined as a process of population concentration in towns and cities, that is, in urban areas. The term 'urban' may be defined on the basis of one or more criteria—size, function, demographic density as well as legal, administrative, economic and social criteria. The most widely used is that of size, and in the majority of countries, including Malaya, a population cluster with well-defined boundaries and containing more than a certain number of people is classified as an urban centre. Such a definition, although convenient and easily applied for census purposes, suffers from the fact that the line between 'urban' and 'rural' must of necessity be drawn arbitrarily, since there is no clear-cut dichotomy between town and country but rather a continuum made up of population clusters ranging in size from the smallest to the largest. There is no point in this continuum at which 'rural' ends and 'urban' begins, so that any line dividing such a graduated distribution must be an arbitrary one. Thus in India the minimum population requirement is 5,000, in the United States 2,500, and in the United Kingdom 3,500.

In Malaya the dividing line between urban and rural was set at 1,000 in the 1947 census, and increased to 2,000 in the 1957 census. Two thousand is still too small a statistical criterion to define an urban centre in Malaya today for a number of reasons. In the first place there is a large number of settlements of 2,000 and over, which are no more than overgrown villages without any of the cultural, commercial, industrial and administrative activities which are associated with distinctively urban functions. Secondly, the 2,000 minimum population requirement would mean that a good proportion of the New Villages that have sprung up as a result of the resettlement campaign of 1950–52[1] would be classed as urban centres, when in fact they are artificial groupings of squatters without any of the functional characteristics of towns. On the other hand, however, lack of data makes the substitution of the statistical criterion for a functional one an impracticable proposition.

A compromise solution would be to raise the minimum population requirement to a higher figure so as to avoid as far as possible the inclusion of villages and New Villages within the urban category. A minimum of 5,000 is therefore chosen as the dividing line between urban and rural settlements. A rough check on whether this higher figure would provide a more realistic picture of the degree of urbanization in Malaya can be made by comparing the percentage of the total working force engaged in secondary and tertiary industries with the percentage of the total population living in settlements of 5,000 and over. A correlation between the two percentages will mean that the statistical criterion adopted for defining 'urban' is a fairly realistic one since one of the chief characteristic features distinguishing urban from rural areas is an occupational structure oriented to non-primary industries, that is, to secondary and tertiary industries. Primary industries are defined here as including agriculture, mining, fishing and forestry; secondary industries include manufacture, building and construction, and tertiary industries include commerce and finance, transport, storage, communication, and professional, personal, defence, gas, water, electricity, sanitary and other services. The natural and usual location of the manufacturing and especially the service industries is in towns and cities, just as the natural *locale* of primary production is in the countryside and rural areas. The 1957 census shows that 31·3 per cent of the total population of Malaya lived in settlements of 5,000 persons and over, and that 37 per cent of the gainfully employed population were engaged in the secondary and tertiary industries. Allowing for the distribution of a small percentage of the working population engaged in these industries (particularly in the processing of primary produce, in retail trading and in the cottage industries) in the rural and suburban areas, the relationship between the proportion in the urban settlements and the proportion engaged in the secondary and

[1] See below, p. 151.

tertiary industries is sufficiently close to justify the use of the 5,000 minimum population requirement.

Using the 5,000 statistical criterion as the basis for defining 'urban', the 1957 census enumerated eighty-four urban centres with a total population of 1,977,180, amounting to 31·3 per cent of the total population of Malaya. A total of 912,344 people or 63·1 per cent of the total population lived within the city limits of Singapore in the same year. The urban population of the Federation is distributed as follows:

TABLE 17. *Distribution of the Urban Population, Malaya, 1957*

STATE	Total Population	Number of Urban Centres	Total Urban Population	Percentage of Urban to Total Population
Penang and Prov. Wellesley	572,132	6	336,026	59
Selangor	1,012,891	16	505,038	50
Perak	1,221,390	25	407,552	33
Johore	927,565	13	263,899	28
Pahang	312,949	6	84,883	27
Malacca	291,246	1	69,851	24
Negri Sembilan	364,331	3	69,443	19
Trengganu	278,165	3	52,834	19
Kelantan	505,585	6	82,935	16
Kedah	701,643	4	98,654	14
Perlis	90,866	1	6,065	7
MALAYA	6,278,763	84	1,977,180	31

For a primarily agricultural country, Malaya exhibits a high degree of urbanization. The urban proportion would be considerably higher if the 2,000 statistical criterion is adopted, amounting to 2,441,676 people or 39 per cent of the total population in 1957. In point of fact, the degree of urbanization is greater than the census figures would suggest because the large number of people living in the suburban areas outside the municipal limits were not included in the town population during the process of census-taking.

The inter-censal years 1947–57 saw a tremendous growth of the urban population. Whereas there was, in 1947, a total of 1,037,637 people (amounting to 21 per cent of the total population) living in thirty-seven urban centres of 5,000 and over, the 1957 census shows that the number of urban centres has more than doubled and the urban population was nearly double that of 1947. Thus while the total population of Malaya increased by 28 per cent over the ten years, the urban population increased by as much as 90·5 per cent. Such an increase was not due to immigrants flocking to the towns as in the earlier years of the century, but rather due to a high rate of natural increase (medical facilities, as in most other tropical countries, are better in the towns) as well as the migration of rural peoples to the urban centres. One of the major reasons for the drift to the towns was the Communist uprising of 1948–60, popularly known as the 'Emergency', which made the towns safer places to live in than the outlying areas, and in particular the resettlement campaign which brought a good proportion of the suburban population into the town boundaries and directly resulted in the formation of fifteen New Villages which had populations of over 5,000. Many of the rural Malay recruits to the security forces decided to stay on in the towns after being demobilized, thus swelling the urban population. The trend in urbanization is not only peculiar to Malaya. Most of the Asian countries are experiencing a period of accelerating urban growth comparable to that of Malaya though at a less rapid pace.[1]

Table 17 shows that 76 per cent of the total urban population lived in the four states with the highest proportion of urban residents to total population—Penang and Province Wellesley, Selangor, Perak and Johore. In these states, too, were located sixty of the eighty-four urban centres of Malaya. Penang and Singapore have the two largest towns in the Peninsula; both are entrepôt ports and both exhibit a similar degree of concentration of people within the urban limits, 63 per cent of the total population in the case of Singapore and 59 per cent in Penang. Two other States have high urban percentages, Pahang with 27 per cent and Malacca 24 per cent. The high degree of urbanization of Pahang is due to its small population in relation to its size, and the inclusion of two mining settlements, Raub and Sungei Lembing, with populations of 15,370 and 6,535 respectively, which has helped to swell the urban popula-

[1] See *Urbanization in Asia and the Far East*, Proceedings of the Joint UN/UNESCO Seminar, Bangkok, Aug. 1956 (Calcutta, 1957), Chap. IV.

tion. The low degree of urbanization of the predominantly Malay States of the north-east (Kelantan and Trengganu) and the north-west (Perlis and Kedah) indicates clearly the agricultural nature

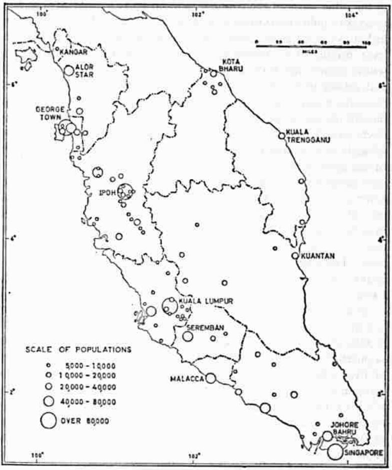


FIG. 29. Towns with a population of 5,000 and over, 1957

of their economy and the essentially rural character of their population.

Figure 29 shows distribution of the eighty-four urban centres of Malaya. Sixty-two of them containing 85 per cent of the total urban population fall within the western belt of high population densities, demonstrating the fact that as in many of the Asian countries, urban development is a product of colonial rather than indigenous organization. The growth of towns in the western belt, or for that matter in the other parts of the country, is in no sense associated with any process of industrialization as in Western countries. Industrialization in Malaya is still in its infancy. Rather, the towns of western Malaya have originated as commercial, trading and distributing centres whose growth has been largely influenced by the success of the tin and rubber industries. The establishment of this important export economy meant that an increasing number of people was needed to handle the transport, financing and distribution of the export products as well as the essential imports. The overwhelming majority of such people were immigrants, both European and Asian. Thus of the total urban population in Malaya in 1957, only 21 per cent was composed of Malays; the rest were immigrants (63 per cent Chinese, 12 per cent Indians, and the remainder Europeans and others). Of the eighty-four urban centres, only ten had a Malay majority, including all six in Kelantan, all three in Trengganu and the remaining one in Kedah. With the exception of Kota Bharu and Kuala Trengganu, all these Malay towns had populations of less than 20,000 each. All the other urban centres had immigrant, mainly Chinese, majorities.

Of the eighty-four urban centres in the Federation, forty-six had a population of between 5,000–10,000, seventeen a population of 10,000–20,000, ten a population of between 20,000–40,000, eight a population of 40,000–80,000 and the remaining three a population of over 100,000. The three largest towns of Malaya were Kuala Lumpur (pop. 316,230), Georgetown (pop. 234,930) and Ipoh (pop. 125,776). Together these three accounted for slightly more than one-third (34·3 per cent) of the total urban population of Malaya. Most of the urban population continues to be concentrated in towns of 20,000 people and over—82 per cent in 1947 and 80 per cent in 1957. The largest town in the Peninsula is the City of Singapore, which returned a population of 912,344 in the last census.

As has been seen, the rate of urbanization in the inter-censal years has been markedly rapid. In fact, urbanization has proceeded more rapidly than economic circumstances warranted, in the sense that economic opportunities have lagged behind urban population growth, with the result that the urban centres are faced with problems of acute unemployment, under-employment, over-crowding and housing shortage. Such problems are not confined to Malaya but are extant in many other countries of Asia where the 'push' from an overcrowded countryside and, to a lesser extent, the 'pull' exerted by urban centres have contributed to over-urbanization.

The Distribution of the Main Racial Groups: The Malays. The term 'Malays' is used here to cover the aborigines, the indigenous Malays as well as the immigrants from Java, Sumatra and other parts of Indonesia. The distribution of the aboriginal groups has been discussed earlier. The opening up of the country over the last century or so has not materially affected the distribution of the aborigines whose natural habitat is the remote forested interior which has remained almost totally untouched during this period. The greatest changes have occurred in the case of the Jakun who were originally found in the southern part of the Peninsula, many of them in the coastal lowlands. A number of such tribes have been absorbed into the Malay community, others pushed back into the interior and some have died out with contact with modern civilization. The rest of this section will deal with the distribution of the settled Malay (including the immigrant Malay) population.

The basic pattern of the distribution of the Malays on coastal and riverine areas in pre-colonial Malaya has been altered to varying degrees in the different States due to the movement of Malays towards interior sites and into towns. The establishment of British rule and the development of new roads and railways in the country laid the foundations not only for immigrant but also for Malay settlement in the areas thus opened up. These modern transport lines were usually laid in a direction following the grain of the country, cutting across the traditional lanes associated with the rivers. Passing, in the early days, through new territory, the roads and railways quickly attracted new settlement. Land was cleared on either side and cultivated with rubber and other cash crops, by the immigrant population as well as by the Malays, particularly the recent arrivals from Indonesia. Sir Frank Swettenham states that with '. . . the opening of the country . . . the opportunity was quickly seized of putting up small native houses in the middle of a few acres of good land, on the side of a track which was almost certain to become a great highway. Malays, Chinese, and Indians, but especially Malays, were thus induced to take a large interest in the earlier stages of development. A bridle road was no sooner completed than small houses, plantations, and fruit and vegetable gardens sprang up along its whole length.'[1]

Such ribbon settlements were but repetitions of the usual form of Malay settlements, except that instead of being along the coast or river banks, they now followed the line of the roads and railways. This dispersal of population was a gradual one and never assumed the scale of a mass migrational wave of land occupation as in the case of the immigrant population. Nevertheless, it was considerably accelerated through the natural increase of the Malay population as death rates were lowered and birth rates remained high, and through the influx of Indonesians into Malaya. The creation of points of population pressure on land resources arising from the population increase and local saturation of the land carrying capacity, led in turn to a flow of Malays to areas of lower economic pressure inland from the coast. In addition to this 'push' exerted by population pressure was the 'pull' exerted by the new economy, in particular the attractions of rubber cultivation. Rubber planting quickly found favour among a great many Malays because it involved little labour apart from the initial effort of clearing the land and planting the seedlings. Production techniques were simple and the capital outlay in establishing a smallholding modest. Best of all, the Malay farmer discovered that in times of good prices a few acres of rubber could supply him with the cash needed to provide a standard of living which was higher than could be obtained from padi growing, and with less physical effort. Rubber grows best on well-drained soils, and since such soils are most extensively distributed in the undulating foothill region bordering the western mountain ranges and in the rolling country of central Johore, the rubber-growing Malays moved away from their traditional coastal habitat towards the interior.[2]

The movement into the interior also occurred along the rivers. River or levee settlements in the pre-colonial days rarely penetrated far inland but with the growth of population and the establishment of peaceful conditions there has been a gradual advance up-river. This advance is more noticeable in the eastern States, along the Sungei Pahang, the Sungei Kelantan and the Sungei Trengganu as

[1] SIR FRANK SWETTENHAM, *British Malaya, An Account of the Origin and Progress of British Influence in Malaya* (London, 1948), p. 238.

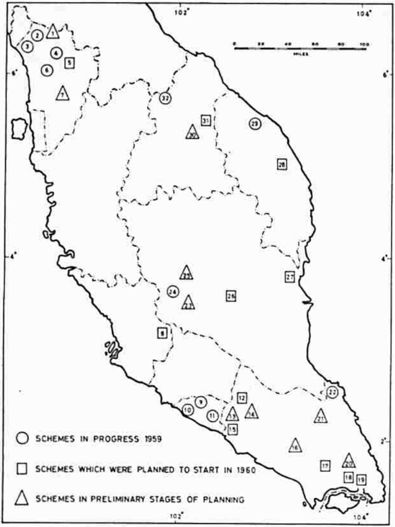
[2] The term 'interior' is used here in the sense of 'inland from the coast' and does not mean the mountainous forested interior.

well as along the lesser rivers. Malay settlements also stretch along most of the length of the Perak River. In many places on the west, however, riverine sites have been rendered valueless by excessive silting of the rivers due to the indiscriminate discharge of tin tailings and to erosion from agricultural clearings.

Not only has there been a spread of Malay ribbon settlements towards the interior, but at the same time there has been a perceptible movement of Malays on a broad front inland from their traditional coastal locations, this movement being conditioned by the character of the soil and the surface relief in different parts of the Peninsula. Over the last half-century Malay settlements, once confined to the coastal strip between the seas and the inland swamps on both sides of the Peninsula, have advanced landwards into the swamps as pressure of population on available padi-land increased. This advance has been considerably facilitated by government assistance in swamp clearing, drainage and irrigation, especially on the west where large padi areas have been reclaimed from freshwater swampland. Notable among these reclamation schemes are the Krian, the Sungei Manik, the Tanjong Karang, the Kubang Pasu and the Besut Padi Irrigation Areas.

Similar in concept to the planned settlement of Malays in these pre-war Irrigation Areas is the settlement of Federal citizens, mainly Malays, on agricultural land in both coastal and interior sites which is at present taking place under the direction of the Federal Land Development Authority (Fig. 30 and Plate 8). Each settler is given six to seven acres of land for rubber or other cash crops, two to three acres for orchards, about two acres for padi, and a quarter acre of house lot. When fully completed these schemes will result in the settlement of at least 32,000 people, the majority of whom will be Malays, in areas which until recently were sparsely populated. It is possible that the pattern of population distribution of the Malays will be further modified in the future by such planned settlement projects.

In a manner similar to the landward movement along a broad front from the coasts is the expansion of ribbon settlements outwards on both sides of the river banks, roads and railways where these passed through swampland suitable for wet-padi cultivation or through dryland sites suitable for rubber. In a hill and valley environment as exemplified in Negri Sembilan, the spread of population from the valley bottom has not only been outwards but has also



Scheme	*Eventual Size (acres)*	*Scheme*	*Eventual Size (acres)*	*Scheme*	*Eventual Size (acres)*
1 Sintok	4,400	12 Paya Lebar	2,400	23 Lower Kelau	12,000
2 Batu Lapan	1,000	13 Hang Tuah	1,000	24 Bilut Valley	12,600
3 Guar Napai	1,500	14 Bukit Serampang	6,400	25 Upper Kelau	14,000
4 Bukit Tembaga	1,500	15 Parit Haji Idris	322	26 Maran Road	5,500
5 Naka Nami Road	7,600	16 Ayer Hitam	4,000	27 Bukit Goh	10,000
6 Sungei Tiang	4,800	17 Kulai	2,600	28 Jerangau	10,000
7 Teloi Kanan	10,000	18 Sungei Tiram	550	29 Chalok	4,200
8 Sungei Tekali	1,500	19 Kong Kong	3,800	30 Sungei Temiang	4,000
9 Solok Menggong	1,100	20 Sungei Telor	2,500	31 Batu Mengke-bang	5,000
10 Machap	1,500	21 Kahang	1,800	32 Ayer Lanas	4,200
11 Kemendore	4,200	22 Endau	2,500		

FIG. 30. Land settlement schemes of the Federal Land Development Authority, 1959

occurred in an upward direction along the valley sides. The extent of population dispersion here is therefore restricted and depends on the breadth of the valley floor and the steepness of the valley slopes. There is no indigenous terrace cultivation on hill slopes as in Java and the Philippines.

In a coastal alluvial plain environment, all the large rivers have in the course of time built up levees along both banks. The usual site for a Malay settlement is on the levees away from flood risk. The spread of population has in this case been towards and into the swampland on either side. In contrast to the hill and valley regions where the outward movement has been up-slope, here it has occurred downslope along the outside flanks of the levees and on to the flat land below.

In addition to the gradual spread of Malays inland from their traditional coastal habitat, there has been a small but significant flow of Malays to the urban centres. Although the Malays are still primarily a rural people, a number of forces have worked over the years, especially at the present period, to draw them away from the countryside to the towns. The basic cause has been the rapid growth of the Malay population due to both natural increase and the influx of Indonesians. In many localities the increase in population numbers has not been followed by a corresponding increase in economic opportunities, with the result that the excess people had to look elsewhere for work. Most of them moved inland as described earlier, to new farmland. Others became wage-earners in the estates and mines. A small proportion migrated to the towns. Included among these were some of the immigrant Indonesians who also settled in the urban areas. A number of Malays were already in nucleated settlements such as Klang, Kota Bharu and Dungun, before these grew into towns, so that the Malays in these towns represent part of the original population. In addition, there has been in recent years a general 'drift to the towns' on the part of the rural Malays. This drift to the towns is caused not so much by the economic factors of population pressure and lack of work in the countryside as by a general dissatisfaction with rural life coupled with a desire to live in the town, and enjoy the superficial pleasures of urban life. The basic cause is therefore sociological, but the economic implications are serious. On the one hand, the rural community is deprived of many of its able-bodied people with consequent adverse effects on production and, on the other, the uncontrolled addition to the urban population of such rural people leads to unemployment and under-employment in the towns as the number of people begins to outstrip the available economic opportunities.

The above discussion serves as an introductory background to the present-day pattern of the distribution of the Malay population in Malaya. The distribution of the Malays on a State basis is indicated in Table 18.

There are five States with a distinct Malay majority ranging from 57 to 92 per cent of the total population of the States. Altogether

TABLE 18. *Distribution of the Malay Population by States, 1957*

STATE	Number of Malays	Percentage of Total Population
Trengganu	256,349	92
Kelantan	463,292	91
Perlis	71,268	78
Kedah	475,747	68
Pahang	179,113	57
Malacca	143,252	49
Johore	444,907	48
Negri Sembilan	151,426	41
Perak	484,878	39
Penang & Prov. Wellesley	165,081	29
Selangor	291,393	28
MALAYA	3,126,706	49·8

the Malays in these five States make up 46 per cent of the total Malay population of Malaya. It is clear that the Malays tend to concentrate in the areas least affected by the money economy introduced during the colonial era, namely, in the north-east (Kelantan and Trengganu), the north-west (Perlis and Kedah) and the eastern State of Pahang. In the three contiguous States of Negri Sembilan, Malacca and Johore are found significant numbers of Malays—over 40 but under 50 per cent of the total population of these States. The low proportions of Malays in the west-central States of Penang and Province Wellesley, Perak and Selangor are a reflection of the extent of the penetration of non-indigenous economic interests and people in these areas.

The density of the Malay population on a district basis is shown in Fig. 31. There are five main areas of Malay concentration, all coastal, where densities are above 100 persons per square mile. These are: (1) the long coastal strip in the north-west running from Perlis to Krian, including parts of Kedah and the entire State of Penang and

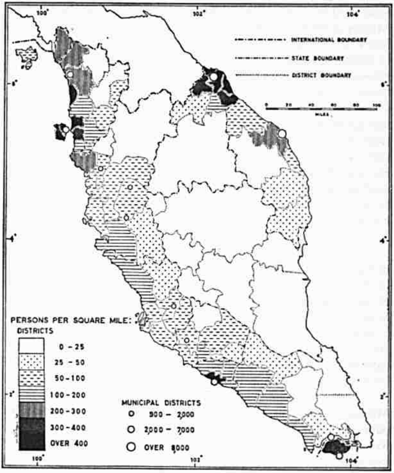


FIG. 31. Density of the Malay population, 1957

Province Wellesley; (2) the districts of Lower Perak and Kuala Selangor; (3) another long coastal strip running from the district of Rembau through Malacca State to Pontian in Johore; (4) the Kelantan delta and (5) the Trengganu delta. Within these areas of Malay concentration are four clusters where densities are very high, from

300 to 800 persons per square mile. These are the district of Yen in Kedah, the island of Penang and the northern two-thirds of Province Wellesley, the district of Malacca Central, and the Kelantan delta made up of the districts of Kota Bharu, Tumpat, Bachok, Pasir Puteh and Pasir Mas. The highest Malay densities in the whole of Malaya are those of the districts of Tumpat (818 per square mile) and Kota Bharu (709).

Adjoining the five main areas of Malay concentration are areas of moderate densities—from 25 to 100 persons per square mile. These include the gaps between the three main areas of high densities along the western littoral, as well as the other coastal areas of Trengganu and the interior district of Tanah Merah in Kelantan (Fig. 31). All the other parts of the country, including the mountainous interior and the eastern coastal districts of Pahang and Johore, are sparsely populated. Malay settlements here are scattered and confined to the more favourable locations—along the coasts in fishing villages, along the banks and levees of rivers as riverine kampong, in small interior valleys, and in the more accessible regions along roads and railway lines.

The Malays are predominantly a rural people. In 1957 87 per cent of the total Malay population lived in the countryside and in villages of less than 5,000 people. The essentially rural character of the Malays is also reflected in their occupational pattern. Of the 998,400 economically active Malays in 1957, 759,600 or 76 per cent were employed in the primary industries of agriculture, fishing, mining and forestry. Of these 759,600 Malays, half were engaged in padi cultivation, one-third in rubber cultivation, and the remainder in the other forms of agriculture, and in fishing, mining and forestry. Since the overwhelming majority of the padi growers of Malaya are Malays there is thus a close correlation between the distribution of padi (Fig. 55) and areas of high Malay densities (Fig. 31) except in western Johore where padi growing is unimportant. In areas where the Malays form a small proportion of the total population, mainly along parts of western Malaya, they are again distributed in the rural districts while the immigrant peoples are found largely in the towns.

Although the Malays are not urban dwellers an increasing number of them are beginning to move to the towns, as noted earlier. Thus in 1947 only 198,704 Malays forming 8 per cent of the total Malay population lived in towns with a population of 5,000 and over. By

1957 the number of urban Malays had increased to 422,225, comprising 13 per cent of the total Malay population. Of the eighty-four urban centres in Malaya, only ten had a Malay majority in 1957. These include all six towns in Kelantan, all three in Trengganu and the town of Guar Chempedak in Kedah. Elsewhere, even in areas that are predominantly Malay, the Malay proportion of the urban population is less than half, and one town, Kampong Koh in Perak, had no Malays at all in 1957. Of the twenty-one major towns of Malaya with populations of at least 20,000 each, only two had a Malay majority (Table 19). Both of these are in the traditional Malay areas of north-eastern Malaya.

The Chinese. The reason for Chinese immigration to Malaya was the desire to better their economic status. Thus from the start they have not concerned themselves with subsistence agriculture, which was the basis of their livelihood in China, but have been involved with all types of occupations which brought in monetary rewards—initially with tin-mining, trade and commerce, and later with cash-crop agriculture, and with occupations in the secondary and tertiary industries.

There is a close correlation between the occupational structure of the Chinese and their distribution. In 1957 there were 749,700 economically active Chinese, 46·7 per cent of whom were engaged in the primary industries, 17·4 per cent in the secondary industries, and the remaining 35·9 per cent in the tertiary industries. More than half (53·3 per cent) of the gainfully employed Chinese were engaged in the secondary and tertiary sectors of the Malayan economy. In comparison, less than a quarter of the gainfully employed Malays were engaged in the non-primary occupations. The Chinese provided nearly two-thirds of the labour force employed in the secondary industries—in the manufacture and repair of footwear, furniture, wearing apparel and textile, and in the running of motor garages, repair shops, foundries, sawmills and joinery works, as well as in building and construction. Most of the Chinese employed in the tertiary industries were engaged in retail trade, personal services of a domestic nature, transport, and education and health services. Both secondary production and tertiary activities are most advantageous in or about industrial centres and densely populated areas, for the consumers of manufactured products as well as the mass of specialized servicing are usually urban or suburban people. Towns are the natural loci of these industries. There is, in fact, a remarkable coincidence between the percentage (53·3) of the gainfully employed Chinese engaged in these typically urban occupations and the percentage (53·2) of the total Chinese population living in towns in 1957.

TABLE 19. *The Racial Composition of the Major Towns of Malaya, 1957*

Town	Number of Persons	Percentage			
		Chinese	Malays	Indians	Others
Kuala Lumpur	316,230	62	15	17	6
Georgetown	234,930	73	11	13	9
Ipoh	125,776	67	16	13	4
Klang	75,649	61	16	19	4
Johore Bahru	75,080	44	38	9	9
Malacca	69,851	73	13	7	7
Alor Star	52,929	48	38	11	3
Seremban	52,020	66	12	15	7
Taiping	48,183	59	19	18	4
Butterworth	42,506	51	24	22	3
Bandar Penggaram (Batu Pahat)	40,016	66	23	5	6
Bandar Maharani (Muar)	39,050	64	29	5	2
Kota Bharu	38,096	29	67	3	1
Telok Anson	37,040	63	19	16	2
Kluang	31,183	65	23	8	4
Kuala Trengganu	29,436	19	77	3	1
Bukit Mertajam	24,658	77	10	12	1
Kampar	24,611	84	6	9	1
Kuantan	23,122	55	35	7	3
Sungei Patani	22,886	58	27	15	0
Ayer Itam	22,369	82	8	9	1

The other 46·7 per cent (350,377 persons) of the gainfully employed Chinese were engaged in primary production. Here again the occupational structure of the Chinese differs from that of the Malays, which in turn results in a different distributional pattern of population. Whereas half of the Malays engaged in the primary industries were padi growers, only 2·7 per cent of the Chinese in this sector of the economy cultivated padi. This disinterest on the part of the Chinese in padi planting is simply due to the fact that it is the most unremunerative of all agricultural occupations in Malaya. Their interests are directed to growing the better-paying crops, especially rubber. Thus 57 per cent of the Chinese in primary production were employed in the rubber industry, and nearly 17 per cent in mixed agriculture, mainly market-gardening. A further 10 per cent were employed in the tin-mining industry. Most of the rubber areas, nearly all the tin-fields and the Chinese market-gardens are located along the western belt of high population densities. It is along here, too, that most of the rural Chinese are found.

The distribution pattern of the rural Chinese was altered during the inter-censal period as a result of the resettlement campaign when some 450,000 Chinese squatters—market-gardeners, rubber smallholders and shopkeepers in the rural areas—were resettled in New Villages (Plate 9). The 'squatter problem' had its origin during the Great Depression when many of the unemployed Chinese turned to growing food, cultivating their plots on the fringes of estates, mining areas, on Government and State land, on Malay Reservations and Forest Reserves. None of them had a title to the land they occupied. There was a return flow of these squatters to the towns when trade revived. But a further, and greater, exodus from the towns, mines, estates and other places of employment took place during the Japanese occupation of 1942–45, when thousands of Chinese 'returned to the land' to grow their own food, or to escape from Japanese surveillance, or both. Many of them remained on their farms even after the war was over. These squatters, as well as the Chinese rubber smallholders, were a source of help to the Communist guerillas during the Emergency. Part of the Government campaign against the guerillas included the elimination of this source of help to the Communist war effort. The rural Chinese, as well as some Indians and Malays, were therefore resettled in New Villages located along main roads for easy access to reinforcements in case of attack, and fenced-in for added protection. In all, 580,000 rural dwellers were resettled in 536 New Villages distributed largely along the western belt. The once dispersed Chinese rural population has now been withdrawn into these planned villages, most of which still remain today. The result of resettlement has been to produce a nucleated Chinese rural population pattern instead of the previously dispersed one (Fig. 32). The overall distribution of the rural Chinese, however, remains substantially the same, that is, within the western belt.

Table 20 shows present-day distribution of the Chinese population on a State basis. The Chinese form the majority in only one State—Penang and Province Wellesley—but in five other States, all in western Malaya, they make up over 40 per cent but under 50 per cent of the total State population. The concentration of the Chinese in the more developed western States is evident. In contrast the proportions of Chinese in the north-western States of Kedah and

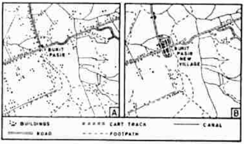


FIG. 32. Chinese rural settlement pattern in a rubber growing area, Muar, Johore (A) before resettlement, and (B) after resettlement

TABLE 20. *Distribution of the Chinese Population, by States, 1957*

STATE	Number of Chinese	Percentage of Total Population
Penang and Province Wellesley	327,287	57
Selangor	488,634	48
Perak	539,368	44
Johore	392,425	42
Malacca	120,690	42
Negri Sembilan	149,911	41
Pahang	108,140	34
Kedah	143,833	20·5
Perlis	15,763	17
Trengganu	18,069	7
Kelantan	28,816	6
MALAYA	2,332,936	37

Perlis and the north-eastern States of Kelantan and Trengganu are small, a reflection of the disinterest of the Chinese in padi cultivation, the main economic occupation in these areas. Pahang occupies

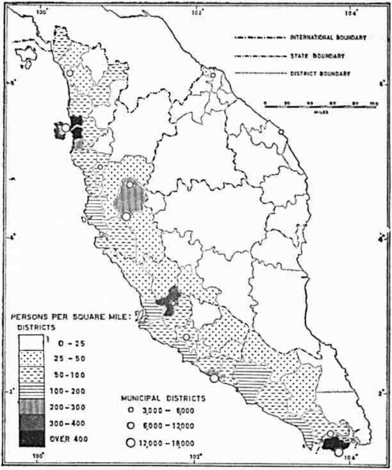


FIG. 33. Density of the Chinese population, 1957

an intermediate position, with the Chinese comprising one-third of the State population, and engaged mainly in rubber cultivation, mining, trade and retail shopkeeping.

Figure 33 illustrates the density of the Chinese on a district basis.

The extreme localization of the Chinese along the western belt is clearly revealed. Except for the small district of Tumpat, population densities in the rest of Malaya are very low—less than 25 Chinese per square mile. Within the western belt are three main areas of Chinese concentration where densities are over 200 per square mile. These are: (1) the entire area of the State of Penang and Province Wellesley which from early days have been a focal point for Chinese settlement; (2) the Kinta Valley with its large Chinese population engaged in tin-mining and, to a lesser extent, rubber cultivation; and (3) the district of Kuala Lumpur which forms part of the Klang Valley, again with an economy based on tin and rubber. A fourth area of Chinese concentration is the Republic of Singapore.

Elsewhere along the western belt rural densities vary from 25 to 200 persons per square mile, with five districts of higher densities (100 to 200) located at discontinuous points along the coast—the Dindings, Klang, Port Dickson, Muar and Pontian. Trade and commerce, agriculture and fishing are the main economic interests of the Chinese here. The rural Chinese are not spread widely over the area of the western belt, but are localized in small nucleations in the rubber and tin-mining districts, in fishing villages along the coasts, in a great number of villages with a population of less than 5,000, and in New Villages strung out along the main roads.

The Chinese form the bulk of the urban population. In 1957 63 per cent of the total urban population of Malaya were Chinese. The numbers as well as the proportions of the Chinese living in the towns have increased over the decade between the last two censuses. In 1947 there were 655,991 Chinese urban dwellers, amounting to 35 per cent of the total Chinese population. By 1957 the number of Chinese urban dwellers was almost doubled, being 1,250,903 or 53 per cent of the total Chinese population. The Chinese formed half or more of the population of seventy of the eighty-four towns in Malaya in 1957. Of the twenty-one major towns with a population of over 20,000, seventeen have a Chinese majority (Table 19). The concentration of the Chinese in the three main towns of Malaya is very striking. Kuala Lumpur, Georgetown and Ipoh together contain 54 per cent of the urban Chinese and 29 per cent of all the Chinese in Malaya. In comparison, 65 per cent of the Chinese in Singapore live within the City limits.

The Indians. The distribution pattern of the Indian population is similar to that of the Chinese in that the Indians are concentrated in the towns and more developed parts of the western belt. The expansion of Indian settlement in Malaya was closely linked with the rise of the plantation economy based largely on rubber. Later groups of Indians settled in the towns and smaller villages as shopkeepers, and as wage-earners in transport and in the urban services. The distribution of the Indians today is, as in the case of the other racial groups, closely related to the nature of their economic activities.

Of the 304,800 gainfully employed Indians in 1957, 59·5 per cent were engaged in the primary sector, only 7·3 per cent in the secondary sector, and 33·2 per cent in the tertiary sector of the Malayan economy. Of the 181,323 Indians in primary production, the large majority (83 per cent) were employed in the rubber industry. Only 22,398 Indians were in the secondary sector, of which more than half were labourers engaged in building and construction. One-third of the gainfully employed Indians were in the tertiary sector, mainly in retail trade (28 per cent) and engaged in the government, community, personal and other services (47 per cent).

Almost all the Indians in Malaya are found along the western belt (Fig. 34). The highest densities of Indians are in the Penang–Province Wellesley and south Kedah area. It was here that the original streams of immigrants entered Malaya and spread along the other parts of the western belt as the country was opened up for cash-crop agriculture. The other main area of Indian concentration is the Klang Valley, associated since the early days with the cultivation of rubber under the plantation system. Two-thirds of the 695,985 Indians in Malaya in 1957 lived in the rural areas, largely as labourers in the rubber, coconut and oil-palm estates. The distribution of the rural Indians is therefore closely related to the distribution of the main rubber, coconut and oil-palm areas along western Malaya, with heaviest concentrations of Indians in the Province Wellesley–south Kedah region and the coastal districts of southern Selangor around the Klang Valley. Other areas of Indian concentration are southern and central Perak and the Kinta Valley, and the rubber and oil-palm areas of Negri Sembilan, Malacca and central Johore.

Only some 12,000 Indians were moved into New Villages during the resettlement campaign. The majority of the rural Indians were in estates, and instead of being resettled in New Villages at governmental expense, were regrouped at the expense of the estate owners. Regrouping in each estate involved transferring the labourers' settlements to the protection of a defended point within the estate. Apart from the labourers' quarters, the defended area included the plantation offices, factory, smokehouse, engine rooms, etc., as well as the manager's house. Unlike the resettling of Chinese squatters, regroup-

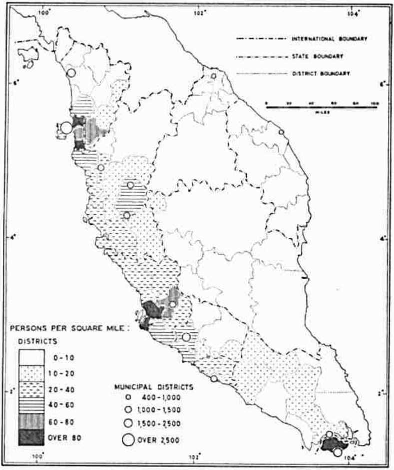


FIG. 34. Density of the Indian population, 1957

ing of Indian labourers did not result in any significant change in the distributional pattern of the rural Indian population.

One-third (34 per cent) of the total Indian population lived in urban centres in 1957. The Indians therefore occupied an intermediate position between the Chinese and the Malays in the proportion of people living in towns. The proportion of urban dwellers has increased from 28·5 per cent in 1947 to the 34 per cent recorded in 1957. A further indication of the rate of urbanization among the Indians is the increase in the number of towns with more than 5,000 Indians—from two in 1901, four in 1911, five in 1921, six in 1931, eight in 1947, to eleven in 1957.

Most of the 238,047 urban Indians live in the larger towns. In 1957 almost 90 per cent of the urban Indian population lived in towns of more than 10,000 inhabitants, 69 per cent in towns of more than 40,000 inhabitants, and 42 per cent in the three major towns of Kuala Lumpur, Georgetown and Ipoh. The Indians are numerically the smallest of the three main racial groups in Malaya, and in no town except Butterworth do they form more than one-fifth of the total urban population (Table 19). Only four towns in Malaya had an Indian population of more than 10,000 in 1957. These were Kuala Lumpur with 53,505 Indians, Georgetown 32,023, Ipoh 16,106 and Klang with 14,958 Indians.

CHAPTER 7

SETTLEMENT PATTERNS

The history of Malay settlement in the Peninsula and the other parts of the Malay Archipelago goes back many centuries, and while the forms and patterns of their settlements may vary in detail due to differences in local environmental conditions, their broad outlines remain basically similar. Thus the kampong of the Malays in Malaya and the Indonesians in their island world are similar in appearance and pattern, bearing the imprint of a people coming from the same racial stock with much the same cultural background, and living under tropical conditions. In Malaya the settlements that are distinctively Malay have been little modified by the coming of the immigrant peoples during the last century or so. This is to a large degree due to the fact that the immigrants are racially and culturally different from the Malays. They have not been assimilated into the Malay groups, but have remained separate from them, and have also settled in locations removed from the traditional areas of Malay settlement.

The settlements of the immigrant peoples, with their different cultural background, are distinct from those of the Malays. The most distinctive of these are the towns which have sprung up as a result of the economic activities of the immigrants. In the rural areas the Europeans, Chinese and Indians have also established new settlement forms in association with their agricultural and mining activities. In recent years another settlement form has been imposed on the Malayan landscape—that of the New Villages. The New Villages are an expression of a political and military decision, and the fact that they are generally associated with the rural Chinese population is because most of the people resettled happened to be Chinese and not because this settlement pattern is peculiarly Chinese. Since many of the New Villages were built in settings which are unfavourable both physically and from the economic point of view, such settlements may gradually disappear from the landscape now that the Emergency is over and their *raison d'être* no longer applies. On the other hand, many others established in suburban fringes and within the boundaries of existing towns and villages are showing signs of becoming permanent features of the landscape.

MALAY SETTLEMENTS

The Malays are characteristically a rural people, and Malay settlements predominate in the rural areas of Malaya. The unit of Malay settlements is the village or kampong, composed of a number of houses commonly strung along the sides of roads, footpaths, rivers, canals and along beaches. The houses are usually set well apart from one another, and there is little tendency for Malay kampongs to assume a compact form, except in the case of fishing villages occupying sites of limited extent, in which case the houses may be set close together and sometimes one behind the other along a short coastal front. Each individual house in an agricultural kampong is usually set in the midst of a collection of miscellaneous tree and ground crops (Plate 10). The house itself is raised on stilts with a floor and walls of wood, and a roof of *atap* (a thatch weaved from the leaves of the nipah palm). Since the original foci of Malay settlements were semi-wet locations along coast and river suitable for padi cultivation and fishing, raising the houses on stilts would provide protection against floods. However, Malay houses are also built on stilts even in locations where floods do not occur. There are other advantages in building a house above the ground apart from that of flood protection. In a hot, humid environment stilts help to keep the house free from damp by allowing air to circulate underneath the floor. They also provide protection against wild animals and snakes, especially in newly cleared areas adjacent to the jungle.

Within these general considerations Malay settlements exhibit different forms and patterns due to variations in local physical conditions and differences in the nature, and hence the *locale*, of economic activities. In general four main Malay settlement types can be easily recognized in the Malayan landscape: (1) fishing villages, (2) padi settlements, (3) settlements in a cash-cropping area, and (4) settlements in a mixed cultivation area.

Fishing Villages. Fishing has always been an integral part of the Malay economy, and Malay fishing settlements are found at irregular intervals along both the eastern and western coasts of the Peninsula. The forms which these villages take depend largely on the morphology of the coast. In eastern Malaya where the beaches are sandy and may stretch uninterruptedly for miles, fishing villages are generally linear in pattern, with the first row of houses only a few yards above the high water mark (Plate 11). In many cases the landward side of the villages for several miles inland is composed of a series of old beach ridges interspersed with freshwater swamps. The villagers may grow some padi in the depressions between the old beach ridges, but on dry land the soil is too sandy for any economic crop other than coconut (Fig. 35). The houses of the fishing kampong

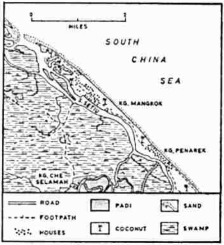


FIG. 35. Malay fishing settlements in Trengganu

are built in the shade of coconut and casuarina trees. In some cases the individual fisherman may erect a thatch windbreak in front of his house to break the force of the north-east monsoon. Some fishing settlements are located on the southern landward side of north-west–south-east trending ridges so as to obtain natural shelter from the monsoon.

Along western Malaya the coast is usually muddy and mangrove-covered so that suitable sites for settlement are difficult to find. In such circumstances the village may be located on the landward side of the mangrove fringe. Most of the Chinese fishermen of Malaya are found along this western stretch of coast, and their settlements duplicate in pattern, if not in detail, those of the Malays. Because of the muddy conditions, the Chinese houses are built on stilts, a

17. A rubber factory in Singapore. The Chinese women are checking first quality smoked sheets of rubber by holding them against the light and snipping out the impurities and spots thus revealed. The sheets are then packed in bales for export.

18. Pioneer cultivation in a swampy valley in Pahang. The forest has been cut down and partially cleared. It is not possible to clean-burn the clearing because of the water-logged conditions. The felled vegetation is therefore being left to rot. The first crop of padi is already in the ground.

19. Part of the Kedah alluvial plain, looking east towards the mountainous interior. On the wooded 'islands' in the flooded padi-fields are the settlements of the Malay farmers. Each settlement stands in a garden of miscellaneous kampong crops—coconut, banana, other fruit and vegetables.

20. A typical landscape in the Kelantan delta. The small padi fields here are dependent on rainfall so that careful timing is necessary to ensure that the period when the water needs of the padi plants are greatest coincides with the wettest period of the north-east monsoon, viz., in November and December. The padi varieties that require standing water are not cultivated in these fields because of the rolling nature of the terrain. Instead, dry padi is normally sown; yields are lower than those from wet padi.

method of construction not otherwise employed by the Chinese in other parts of the Peninsula (Plate 12). Figure 36 shows two typical Chinese fishing villages on the south-west coast of Johore. Each consists of a collection of stilted houses built over the mud flats on the seaward side of the mangroves. Each house is connected to the neighbouring houses by plank walks. Kukup village is linked to the main road by such a plank walk, but Kangkar Ayer Masin is completely isolated from the land during high tides. Inland from the

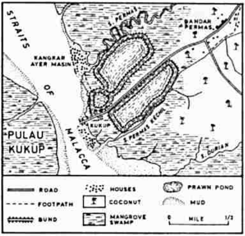


FIG. 36. Chinese fishing settlements in south-west Johore

villages and within the mangrove fringe itself, the villagers have carved out prawn ponds, a method of land-use rarely found in Malaya but common in Singapore.

Padi Settlements. In the past British colonial policy aimed at making padi lands and padi cultivation a preserve of the Malays. There are a few thousand Chinese and Indian padi farmers in Malaya today, but cultivation of the crop is still very much a Malay interest. Padi growing is not only an economic activity, but is also a way of life to the rural Malays. The settlements in most padi areas are typically Malay, and their patterns have not changed over the years except in the new colonization areas where the patterns are determined by the original layout of the lots. In such areas the houses are usually arranged in single rows following the lines of the drainage and irrigation canals, so that the overall pattern is a geometrical one.

Houses in the flat swampy terrain associated with padi growing are built on sites which stand above the general level of the ground. The distribution of the houses is therefore determined by the distribution of available high ground. The lower slopes of hills, the tops of levees and *permatang*, the built-up sides of metalled roads and canals and even small mounds of land standing a few feet above the level of the surrounding fields offer the best house sites. Such features on

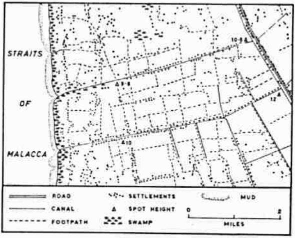


Fig. 37. Padi settlements in the coastal plain of Kedah

the landscape, both natural and cultural, tend to be long and narrow, with the result that most padi settlements assume linear patterns (Figs. 37 and 38).

Settlements in a Cash-Cropping Area. In the pre-colonial days when the Malay farmer cultivated those crops he could eat and not those that he could sell, the typical Malay farm was made up of a few acres of padi and a small plot of kampong land in which some spices, vegetables, coconut and fruit trees grew. The farm was usually set in a riverine coastal area where the best padi lands are found. Today, however, many coastal riverine areas, especially in southern Malaya, are not under padi but under tree crops which are grown for the market and not for consumption. These areas may be settled by Malays working in smallholdings or may be parcelled out in large lots and worked as estates. Such low-lying land is more naturally suited to wet padi than to tree crops, but rubber and to a lesser extent oil-palm and coconut, have become such lucrative crops to grow that the Malays, notably those who have migrated from Indonesia, preferred to put their land under these rather than under padi. In order to render it firm enough to support the heavy rubber, oil-palm and coconut trees, the land has to be drained by an efficient system of canals. In such Malay smallholdings the houses are again built

FIG. 38. Levee settlements along the Pahang River

alongside the canals, roads and footpaths, so that the patterns of settlements are similar to those in a padi area (Figs. 39 and 40). The only difference in the landscape comes from the nature of the crops grown. In a padi area the general aspect is more open than in a cash-cropping area.

Settlements in a Mixed-Cultivation Area. An entirely subsistence economy does not exist today among the Malays, who even in the most remote jungle areas participate to some extent in the monetary economy by selling jungle produce and purchasing food, tobacco and other commodities. The introduction of the monetary economy during the colonial era has led to different degrees of specialization of production for the market. There are Malay peasants who

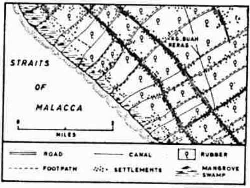


FIG. 39. Malay settlements in a rubber growing area

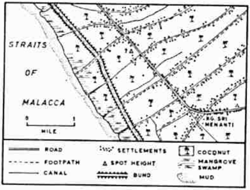


FIG. 40. Malay settlements in a coconut growing area

specialize in fishing, in padi cultivation and in cash-crop cultivation. On the other end of the scale, there are those who do a little bit of each, and these peasants can be considered to have an economy nearest in characteristics to the subsistence economy. In the small interior valleys of Negri Sembilan, Malacca and other parts of interior Malaya, are settlements associated with the cultivation of padi for home consumption and the cultivation of rubber and coconuts for the market. The settlement patterns in these valleys are distinctive, consisting of a linear arrangement of houses on one or both sides of the break of slope of the valleys, with padi occupying the flat bottom land, and rubber and/or coconut on the well-drained slopes (Fig. 41).

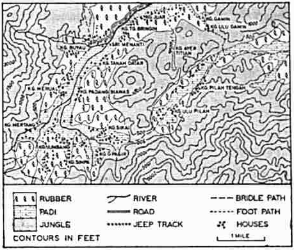


FIG. 41. Malay settlements in a mixed cultivation area

SETTLEMENTS OF THE IMMIGRANT PEOPLES

Mining Settlements. The first immigrants to enter the country in large numbers were Chinese tin miners. The earliest immigrant settlements in the Malay States were the mining camps which sprang up along the western tin belt. Most of these disappeared from the landscape when the ore in their vicinity was exhausted or when water flooded the mines and prevented further excavation, but other mining camps grew into villages and a few expanded into permanent towns. The alluvial nature of ore occurrence and methods of mining has given rise to a distinctive form of landscape characterized by stretches of upturned, worked-out ground and mining pools. Because mines are constantly shifting to new locations as the old sites are worked out, mining settlements are usually ephemeral features of the landscape, consisting of a number of temporary buildings and shacks housing the labourers and other mining personnel, all grouped close to the mines. All the Chinese mines employ Chinese labour. The European mines may employ labourers from all or any of the main racial groups. The resettlement campaign has changed the patterns of settlements associated with mining. Previous to the campaign mining settlements consisted of a loose agglomeration of huts spread over the mining area. The regrouping and resettlement of mining labourers have altered the dispersed patterns of settlements

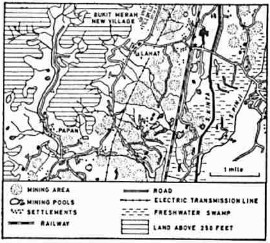


FIG. 42. Mining settlements in the Kinta Valley

into tightly nucleated ones, with the workers enclosed either in a small central site near the mines or in New Villages which may be some distance away from the mines (Fig. 42).

Estate Settlements. Most of the estates in Malaya are rubber estates. A few grow oil-palm, coconut, pineapple and tea. The estate or plantation is an introduced method of growing cash crops in large holdings with a paid labour force. Estates are easily recognized features of the landscape. The boundaries of an estate are well marked and usually straight, the crops are planted in neat, straight rows, with a low undergrowth of cover crops. A system of internal transport lines, usually laterite roads but occasionally light tramways, divides the estate up into a number of rectangular blocks. Occupying a central position in the estate and connected to the main road or railway are the labourers' quarters, the processing factory, the smoke house, the store house and the manager's house (Fig. 43). The original pattern of settlement was a nucleated one, and the regrouping and resettlement campaign has not altered it, except through the addition of a boundary of barbed wire enclosing the buildings. In some cases the labourers' quarters and the manager's house have

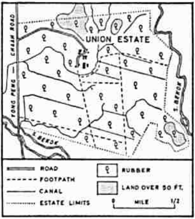


FIG. 43. Estate settlements

had to be brought in closer to the central nucleus of buildings for easier protection.

Although the estate type of settlement is not indigenous to Malaya, a substantial number of Malays live in such settlements today. These Malays form part of the estate labour force. A total of 60,800 Malays were employed in the rubber estates in 1960.

New Villages. The resettlement of Chinese squatters and other rural dwellers has resulted in the formation of a new settlement type in Malaya, the New Village. The purpose of resettlement was military, and both the location and pattern of the New Villages reflected this purpose. They were located on easily defended sites by the side of main roads, and in some instances, within municipal boundaries. As a further defensive measure, they were surrounded by barbed wire fences. Watch towers and flood lights brought the general appearance of the Villages nearer to that of forts than their names would imply. The usual layout of the houses was in regular grid-like patterns (Fig. 44).

The necessity for speed, and the primary consideration for security, resulted in some of the Villages being badly sited from the point of view of the resettled population's economic requirements. Some farmers found themselves so far removed from their farms that they had to abandon them. Early during the resettlement operations an open type of New Village was experimented with, whereby each

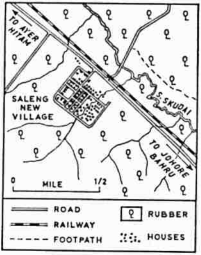


FIG. 44. Saleng New Village

farming family lived on its own plot of land with the entire area surrounded by barbed wire. Such an arrangement was popular with the Chinese who could then work on their own land even after curfew hours. However, from the security angle the extended perimeter was a handicap as it was difficult to patrol and prevent contact between squatter and terrorist. It was therefore decided to abandon this type of layout. In all agricultural New Villages subsequently established the farms were physically divorced from the Villages. The farmer was obliged to walk a mile or more to his plot of land, and he was not able to work on it after curfew hours. At the same time he was compelled to divide his farming operations into two parts: those connected with crop cultivation which was carried out on the farm itself, and those connected with pig-rearing which had to be performed in, or near, his house. He then had to transport the pig fodder from his farm, and the pig manure to the farm every day, an inefficient and slow operation. Considerable damage too, was done to the crops by pests at night. New Villages which did not have a firm economic base are likely to be abandoned with the ending of the Emergency, the farmers transferring their houses to holdings on the outskirts of the Villages. It is difficult to forecast whether the New Villages will remain as permanent settlement types on the landscape now that the Emergency is officially over. Of the 438 New Villages enumerated in a Government report in 1954, 303 were classified as being supposedly permanent, 48 as supposedly impermanent and likely to disappear with the end of the Emergency, and the remainder as occupying an intermediate position.[1]

Urban Settlements. The towns of Malaya are the creation of the immigrant population, having come into existence hand in hand with the economic development of the country during the last 150 years. The immigrant character of the towns is reflected in the location, functions, morphology and especially in the racial composition of the urban population. As noted earlier, most of the towns are distributed along the western belt of high population densities. Along this belt are found the main tin fields and the greater part of the rubber, coconut and oil-palm areas of Malaya. Many of the towns such as Ipoh, the other towns of the Kinta Valley, Taiping, Kuala Lumpur and Seremban originated as mining villages. Others such as Georgetown, Butterworth, Port Swettenham and Malacca developed into important towns because their sites were suitable for the discharge of port functions. The once flourishing port town of Malacca, however, has become moribund because of the increased size of shipping and the silting of the anchorage. A large number of towns are sited at river mouths, a reflection of the early importance of river transport in the Peninsula (Figs. 45 and 46).

Although site conditions are important, a settlement can only grow into a town if it is favourably situated in relation to its surroundings. For example, a site which has all the requirements for a good port cannot by itself create a port unless its situation allows relations with a hinterland. All the major towns of Malaya, with the exceptions of Kota Bharu, Kuala Trengganu and Kuantan are distributed along the western belt of greatest economic activities (Table 19). Their

[1] W. C. S. CORRY, *A General Survey of New Villages* (Kuala Lumpur, 1954), p. 16.

situations in relation to their surroundings are such that they are the nodal points of the traffic that passes along the belt. Georgetown, for example, has developed to its present size and importance because of its situation in respect to its rich hinterland which includes the northern half of Perak, the State of Penang and Province Wellesley and most of Kedah. Similarly the material bases which govern the

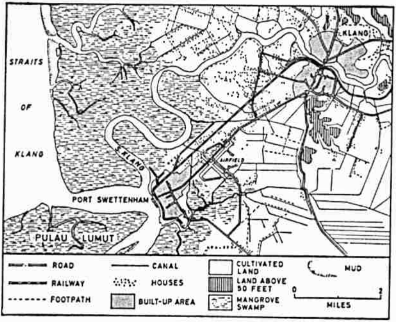


FIG. 45. The sites of Port Swettenham and Klang

growth of Kota Bharu and Kuala Trengganu are external, namely, the resources of the Kelantan and Trengganu deltas respectively.

No two towns have sites or situations that are exactly similar, but all the towns of Malaya, with the exceptions of the few New Villages that fall within the urban category, have basically similar functions. They act as collecting, processing and distributing centres of the tin, rubber, copra, palm-oil and other mineral and agricultural products of the country, and as distributing centres of the food, machinery and other consumer goods imported from overseas. In addition they may also have administrative functions as district or State capitals.

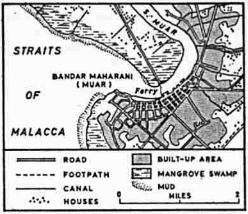


FIG. 46. The site of Bandar Maharani (Muar)

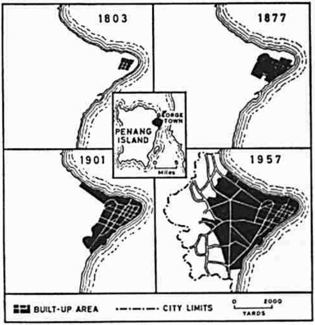


FIG. 47. The growth of Georgetown about its pre-urban nucleus

Kuala Lumpur and some of the larger towns have a small but growing secondary manufacturing function. The towns are also service centres for the maintenance and repair of transport facilities, and for health, education and entertainment services. The larger towns are shopping centres with a full range of specialized retail services.

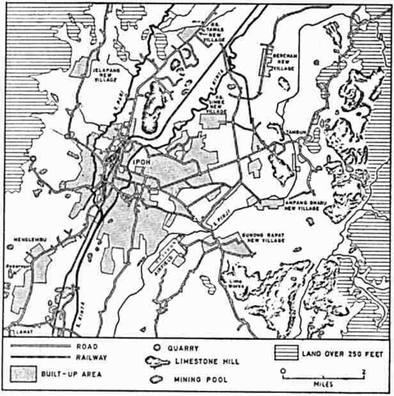


FIG. 48. Ipoh: urban core and environs

Except for the satellite town of Petaling Jaya, the towns of Malaya have grown and have been adapted to perform urban functions without any conscious planning. The unplanned nature of the towns is evident in their layout, which is usually the product of an accumulation of buildings about a pre-urban nucleus (Fig. 47). Most towns exhibit similar patterns, each consisting of a kernel of narrow streets lined with shophouses and arranged in a simple chequerboard or grid plan and surrounded by irregularly-shaped areas with government and residential buildings, and other areas where cultural and recreational activities take place (Fig. 48). The roads in this outer zone do not follow any set pattern but are usually winding. The urban core is made up of a series of long blocks of shophouses (Plate 13). The shophouses are of brick and timber and have tiled roofs. They have two storeys, the ground floor being the shop area and the upper floor the dwelling area. Large multi-storey buildings occupied by commercial, insurance and banking concerns are now commonly found within the urban core of the larger towns, in most instances displacing the older shophouses but in some cases built on vacant land where it happened to be available. Around the fringes of the urban core are the government buildings, schools and places of worship, each set in a space by itself. The rapid pace of urbanization in the post-war years has resulted in the outward extension of the boundaries of the urban core in many of the bigger towns, and many of the government buildings, schools, temples, mosques and churches are now hemmed in by shops and other commercial establishments. Surrounding the urban core are the main residential areas of the town, the more crowded and smaller houses of the lower-income groups usually being located closer to the town centre while the houses of the wealthier class tend to be on the outskirts. Bus depots are commonly sited within the town centre, but the railway station is usually some distance away.

The immigrant character of the towns of Malaya is most evident in the racial composition of the urban population. Except for the towns in the predominantly Malay States of Kelantan and Trengganu, and one town in Kedah, all the other towns of Malaya and Singapore have immigrant, mainly Chinese, majorities. The Chinese dominate the business life, and also provide most of the labour. The long rows of Chinese shop-houses are typical features, even in towns with a Malay majority. The other immigrant groups—the Indians, Pakistanis and Europeans—are also town-dwellers. One-third of the Indians in Malaya live in towns, but most of the European population, with the exception of the planters and miners, are concentrated in urban centres, where they form an important financial, commercial, governmental and professional group.

PART III
THE ECONOMY

CHAPTER 8

THE PRIMITIVE ECONOMIES OF THE ABORIGINAL GROUPS

The 1957 Census returns recorded a total of 41,360 aborigines in the Malay Peninsula. But it is likely that this is an underestimate and that the total may be as high as 80,000 to 100,000. Although there are more than sixty different aboriginal subgroups most of the aborigines belong to one or other of these racial divisions: Negritoes (Malay: *Semang* or *Pangan*), Senoi (Malay: *Sakai*) and Aboriginal Malay (Malay: *Jakun*). The Negritoes constitute about 10 per cent of the aboriginal population, the Senoi about 60 per cent and the Aboriginal Malays about 30 per cent.

The economies or ways of life of these aborigines are varied. A small section of them (about 15 per cent) live a settled life, following an economy similar to that of the lowland Malays, with permanent settlements, padi fields, domestic animals such as the buffalo, and kampong of fruit and rubber. The rest follow ways of life which are characterized by constant movements from place to place. These wandering aborigines can be subdivided into two main classes—the hunters and gatherers and the shifting cultivators.

The Hunters and Gatherers. Most of the Negritoes are hunters and gatherers practising no agriculture of any sort, except where they have interbred with other agricultural tribes and adopted their habits. They are completely dependent for their subsistence on what they can gather from and hunt in the jungle. The natural produce of any one jungle locality is necessarily limited, so that when this is exhausted the Negrito group will have to migrate to a different locality. For this reason they seldom stay more than a few days in any one place but are more or less continually on the move in search of food. Occasionally, when jungle fruit ripens, they may remain in a particular spot for a longer period in order to gather the fruit harvest. Each community has a tract of jungle which forms its tribal territory, and the wild fruit trees within it belong to its members. Each member may own several fruit trees and one or more Ipoh trees (*Antiaris toxicaria*). The durian is specially prized by the Negritoes.

The limited resources of the jungle cannot support a dense population, so that the Negrito communities are small, consisting of six or seven families totalling perhaps twenty to thirty persons in all. A group may cover five or six miles daily in search of food, though the rate of movement varies considerably with the luck of the hunters and the availability of food from place to place. Their traditional habitat is the coastal jungle and the swampy terrain that borders the Main Range in upper Perak, Kelantan and Trengganu, but their wanderings sometimes lead them south to the forests of Pahang. With the invasion of the lowland Malays and later of immigrant peoples on their land the Negritoes have gradually been pushed into the interior towards the remote flanks of the central mountain ranges; many small tribes have died out altogether in recent years.

The Negritoes usually hunt with bow and arrows, though some have adopted the blowpipe of the hill Senoi. The arrow tips are poisoned with gum from the Ipoh tree. Rats, squirrels, lizards, birds, monkeys, wild pigs and other small game are hunted, as well as trapped with a variety of snares, pitfalls and noose and spring traps. Birds are caught with birdlime made from *Ficus* sap. The larger and more dangerous animals such as the tiger, the elephant and the *seladang* are normally avoided. Fish may be trapped, speared or poisoned with the juice of the *tuba* root.

On the whole, however, the Negritoes depend largely on vegetable food rather than on meat. Leaves, shoots, berries, nuts, fruit as well as roots and tubers, are gathered by the women and children while the men are out hunting. Crude digging sticks, sharpened at one end with a *parang*, are used to dig out yams and tubers as well as bamboo rats from their underground burrows. Women generally prepare the food. Meat is usually roasted, but sometimes eaten raw. Yams and tubers are grated and baked in banana leaves. Rice, when it is available, is cooked in green bamboo, and is considered a luxury. The Negritoes eat nearly everything that is edible, and many other things which are not considered edible by the other races of Malaya. But days of plenty are not common, while there may be periods when they are reduced to a state of semi-starvation.

The simplicity of their way of life is exemplified by the crudeness of their shelters. These are no more than rough lean-to structures consisting of two or three sticks stuck into the ground at an angle and covered with large leaves such as those of the *bertam* palm, or wild banana or wild ginger. Beneath the shelter is a sleeping platform of bamboo. Each shelter houses a family. The Negrito camp consists of as many shelters as there are families and is arranged in a rough oval. Occasionally caves and overhanging ledges of rock are inhabited instead. The whole community generally stays in the same place for a week to ten days once the shelters are put up. When the available food in the area is exhausted the camp is abandoned and a new one constructed at the next halting place. Their wandering existence precludes the building of more elaborate and permanent houses.

The primitive economy of the Negritoes has not changed over the thousands of years since the little men migrated to the Malay Peninsula. Such a way of life is also followed by Negritoes in other parts of Asia—in the Andaman Islands, in New Guinea, in the Philippines and in Indonesia. In Malaya the growing pressure of other races on the lowlands has resulted in a gradual displacement of the Negritoes into the interior and the highlands. This has brought them into contact with other aboriginal groups such as the Ple-Temiar, Temiar, Semak, Sisek and Semelai. Evidence of such contact is the adoption of the use of the blowpipe by Negrito groups, the blowpipe being traditionally a Senoi weapon. Again, some Negritoes have also benefited from this contact by taking the initial step to an agricultural life by casually planting tapioca and banana in clearings and returning to them some months later to gather the harvest. However, the main body of the Negritoes still remains on the same very low level of material advancement as their ancestors of thousands of years ago. The total number of hunters and gatherers today is probably about 1,000. Their hunting and gathering economy has made no material impact on the landscape.

The Shifting Cultivators. The majority of the aborigines of Malaya practise a form of agriculture usually known as shifting cultivation and locally as *ladang* cultivation. Some of the more enterprising communities living on the margins of the jungle may have smallholdings of fruit and rubber in addition to their *ladang*. A few groups have graduated from shifting agriculture and the aboriginal way of life to sedentary agriculture based on the Malay model (padi growing with kampong of fruit, coconut and other tree and bush crops) and have been absorbed into the Malay population.

Both the Senoi and the Aboriginal Malays are shifting cultivators. Shifting cultivation is a form of agriculture which has been evolved to meet the limitations imposed by infertile tropical soils. The details of this system vary slightly among the different communities but the main features remain the same. The system depends on the clearing of a forest site, the burning of the felled trees and other vegetation, the planting of food crops on the cleared site, and the subsequent abandonment of the *ladang* after two or three harvests, by which time the soil would have become too poor to support good crops. A new *ladang* is made in another part of the jungle and the old *ladang* is left to revert to secondary forest and very gradually recover its lost fertility. The aborigines whose natural habitat is the higher slopes of the mountain ranges of the Peninsula usually plant a new *ladang* several miles away from the abandoned one, and this movement is followed by a shift of their dwellings to the new site. Among the aborigines living in the lower slopes the usual procedure is to plant successive *ladang* adjacent to one another for several years before moving to a new dwelling site (Plate 14). Such a practice differs from that of the hill aborigines in that each new *ladang* is only a few yards from the abandoned one, and the dwellings remain fixed for some time in the same spot while the *ladang* are rotated.

The technique of *ladang* cultivation has been closely studied by a number of experts in the field. A site of 20 acres or more is selected on the basis of the appearance of the ground and an initial area of 2 to 3 acres is felled with axes and *parang*. A fairly steep hillside is usually chosen so that there will be a good updraught when firing takes place. The tallest trees at the highest point are cut down and on falling drag down the smaller trees in their paths. In this way a great deal of extra labour is saved. The timber is left to dry for three to six weeks and is then set on fire. When the ashes have cooled, the crops—maize, tapioca, hill padi, banana, chillies and sugar cane—are planted. The planting holes are made with pointed digging sticks and a few grains of padi or maize tossed into each hole. Tapioca, banana and sweet potato are planted by cuttings. The work may be done communally or by family groups. House building, however, is always a communal effort, with the men doing the heavy work such as cutting the poles, while the women make the thatch for the roofs.

After the houses have been built the main *ladang* is cleared by communal effort and the timber burnt when dry. The burning must be carefully controlled in order that the houses are not set alight or the existing crops destroyed. Planting takes place as soon as the *ladang* has cooled. No further attention is paid to the *ladang* once

TABLE 21. *Annual Work Cycle and Sources of Food of Shifting Cultivators in Malaya*

(after Williams-Hunt)

PERIOD	AGRICULTURAL WORK	OTHER WORK	MAIN SOURCES OF FOOD	SUBSIDIARY SOURCES OF FOOD
April–May	New *ladang* site selected and initial area of two or three acres cleared.	Some collection of jungle produce—bamboo, rattan and gums.	Tapioca from last year's harvest.	Purchased food from sale of jungle produce. Also animals, fish and roots.
May–June	Initial site burnt and planted to maize, tapioca and banana. Felling of main *ladang* started.	Temporary shelters erected, followed by erection of new houses.	As above.	As above.
July–August	Main *ladang* burnt and planted to hill padi, tapioca, maize, yams and sweet potato.	Fruit season. *Petai* and *perah* nuts very important.	As above, plus jungle fruits.	As above, plus food bought through sale of jungle fruit, especially *petai*.
September–October	Some weeding.	Repair of fish traps. Some fishing.	As above, plus maize crop.	End of fruit season. Some collection of produce.
November–December	Harvest of main padi crop.	Durian season.	Padi.	As above.
January–March	None.	Fishing and collection of jungle produce.	Padi and new tapioca, yams, sweet potatoes, etc.	Sale of jungle produce.

the crops are in; occasionally the larger weeds are pulled out, but apart from this no serious attempts are made to protect the crops from the depredations of the numerous pests such as elephants, deer, wild boars, rats and birds. A large part of the padi crop may be lost through bird raids.

Table 21 illustrates the annual cycle of work and the sources of food of a typical aboriginal community of shifting cultivators. It will be seen that the aborigines rely to some extent on the sale of collected jungle produce such as rattan, various jungle gums, bamboo, and jungle fruit for the money to buy some of their needs, including some food, the useful *parang*, food vessels, matches, etc. This is an indication of the increasing contact between the aborigines and the other lowland races of Malaya. Such contact is not always to the advantage of the aborigines, particularly in the case of those groups which have been evacuated to the lowlands because of the Emergency. These resettled aborigines suffer greatly from diseases to which they have no natural or acquired immunity. In cases where the contact with lowland races has been gradual and spread over a number of years and even generations, some of the aborigines have tended to abandon their old way of life and adopt the ways of the lowland Malays, including following the Muslim religion. Many of these people have been absorbed into the Malay community and are practically indistinguishable from the other ordinary Malays.

CHAPTER 9

THE AGRICULTURAL ECONOMY

Malaya's economy is based primarily on the production and export of raw materials, of which rubber and tin are by far the most important. The export value of these two commodities represents more than 80 per cent of all domestic exports from Malaya. In general, agricultural industries (including rubber) dominate the Malayan economy. Other primary industries of major importance are mining, fishing and forestry. Small-scale manufacturing is also an important part of the economy. These secondary industries include the processing of raw materials such as rubber and tin for export, and the manufacturing of a variety of consumer goods for the domestic market.

The dominant position of agriculture in the national economy is indicated by the fact that it contributes only slightly less than half the gross national income. Three-fifths of the total working population of Malaya are engaged in agricultural activities. Table 22 shows the total area under crops of economic importance. The outstanding importance of rubber is apparent. Rubber occupies 64 per cent of the total cultivated area of Malaya and contributes about 60 per cent to the total export earnings. Most of the rubber holdings are distributed along the coastal and foothill belt of western Malaya from Perlis to Johore. There are two main zones of concentration—the first or northern zone includes central and south Kedah, parts of Province Wellesley and north Perak, and the other (southern) zone lies roughly between Sungei Selangor and the southernmost tip of the Peninsula, and includes south Selangor, Negri Sembilan, Malacca and western Johore. The rubber areas of eastern Malaya are small and scattered. Rubber is grown in the Kelantan delta, in pockets along the southern Trengganu coast, in the Kuantan area, in patches along the Pahang River, the East Coast railway and along the major roads of Pahang as well as in the Johore Bahru–Kota Tinggi area of eastern Johore.

Padi occupies the second largest area of cultivated land in Malaya. More than 90 per cent of the padi cultivated is of the wet variety requiring flooded fields, and cultivation is confined to riverine, coastal and deltaic locations which can be easily flooded. In western Malaya the main padi areas are in Perlis, Kedah, Province Wellesley, Perak (Krian, Sungei Manik, Changkat Jong), Selangor (Tanjong Karang), and the coastal plains of Malacca. The largest acreage under padi in eastern Malaya is in the Kelantan delta; other smaller

TABLE 22. *Cultivated Area under Main Crops, Malaya, 1960*

CROP	Area (000 acres)	Percentage
Rubber	3,442	64
Padi	941	17
Coconut	520	9
Fruits[1]	213	4
Oil-Palm	135	2
Foodcrops[2]	118	2
Miscellaneous[3]	72	1
Spices[4]	48	1
TOTAL	5,489	100

[1] Pineapple, banana, cashew nut, durian, rambutan, mangosteen, citrus and other fruits.

[2] Tapioca, sweet potato, sago, sugar cane, groundnut, maize, yam, colocasia, ragi, soya bean, pulses and vegetables.

[3] Tea, coffee, cocoa, tobacco, derris, nipah, gambier, kapok, ipecacuanha, patchouli, citronella, gutta percha, and other miscellaneous crops.

[4] Arecanut, chillies, pepper, cardamom, ginger, sireh, nutmeg, clove and tumeric.

areas are found in the Trengganu delta, the Pahang delta and the Endau delta.

The other major revenue crops are coconut and oil-palm. Coconut is usually grown in small peasant holdings mixed with other tree crops, but it is also grown in pure stands in smallholdings. About 15 per cent of the total acreage is in plantations. The main areas are the coastal plains of Province Wellesley, the Bagan Datoh Peninsula in Perak and the west coastal area of Johore. The trees are also found in Malay kampongs and fishing settlements in eastern Malaya. The largest oil-palm acreages are in Johore, Selangor and Perak.

Apart from the major crops, Malaya also produces a great variety of fruits, foodcrops, spices and other miscellaneous crops. These crops together occupy 451,000 acres. Pineapple and banana are the most important of the minor crops, together accounting for 109,000 acres. Pineapples are ubiquitous in Malaya, but are grown for canning only in Johore, Selangor and Perak. The other minor crops which occupy significant areas are tapioca, sweet potato, vegetables, durian, rambutan, arecanut, tea, coffee and nipah. Many of the minor crops are grown for subsistence purposes in small kampong holdings. Some of the produce may go to supplement the income from the major revenue crops of rubber and coconut in the smallholdings.

Although Malaya's economy hinges largely on agriculture, the emphasis is on revenue crops and the country is not self-sufficient in food. About one-quarter (by value) of the imports of Malaya are foodstuffs, including rice. The Government is trying to counter the over-dependence on outside sources for these essential commodities by opening up new padi lands and encouraging the growing of food-crops, but at present the progress has been slow, largely because the increase in food production has been nullified by the rapid rate of population growth.

SYSTEMS OF PRODUCTION

Two basic systems of production prevail in the agricultural economy, both based on the continuous cultivation of crops on permanent and well-defined holdings:

Plantation Production. The plantation system of agricultural production is a highly specialized one, and has the following characteristic features: (*a*) It is usually organized on a large scale, that is, the scale of operations, the area per unit holding and the labour force are large. In Malaya the minimium size of a rubber estate or plantation is 100 acres, but in 1960 one-third of the 2,274 estates were between 500 and 5,000 acres in size, and 56 estates with a total area of more than 400,000 acres were over 5,000 acres in size. (*b*) It specializes in the cultivation of a single crop, produced primarily for export. (*c*) While the labour force may be of local origin or recruited from neighbouring countries, the capital is usually of foreign origin, and the managerial staff is also usually expatriate. (*d*) In many instances the crop or crops undergo preliminary processing or preparation before they are exported, as in the case of rubber and oil-palm.

The plantation as an instrument of production is generally efficient, and is in a position to use the latest advances in technological knowledge to solve its problems of production. It is able to command sufficient capital for such requirements as machinery and for the expenses of setting up and carrying out the functions of a large agricultural unit. It also has the resources needed to provide the regularity of supply and the uniformity and high quality of product which world markets demand. But the plantation also has to bear heavy overhead charges which become a serious burden when prices drop below the profit margin. Furthermore, the plantations of Malaya today cannot depend upon unlimited supplies of cheap labour as in the past. Labour, while adequate in quantity, is no longer cheap, and production costs have increased because of the larger wage bills. Mechanization can only partially solve the problem as much of the work carried out by the labourers cannot be performed by machines.

The first plantation crops established in Malaya were spices and gambier. These were followed by sugarcane which was fairly extensively cultivated in Province Wellesley in the mid-1850s. Tapioca was also planted on plantations and, in the latter part of the nineteenth century, coconut and coffee were added to the list. Then came rubber in the last decade of the century, and the phenomenal success of rubber led to the decline and abandonment of spices, tapioca, sugarcane and coffee as plantation crops. Up to 1910 the plantations were only interested in planting rubber, but between 1910 and 1925 many coconut plantations were also opened up in addition to rubber plantations, and after 1926 oil-palm, too, became a plantation crop. Pineapples were not grown on a plantation basis until after the Second World War. The other important plantation crop is tea. Table 23 shows the area under plantation crops. The large area under plantation crops (40 per cent of the total cultivated area) illustrates the importance of the plantation system of production. The major role of the plantation in the Malayan economy is a reflection of the policy of the Government to encourage economic development in all its forms, both on a peasant basis and on a large scale. (In this respect British colonial policy in Malaya has differed from that followed in British territories in West Africa, where plantation agriculture was regarded as being a disruptive influence on tribal life and was therefore prevented from playing any significant role in the territorial economies.) At the same time it was possible to alienate land on a large scale for plantations because the population was sparse and land was abundant in the Malay Peninsula. There was no encroachment on indigenous Malay land since most of the Malays were settled on riverine and coastal locations where padi could be

TABLE 23. *Area under Plantation Crops, Malaya, 1960*

	Area (acres)
Rubber	1,942,000
Oil-Palm	135,000
Coconut	86,000
Pineapple (estimated)	15,000
Tea	9,000[1]
TOTAL	2,187,000

[1] Includes a small area planted in smallholdings.

grown, whereas the plantations were usually established on dry-land sites—foothills and undulating land—away from the centres of Malay concentration.

The future of the plantation in independent Malaya depends largely on the policy of the Government. Although the plantation as a system of agricultural production has its merits, nevertheless there are several factors which work against the extension of the plantation acreage. Firstly the social and political climate in Malaya today, as in other parts of South-East Asia, is unfavourable to plantation development. Most of the established plantations were colonial creations, expatriate-managed, the profits of which for the most part went to persons not resident in Malaya. The Malays own only a very small proportion of the plantation acreage. It is understandable therefore that the plantation industry should face adverse public opinion in a newly independent country. Most important still, the continued existence of the industry depends on the ability to make profits. At the moment the rubber estates bear a heavy burden of taxes in the form of an export duty on rubber and a 30 per cent income tax on company profits. These taxes greatly reduce the net profits of the estates, and it is likely that any further increase of the tax burden coupled with low rubber prices would drive the marginal estates out of production. At the same time production costs have increased in the post-war period because of the high cost of labour.

Another problem which the plantation industry has to face and over which it has little control is the political uncertainty of the future. The present Alliance government has promised that there will be no discrimination, nationalization of industries, or exchange controls that will prevent the withdrawal of dividends and the repatriation of capital invested in the country. But there is no guarantee that future governments will share similar views on foreign enterprises and investment. Such risks, non-existent in a colonial territory, become very real once that territory has acquired its independence.

Peasant Production. The peasant has been defined as '. . . a countryman—a man engaged in rural pursuits, primarily agriculture, with a comparatively simple technology and a special interest in the land he works. In South-East Asia, one may extend the application of the term to cover the majority of fishermen and even village craftsmen, too. They are of the same social class as the agriculturists, and often members of the same families. As occupational groups, they may even be separable only in theory, since many a peasant farmer is also a fisherman or craftsman by turns as his seasonal cycle or cash needs influence him.'[1] The peasant system of production, in contrast to the plantation system, is based on individually small units, each unit usually being run by the farmer and his family without hired labour. The Malayan peasant farmer today cultivates both subsistence and cash-crops, though some may specialize entirely on cash-crops. The range of such crops suitable for peasant cultivation is limited to those which can be marketed without processing or those which require only simple processing within the peasant's technical and financial capacity. However, until recently, the only crop of economic importance which was not cultivated by peasant farmers in Malaya was oil-palm. Table 24 shows the total area under peasant crops.

Rubber, again, dominates the peasant sector as it does the planta-

[1] R. FIRTH, 'The peasantry of South-east Asia', *International Affairs*, 5 (1950), 503.

tion sector of the agricultural economy, and the total rubber area is nearly half of the total area under all peasant crops in Malaya. However, not all of the 1,500,000 acres of rubber are cultivated under the peasant system. About 20 per cent of the acreage is composed of 'medium-holdings' or 'small estates' of between 25 and 99 acres each. Padi is grown solely as a peasant crop. Coconut is next in importance as a peasant crop, and is usually grown in conjunction with other peasant crops such as padi and fruit, though some holdings are devoted entirely to coconut. The other crops together cover

TABLE 24. *Area under Peasant Crops, Malaya, 1960*

	Area (acres)
Rubber	(estimated) 1,500,000
Padi	941,000
Coconut	434,000
Fruits	198,000
Foodcrops	118,000
Spices	48,000
Miscellaneous (excluding tea)	63,000
TOTAL	3,302,000

just over 400,000 acres. Altogether about 60 per cent of the total agricultural land in Malaya is peasant-cultivated.

The peasant economy has undergone considerable changes during the colonial era. The aim of peasant production in the early days was to provide the farmer and his family with their subsistence needs, and the farmer produced what he ate and ate what he produced. The peasantry was composed of indigenous Malays. The typical Malay farm consisted of a few acres of padi and a small kampong in which an assortment of dryland crops were planted—fruit, coconut, spices and some vegetables. There was no incentive to produce beyond subsistence needs because of the insecurity of life and the instability of political conditions.

The advent of British rule inevitably disturbed the foundations of indigenous life. The underlying reason for colonialism was economic gain, and it was in the sphere of economic activities that the greatest changes in indigenous society were brought about. This was not so much due to the deliberate undermining of the economic foundations of traditional village life as to the indirect influence of the money economy on individual members of the village. There was gradually increasing participation in the new economy, arising firstly from the need to raise money to pay taxes and rates, and later given impetus by the desire to buy various consumption goods to satisfy personal needs. Almost everywhere the peasant began to produce for the market, secure in the thought that his extra effort would not be seized by the ruling aristocracy or by outside raiders.

The first crops sold by the peasant for money were naturally those he normally grew on his farm—padi, coconut, fruit and spices. Later he took to growing crops originally introduced into Malaya as plantation crops. The great success of rubber attracted peasant interest, and since the beginning of the twentieth century rubber has been the outstanding crop in peasant farms throughout the country. The rapid spread of rubber cultivation among the Malay peasants was the outcome of three factors. Firstly, the tree fitted easily and naturally into the kampong setting with its emphasis on tree crops. Secondly, its cultivation made little extra demands on the peasant—as the tree is non-seasonal, the labour involved in its tapping could be spread over the year and there was no clash in labour needs with the seasonal padi crop. (The tree could either be left untapped during the padi sowing and harvest or the tapping rhythm could be adjusted to meet the situation.) There was no necessity for extra draught animals, ploughs or manures, the purchase of which would otherwise be beyond the purse of the peasant. The technique of producing rubber sheet from the latex was simple and required only a little extra investment for the purchase of the tapping knife, coagulant and roller. Thirdly, the peasant soon discovered that in times of good prices an acre or two of rubber could supply his family with the cash necessary to provide a living better than could be obtained from padi planting, with less physical effort and labour. Apart from rubber, the traditional Malay peasant crops are padi (nine-tenths of the padi-farmers are Malays), coconut, fruit, some spices and some food-crops.

The Chinese did not migrate to the Malay Peninsula in large numbers until after the establishment of British rule. Even then the purpose of Chinese migration was not permanent settlement but rather temporary sojournment until such time as they had made enough money to have rendered their stay profitable. Farming was therefore not taken up for subsistence purposes but as a means to raise money, in direct contrast to the normal set-up in their villages in China. Farming methods as practised in Malaya by the Chinese in the early years were not far removed from that of shifting cultivation, a destructive system of 'land-mining' tolerated if not actively encouraged by the authorities, in a country where land was plentiful. Padi cultivation, the traditional agricultural backbone of South China, did not attract the Chinese as it was the least paying of all agricultural occupations in Malaya. Instead the Chinese took to growing those crops which were in great demand in local and export markets and which brought in the highest returns, and they grew them in large estates as well as small peasant farms.

Amongst the earliest crops cultivated by the Chinese peasant farmer were vegetables, grown in market gardens. Market-gardening as practised by the Chinese is a highly intensive form of agriculture based on a closely-knit and interdependent relationship between the growing of short-term crops and vegetables, the rearing of pigs, and the utilization of both pig and human excreta as manure. There were Chinese market-gardeners in Malacca as early as the mid-seventeenth century. Their number increased greatly during the initial phase of Malaya's economic development when large numbers of immigrants entered the country and the demand for food increased correspondingly. There were 50,000 market-gardeners in 1931; by 1947 their numbers had increased to 86,000, mainly as a result of the Japanese occupation when thousands of Chinese were forced by circumstances to grow their own food. But the disruption created by the resettlement campaign caused their numbers to fall to 38,700 in 1957. The Chinese also cultivated pepper and gambier, clove and nutmeg, sugar-cane, coffee, coconut and pineapple during the nineteenth century. Most of these crops, however, had become unimportant by the end of the century because of plant disease or low prices, or both, and when rubber came into the scene the Chinese began to cultivate it as enthusiastically as did the Europeans and the Malays. The Chinese planted rubber in estates as well as in smallholdings, unlike the Europeans who grew it exclusively in estates, or the Malays who grew it mainly in smallholdings. Rubber again takes first place among the crops grown by Chinese peasant farmers, and in 1953 they owned 78,400 peasant rubber holdings totalling about 400,000 acres. Other crops of importance in the Chinese peasant economy, apart from rubber and vegetables, are coconut, pineapple, most of the food-crops, some spices, fruit and miscellaneous other crops such as tobacco and coffee.

The Indians, Pakistanis and other races do not contribute much to the peasant economy of Malaya, except as rubber smallholders. There were 22,000 peasant rubber holdings owned mainly by Indians and Pakistanis, covering a total area of about 100,000 acres in 1953.

TABLE 25. *Distribution of Peasant Farms in Malaya, 1960*

STATE	NUMBER OF FARMS			
	Below 15 acres in size	15–99¾ acres in size	Total	Percentage of Total
Kedah	79,734	3,768	83,502	19
Perak	70,346	2,270	72,616	16
Kelantan	68,908	1,514	70,422	16
Johore	51,688	4,406	56,094	12
Selangor	33,062	966	34,028	8
Trengganu	29,292	1,024	30,316	7
Pahang	26,062	1,846	27,908	6
Negri Sembilan	23,124	640	23,764	5
Penang and Province Wellesley	19,044	626	19,670	4
Malacca	17,994	558	18,552	4
Perlis	12,494	144	12,638	3
TOTAL	431,748	17,762	449,510	100

The Federation-wide census of agriculture conducted by the Ministry of Agriculture and Co-operatives in 1960 revealed that there was a total of 449,510 farms in Malaya larger than a quarter of an acre but smaller than 100 acres in size. Ninety-six per cent of these farms were small farms, that is, consisting of less than 15 acres of land. Such small farms are worked by the farmer with the aid of his family but normally without hired labour, so that they fall within the category of peasant farms. The distribution of these peasant farms is shown in Table 25. Forty-five per cent of the peasant farms

21. The Kedah plain, looking west, with limestone outcrops in the background. The farmer is ploughing the flooded fields with a wooden plough drawn by a water buffalo. The padi seedlings occupying the fenced nursery in the middle background will later be transplanted into the ploughed fields.

22. Winnowing padi in the Kelantan delta. The baskets and mats are made locally from bamboo and *mengkuang* leaves. This is a season of plenty for the buffalo and cattle, for they are now let loose to graze on the stubble in the fields.

23. Malay smallholders use this effective method of unhusking coconuts. The split nuts are then sun- or kiln-dried and sold as copra.

24. An oil palm estate in central Johore, with young palms (left) and mature palms (right). Note the system of internal roads.

are located in the north-eastern States of Kelantan and Trengganu, and the north-western States of Perlis and Kedah, where there is a long history of Malay settlement based largely on the cultivation of padi. The other two States where peasant farming is important are Perak, where padi, rubber, coconut and mixed cultivation are the bases of the smallholders' economy, and Johore, where padi cultivation is unimportant as compared with cash-cropping based on rubber, coconut and pineapple.

TABLE 26. *Size of Peasant Farms in Malaya, 1960*

SIZE GROUP (acres)	Number of Farms	Percentage
Below 1	45,892	10
1 — 1¾	79,666	18
2 — 2¾	78,014	17
3 — 3¾	57,426	13
4 — 4¾	41,726	9
5 — 7¼	72,074	16
7½— 9¾	28,678	7
10 —14¾	28,272	6
15 —99¾	17,762	4
TOTAL	449,510	100

The third preliminary report of the Census contains statistical data on the size of the farms. Table 26 shows the sizes of the farms within the small farm category. Several significant features of the peasant economy of Malaya are brought to light by the table above. Most of the farms (90 per cent) are less than 10 acres in size, and 67 per cent are less than 5 acres in size. The minimum economic holding—that is, one which can give the farmer a fair to good standard of living—is between 8 to 10 acres, according to the Federal Land Development Authority. It is therefore evident that a very high percentage of Malaya's peasant farmers cultivate holdings which fall below this minimum, although the position is generally better than that which obtains in many other parts of tropical Asia, where a farmer does not have more than 2 to 3 acres of land. That Malaya is fast approaching this situation is indicated by the fact that 45 per cent of the total number of small farms are holdings of less than 3 acres.

Of the 45,892 farms that are less than 1 acre in size, about 9,000 are in Kelantan, 7,900 in Perak, 6,900 in Kedah, 3,700 in Malacca, 3,900 in Trengganu and 3,300 in Negri Sembilan. It is significant that all of them are located in States which have a long history of Malay settlement and where the twin processes of population increase and land subdivision have worked to reduce the average size of the individual farm and family holding. The division of agricultural land into minute parcels of less than an acre each is the result both of a congested rural population exerting a heavy pressure on available land and of the prevailing laws of inheritance and succession which demand the splitting up of land.

Thus in many localized parts of Malaya the problem of uneconomic holdings has become acute. The size of a holding which can provide minimum subsistence cannot be assessed without taking into account the soil fertility, rainfall and water conditions, the intensity of cultivation and types of crops. Nevertheless, the process of physical subdivision, if continued long enough, must necessarily lead to a stage when the unit holding cannot by itself yield enough to support the peasant and his family. Up to a certain level the reduction in size may encourage a more intensive form of cultivation, but beyond that the law of diminishing returns begins to operate, and no amount of extra labour or capital will succeed in increasing production. Except in the case of intensive market-gardening, an acre or less of land under any other form of cultivation in Malaya cannot yield even the bare minimum for sustenance. For example, an acre of rubber will yield the smallholder about 400 lb of rubber per annum. Assuming a market price of 55 cents per lb, the annual gross returns will be $220, or $18·33 a month. The same piece of land under padi will yield even less in terms of dollars per annum.

Allied with this problem of uneconomic holdings due to excessive subdivision is the problem of excessive fragmentation, which arises when a single farm is made up of several fragmented parcels of land scattered over a wide area. The dispersal of fields entails extra expense and effort in moving seeds, implements, animals and workers from one plot to another. Efforts to improve conditions of farming on any piece of land are held up unnecessarily because such improvements require the close co-operation of many individual and often individualistic farmers. They become even more difficult when radical changes, such as soil conservation measures, mechanization, and major drainage and irrigation schemes are projected, for then reorganization of the farms, and perhaps of ownership, becomes essential.

As an instrument of agricultural production the peasant system of small farms suffers from a number of defects which collectively manifest themselves in low standards of production and inferior qualities. These defects are not so much inherent in the system as being due to the lack of education and of scientific, technical, financial and administrative assistance. During the colonial era most of the agricultural services provided by the governmental and semi-governmental organizations, such as the Rubber Research Institute and the Department of Agriculture, have benefited the plantations, except in the case of the Drainage and Irrigation Department which provided water control facilities to peasant padi areas.

In spite of the defects of the peasant system, practical experience in Malaya and other tropical countries has shown that a well-organized system of peasant farming, because of its greater flexibility, is better able to withstand crisis conditions than an economy based on plantation agriculture. For example, during the Great Depression of the 1930s, the rubber plantations were very badly hit while the peasant rubber smallholders simply left off tapping and turned to other alternative occupations without having to worry about heavy overhead costs. Again, an economy based on peasant farming gives greater economic and social stability to the country during a major depression because the farmers can always turn from growing cash crops to growing foodcrops. No mass unemployment need follow such a depression, unlike the position in a country which is mainly dependent on plantation agriculture.

With the rapid rate of population increase in Malaya (more than 3 per cent per annum) the existing employment opportunities will soon be exhausted, and new openings for the growing population will have to be created. Agriculture offers the most promising prospect as much of the land area of Malaya is still under forest and undeveloped. It is likely that the mounting pressure of population on land will be relieved by the settlement of the excess peoples in colonization schemes organized on a peasant basis, similar to the padi settlement schemes now operating. So far the postwar settlement schemes have placed the emphasis on rubber cultivation, but the range of crops suitable for peasant colonization areas can be widened considerably to include all the other dryland crops at present grown by the peasantry. Two other cash crops in particular offer promising prospects for peasant cultivation:

(1) *Oil-palm.* This crop has been an estate monopoly since its introduction into Malaya in 1917. The oil-palm is the least soil-destructive of all cash crops, but it requires 312 lb of mineral food per acre per annum as compared with the 53 lb for rubber. The Malayan climate is favourable to good palm growth. Another advantage in its favour as a peasant crop is the similarity of its soil requirements (apart from the mineral foods mentioned earlier) to those of the rubber trees, with which the peasants are already familiar. The palm flourishes on a wide range of soils provided there is good drainage. Yield, even from unselected seedlings, is high, and other factors in its favour are the long productive life (the tree bearing harvestable fruit from its fourth to its thirtieth year), and the even fruiting throughout the year. Harvesting at present is done in estates at intervals of seven to eight days, but shorter intervals between harvests is possible, so that the rhythm of work would not be very different from the tapping cycle in a rubber small-holding.

Several factors have contributed to keep oil-palm cultivation an estate monopoly. The palm was first planted on an estate in 1917, but it was not until 1926 that its cultivation was taken up seriously. The planted area then increased from 12,098 acres in 1926 to 63,646 acres in 1933. The main areas were located in Johore, Perak and Selangor and a few scattered places in Negri Sembilan, Pahang and Kelantan. But by 1926 rubber had already firmly established itself as the dominant crop for both estates and smallholders, and none of the peasant farmers were interested in oil-palm, not even as a source of cooking oil (for which they already had the coconut). The machinery for extracting the oil from the fruit was expensive and the processes involved were complicated. It was estimated that the fruit from 2,000 acres of palm were needed to keep one factory going. Further economies of large-scale production were realized by shipping the oil in bulk instead of in barrels. By careful processing Malayan planters produced a high quality oil with a low free fatty acid content—2 to 3 per cent as compared with the 18 to 60 per cent of West African oil. All these called for a large labour force, heavy equipment, a good network of internal roads and light railways and for heavy capital investment, none of which was within the capacity of the peasant to provide.

The idea soon grew that oil-palm could only be grown successfully by estates, and as early as 1934 the Government had helped to promote this notion by stating that an area of at least 200 acres must be taken up by any person desiring to alienate land for oil-palm cultivation.

That it can be grown in peasant holdings is illustrated in West Africa where the bulk of the oil comes from peasant farms, though the quality and the prices for their product are much lower than those of the carefully prepared oil from Malayan estates. The main stumbling block to peasant cultivation is the expensive machinery needed for extracting the oil, but it has already been found that the small hand-press as used in Nigeria could be adapted to suit the production from an area of about 20 acres, the press being capable of processing an oil equal in quality to estate oil, but having a recovery rate of 70 per cent as against the 90 per cent of the estates. The Director of Agriculture has expressed the opinion that prospects of oil-palm cultivation by smallholders are good, once transport, oil-extraction and marketing are efficiently organized. The International Bank Mission to Malaya has recommended the establishment of a carefully planned pilot scheme to cover both the production and processing aspects of the industry as well as the special study of all the other problems connected with peasant oil-palm cultivation.[1]

(2) *Cocoa.* The second crop which offers a likely avenue for the diversification of peasant cash-crop agriculture is cocoa. There were isolated cocoa trees throughout the Malay Peninsula from as early as 1778 but the crop has never been grown on a commercial basis. After the war considerable interest was aroused in Malaya by the potentialities of cocoa as an alternative to rubber, partly because of the greater world demand and the decreased production in West Africa and the West Indies, due to the 'swollen shoot' disease which attacks the plant. An expert was sent by the Colonial Office to investigate the possibilities of cocoa cultivation in Malaya, Sarawak and North Borneo. His report states that Malaya is capable of eventually producing 100,000 tons of cocoa per annum, and that the

[1] The Federal Land Development Authority is now laying greater emphasis on the cultivation of oil-palm on a peasant basis, and some of its land settlement schemes have oil-palm as its main cash crop.

development of a cocoa industry is unlikely to interfere with either padi or rubber cultivation as the requirements of the cocoa tree are different from those of the other two crops. Malaya also has the advantage of being free from the 'swollen shoot' disease. The hot humid climate of Malaya differs from that in established cocoa areas in its higher total rainfall and absence of a pronounced dry season, but otherwise it appears not unfavourable. The best soils are those derived from igneous rocks, particularly from the Pahang Volcanic Series. These soils are limited in area and are distributed mainly in eastern Malaya (Fig. 25). The lower and gentler slopes of a hill and valley region offer the best conditions for the growth of the tree. Because of its more exacting soil and shade requirements, cocoa cannot be grown on land already planted to rubber, so that the likelihood of its replacing old and less profitable rubber areas can be discounted. Neither can it be successfully interplanted with rubber.

Following the cocoa expert's recommendations, the Department of Agriculture has been engaged in accumulating supplies of planting material and gathering information on the behaviour of the cocoa tree under Malayan conditions. In 1949 trial blocks of seedlings imported from Ceylon and the Gold Coast were made, and experiments on locally available material were also conducted. It was subsequently decided that importation of seed or budwood should be stopped because of the dangers of introducing virus diseases into the country. Multiplication of the material already imported becomes the only method of increasing the supply of seedlings. Agricultural experiments have shown that the tree thrives under jungle or semi-jungle conditions but will not do well when intercultivated with rubber or planted on the poorer soils. Of the three main varieties of cocoa, that imported from the Gold Coast, known as the *Amelonado*, has proved the most promising in Malaya, being more vigorous, of better height and girth than the local *Trinitario* strain. The *Amelonado*'s pods also contain beans of a size acceptable commercially. Recent surveys indicate that a total of 100,000 acres of suitable land are available for cocoa cultivation.

Cocoa is promising as a peasant crop. The kampong or mixed garden environment is well suited to the tree and, in fact, many trees have been found thriving in kampong, though no use was made of the crop. Because of the need for processing and fermentation of the beans, a minimum of two to three acres must be planted as otherwise the number of beans would be insufficient for proper fermentation.

The techniques of cultivation and processing are at present unfamiliar to peasants in Malaya. The exact requirements of the tree which prevent its growth on old rubber areas and the lack of reserve land, however, render the establishment of the crop on existing peasant holdings unlikely, and any development must therefore be confined to new lands. The best argument for cocoa cultivation by peasant farmers is that the bulk of the cocoa in West Africa is produced by peasants.

So far there are five estates in Malaya planting cocoa on a commercial scale—two of these as a sole crop under 856 acres of thinned jungle in Trengganu and the other three totalling 225 acres as a secondary crop under coconut. There is also a pilot scheme for peasants in Trengganu, with 12 peasant farmers cultivating a total of 48 acres. The problem of a virulent tree disease known as cocoa die-back has not been solved. There is little likelihood of large-scale planting of cocoa in Malaya until this hurdle is cleared.

About 60 per cent of the total agricultural area in Malaya is at present cultivated under the peasant system. It is likely that this percentage will increase in future years. The problem here is to find ways and means to raise the efficiency of the peasants and thereby raise the generally low standards of production and the low quality of the products. The individual farmer will have neither the resources nor the ability to achieve this end. There must be a pooling of resources, perhaps on a co-operative basis, and in addition the government must bear the responsibility of ensuring that the peasants receive the necessary assistance.

RUBBER

The history of rubber in Malaya has its beginnings in the latter part of the nineteenth century. The rubber that is exported from Malaya comes from the latex of the tree *Hevea brasiliensis*, native of the Amazon valley. In 1876 Sir Henry Wickham collected some 70,000 *Hevea* seeds from the Tapajos region of the Amazon and sent them to Kew Gardens in England. Malaya received its first consignment of seedlings from Kew in the same year, but these soon died. Another consignment was received in 1877, and the plants were successfully raised in the Botanic Gardens of Singapore.

Until the end of the nineteenth century *Hevea* was planted only on an experimental basis, and in conjunction with similar experiments using other rubber-yielding plants such as *Ficus elastica* and the Malayan species of *Willughbeia*, to determine which of the several varieties was best suited to plantation agriculture. But by about 1895 the superiority of *Hevea* was established beyond doubt when it was found that it was easier to grow, and that it yielded a greater quantity and a better quality of latex than the other varieties. The year 1895 coincided with the advent of the first pneumatic automobile tyres. The rapid development of the motor car industry greatly increased the demand for rubber, causing prices to rise to levels which made it highly profitable to grow the crop.

The first commercial attempt at rubber planting in Malaya was made by a Chinese who established an estate in the north-eastern section of Malacca in 1898. His example was followed by other planters, mainly European, who started a number of small estates in several localities in western Malaya. From this tentative beginning rubber soon became firmly established as the major revenue crop of the country. The successful introduction of *Hevea* into the agricultural economy marked the end of the search for a tropical crop that could be profitably grown in the Malay Peninsula.

The earliest plantation crops grown on a commercial scale were spices and gambier, which were cultivated on Singapore Island, Penang and the adjoining mainland. Of these, pepper was the most important, but its place in the economy declined until, by the middle of the nineteenth century, it became only a minor export crop. There was a similar decline in the export of cloves and nutmegs from Penang when plant diseases devastated large areas under these crops. Meanwhile the 1830s saw the introduction of another revenue crop, namely sugar-cane, in Penang and Province Wellesley. Sugar-cane cultivation was given an impetus in 1846 when the British sugar import duty was reduced. There was an immediate and rapid expansion of sugar-cane estates, to such an extent that planters in Province Wellesley began to encroach on land in the Krian area of Perak. By 1899 there were about forty sugar-cane estates in Perak, occupying a total area of more than 50,000 acres and employing between 8,000 and 9,000 labourers. But sugar-cane did not last very long as a major revenue crop in Malaya. It has never been a very profitable industry, and severe competition from sugar-beet soon reduced prices to levels which forced the sugar-growers of Malaya to stop production. The industry, however, lingered on until 1913 when the last refinery closed down.

The last important revenue crop to be grown before the introduction of rubber was coffee. *Coffea arabica* was planted on a small scale in many parts of the Peninsula, but it was not until the 1870s that it became a plantation crop, cultivated chiefly in Perak. In 1879 a fungus disease, which had decimated the coffee plantations of Ceylon, attacked the Malayan holdings and destroyed all hopes of establishing Arabian coffee as a major crop. A different species, *Coffea liberica*, was then tried in the hope that it would not succumb to the fungus. Planting on a fairly wide scale took place in the 1880s in Perak, Selangor and Negri Sembilan, and the Malays began to cultivate it as a peasant crop. At the end of 1896 there were seventy-two European-owned coffee estates in Selangor alone, occupying a total area of some 47,000 acres and with a labour force of about 4,000 Indians and Javanese. After an initial period of success the price became unremunerative as Brazilian coffee beans flooded world markets, and by 1901 all the European-owned estates of Liberian coffee had been interplanted with the new crop—rubber. Although prices improved after 1912, coffee never regained its status as a principal export crop.

The failure of coffee coincided with the discovery that *Hevea* would grow readily in Malaya. Between 1896 and 1899, as the price of coffee fell and pests and diseases took their toll of the coffee trees, some of the planters began inter-cultivating *Hevea* with coffee. Rubber planting was pursued most vigorously in the area between Klang and Kuala Lumpur, where a number of coffee estates supplied land suitable for rapid planting. Later, as more seeds became available, areas of jungle were cleared and planted with rubber. The average price for rubber between 1890 and 1900 was from Malayan $1.30 and $1.70 per lb. The decline of coffee and the high prices for rubber acted in conjunction to stimulate rubber cultivation on an ever-increasing scale. The rubber areas increased from a meagre 345 acres in 1897 to about 50,000 acres in 1905. Coffee and sugar-cane were then being grown mainly as catch crops interplanted with young rubber trees. In the same year the export of rubber from the Federated Malay States was 105 tons, an insignificant figure compared with the 62,000 tons of wild rubber from South America and other tropical areas. But a large percentage of the Malayan rubber acreage was composed of trees which had not yet attained the tapping age of 6–7 years. After 1905, as more trees reached maturity, there was a corresponding increase in rubber output from the Malayan plantations.

Planting was further stimulated when the demand for rubber forced prices to rise above $2.50 per lb in 1906 and 1909, and to a record of nearly $5.50 per lb in 1910. Boom prices prevailed from 1910 to 1912. The rubber acreage in Malaya leaped from 50,000 in 1905 to over 290,000 in 1909. The spectacular profits realized by the rubber estates during the boom of 1910 to 1912 encouraged investors to put their capital into the large number of new rubber companies being formed in London. Although prices dropped steadily from the record of $5.50 per lb in 1910 to an average of 80 cents per lb in 1920, the rubber acreage and production continued to expand. In 1919 the net exports of rubber from Malaya reached nearly 200,000 tons, exactly half the total world exports of rubber. The pioneers in rubber were Europeans and Chinese, but from 1910 onwards there was a rush by Malay smallholders to grow the crop. In some cases they cut down their fruit trees and even planted their padi fields with rubber; in others, especially where immigrant Malays were concerned, they cleared and opened up new land. Planting was greatly facilitated by the ease with which land could be obtained.

The first setback to the industry came in the years 1920 to 1922 when prices dropped to depression levels, averaging 33 cents in 1921 and 1922. The slump was due to over-production, aggravated by the post-war depression and by extravagant methods of cultivation. The Stevenson Committee of Inquiry was appointed in 1921 to study the situation. The final report of the Committee recommended that the production and export of rubber in Ceylon and Malaya be restricted and controlled by Government. The decision to impose restrictions was made on the strength of the fact that Malaya and Ceylon together produced more than 70 per cent of the world's rubber, and in spite of the refusal of the former Netherlands East Indies to co-operate in the Scheme. The object of the Stevenson Scheme was to raise prices above slump level, and to stabilize them at about 54 cents per lb by curtailing production and imposing a system of variable export quotas. The Scheme was adopted in 1922 and restriction remained in force for six years until November 1928.

The immediate effect of restriction was to raise average prices to 54 cents per lb in 1923, and 47 cents in 1924. The recovery of the motor car industry in the United States, and the growing demand for rubber boosted average rubber prices to $1.25 per lb in 1925. The price increases which resulted from restriction in Malaya and Ceylon benefited all the other rubber producing countries of the world, especially the Netherlands East Indies. Because they were not partners in the Scheme, the Netherlands East Indies were able to take advantage of the rise in rubber prices by increasing production and planting new areas with rubber. The result was that, while the share of Malaya and Ceylon in the total world exports of rubber fell from 70 per cent in 1922 to 52 per cent in 1927, the Netherlands East Indies' share over the same period rose from 25 per cent to more than 40 per cent. The total planted area of rubber in the Netherlands East Indies increased from 378,000 hectares in 1922 to 526,000 hectares in 1928. At the same time, restriction in Malaya and Ceylon encouraged the use of reclaimed rubber in the United States, so that the demand for natural rubber dropped and the accumulated stocks of rubber on the market could not be cleared.

The effect of increased production in the Netherlands East Indies and the drop in demand in the United States was again to lower the price of rubber and in spite of the Stevenson Scheme, the prices of rubber continued to fall steadily until they reached about 36 cents per lb in 1928 and 1929. By then it was apparent that the Scheme was no longer effective because of Dutch competition, and it was therefore abandoned in 1928. During the six years of the Scheme the Government of Malaya had followed a policy of refusing to alienate land for new planting, with the result that Malaya lost its place to the Netherlands East Indies as the territory with the world's largest planted area of rubber. By 1929 the total planted area in the Netherlands East Indies was 3,155,000 acres and that in Malaya was 2,945,000 acres, but a much larger percentage of the acreage in the Netherlands East Indies consisted of immature rubber so that its production remained less than that of Malaya.

With the end of restriction, rubber production increased greatly and surplus stocks began to accumulate as more and more rubber came into the market than could be consumed. In 1930 the market for rubber collapsed due to the world depression, and prices slumped to the lowest so far recorded. Average world prices during the Great Depression were 19 cents per lb in 1930, 10 cents in 1931, 7 cents in 1932, 10 cents in 1933 and 22 cents in 1934. The effects of the Depression in Malaya were serious. A very large percentage of the rubber smallholders discontinued tapping and turned to growing food crops. Some of the estates stopped production and there was widespread unemployment as the estate labourers were discharged. The other estates managed to survive the crisis by practising the strictest economies, and greatly reducing their costs of production to the levels where they could avoid loss at the current prices.

It became clear to all the rubber producers, including the Dutch in the Netherlands East Indies, that some form of restriction had to be imposed on production if the industry was to survive. Accordingly, a committee was appointed for the purpose of formulating a plan to regulate production from the rubber-growing countries of South-East Asia, India and Ceylon. The new agreement was signed by all the countries concerned and came into effect in May 1934. From then until the outbreak of the Second World War rubber production in South-East Asia, India and Ceylon was controlled by the International Rubber Regulation Committee. A definite quota was assigned to each producing country for each year. The basic quota for Malaya in 1935 was fixed at 504,000 tons. At the same time the Malayan Government stopped the alienation of land for rubber planting and prohibited new planting, although it permitted replanting of old rubber land. This law was relaxed for 1939 and 1940, when producers were permitted to engage in new planting on an area equivalent to 5 per cent of their 1938 acreage.

With the curtailment of exports rubber prices began to improve. The average prices increased gradually from about 21 cents per lb in 1934–35 to about 43 cents in 1941, the improvement being due as much to the armaments race and stockpiling as to export restrictions.

The 1920–22 depression, the Great Depression and the restriction schemes of 1922–28 and 1934–41 put a check to rubber planting in Malaya. In fact the official policy over this period was to discourage new planting by refusing to alienate land for rubber. In spite of this, the rubber acreage increased from 2,945,000 acres in 1929 to 3,481,000 acres in 1940, of which 2,107,000 acres were in estates and 1,374,000 acres in smallholdings, that is, holdings of less than 100 acres. The increase in planted area was due to new planting on land already alienated but not yet planted with rubber. Such land had been held either in reserve and unplanted, or for the cultivation of other crops. Many of the large estates had reserved land which could be used for the purpose, but most smallholders did not have unplanted reserve land. The only alternative was to grow the rubber on land which was under some other peasant crops, such as coconuts, fruit and even padi. That many of them were willing to do this and sacrifice a source of income indicates the great attraction rubber growing had for the smallholders. Some of them ignored the planting ban during the Stevenson Scheme and grew rubber on land which had been alienated for other crops, while others went even further and established holdings on untitled land.

The rubber industry, in common with the other sectors of production in Malaya, suffered a reversal during the Japanese occupation. Planting and production came to a standstill. The occupation period saw the destruction of about 8 per cent of the estate acreage and about 4 per cent of the smallholding acreage of the country. In addition, there was widespread destruction of factories and other buildings as well as machinery. Many of the rubber areas suffered badly from general neglect, and were unkempt and overgrown with *lalang* and other growth. The estate labour force was scattered: some of the labourers turned to food growing, others to wage earning in the towns, whilst a large number of them were sent by the Japanese to help build the Burma–Siam railway. When the war ended only about a third of the pre-war labour force remained, so that the estates were greatly handicapped in their efforts to resume production.

The smallholders, on the other hand, relied mainly on family labour, and this, coupled with the fact that only the simplest equipment was required in their manufacturing processes, enabled them as a group to recover more quickly from the neglect of the war years. They were thus able to produce nearly 57 per cent of the total Malayan rubber for 1946, although owning only 44 per cent of the total acreage. By 1947, however, estate efficiency had been restored and estate production exceeded that of the smallholders for the first time after the war. Since then the estates have produced between 55 and 60 per cent of the Malayan output (Fig. 49).

The Malayan rubber industry suffered another set-back when the Communist uprising broke out in 1948. One of the major aims of the Communists was to disrupt the national economy by armed attacks on the rubber estates and the intimidation of workers. Whilst they did not succeed in attaining their objective, the attacks, nevertheless, seriously hampered production in some of the remote estates. In addition, the estate sector of the industry had to bear part of the heavy expenditure involved in providing protection for the plantations. This financial burden cut deeply into the profits for 1948 and 1949, when the profit margin for estates was already poor because of low average prices. However, the overall production remained high.

When the Korean War broke out prices soared high as the United States began to build up her stockpile of rubber. Prices rose to $1.08 in 1950 and later to a post-war record of $1.69 per lb. However, the boom petered out quickly and by 1953 average prices had fallen to 67 cents per lb. Since then they have remained below $1 per lb, except in 1953 when prices reached $1.14, and again in 1959 when the average price was $1.01.

The total area under rubber in Malaya has not increased to any great extent since 1941. From 1946 to 1957 the total area increased

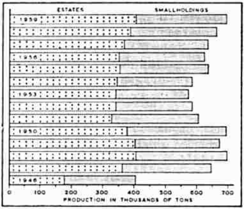


FIG. 49. Rubber production by estates and smallholdings, 1946–59

by about 112,000 acres, mainly due to new planting by estates rather than by smallholders. The planted area in 1957 was approximately 3,520,000 acres, of which slightly more than 2,020,000 acres were in estates and about 1,500,000 acres in smallholdings. The total acreage has since fallen to about 3,442,000 in 1960, due mainly to a decrease in the estate area.

Indonesia has the world's largest planted area under rubber, estimated at roughly 4,500,000 acres. Production in that country, however, is only slightly more than in Malaya, and has been hampered in recent years by internal political and economic troubles. The other rubber growing countries are Thailand, Ceylon, Sarawak, West Africa and South America. Malayan rubber is exported to most of the industrial countries of the world, with the United Kingdom as the largest single importer, followed by the United States. These two countries together regularly consume about 40 per cent of the total Malayan output, although consumption has fallen to between 20 and 30 per cent in recent years. The U.S.S.R. and Japan have recently become important customers of Malayan rubber.

Methods of Cultivation and Production. The rubber tree, *Hevea brasiliensis*, is a hardy plant and in its native habitat in the Amazon Valley can survive the fiercest competition from other jungle species. It is a large tree with a straight trunk and high branching limbs. The smooth dark green oval leaves are shed once a year between January and April, but all the trees are never devoid of leaves at the same time. During this 'wintering' period there is a temporary drop in yield. The tree grows best in an equatorial climate with constantly high temperatures and a heavy, evenly distributed rainfall of 80 to 100 inches or more a year. As far as climatic conditions are concerned, the tree will thrive in any part of the Malay Peninsula below an elevation of about 1,000 feet; its growth becomes stunted at elevations above 1,500 feet.

It is also undemanding in its soil requirements but grows best in soils which are friable, deep, well-oxidized and acid in reaction (pH 4·0 to 6·5). Rubber covers about two-thirds of the total agricultural area of Malaya and is planted on a wide variety of soils. The value of the alluvial soils, most of which contain large amounts of impervious clay, depends on adequate drainage. They are suitable for rubber if the water table lies at an average depth of more than 42 inches. The soils derived from acid igneous rocks (granite) support good stands of rubber, but the sides of most of the granitic mountains are too steep for agriculture. However, rubber is planted where such soils occur in the foothills. Soils derived from basic igneous rocks (Pahang Volcanic Series and Kuantan Series) are the most fertile of the inland residual soils, and rubber trees grow to a large size and give high yields when planted in them. Sedimentary rocks cover a large proportion of the foothills and undulating land between the coastal plains and mountain ranges of western Malaya. Soils derived from such parent materials are of variable value for rubber cultivation. Soils derived from sandstones can be cultivated with *Hevea*, but those developed from shales and phyllites usually contain a lateritic hardpan which is highly resistant to root penetration. Rubber trees planted in areas where the hardpan lies near the surface become stunted and give very poor yields.

Hevea will not grow well in areas of impeded drainage. Good drainage is necessary to maintain a sufficient concentration of oxygen in the soil atmosphere, to allow excess carbon dioxide to diffuse away from the root zone, and to assist in the removal of toxic hydrogen sulphide from the soil. The best sites are undulating land

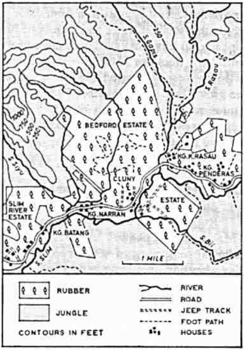


FIG. 50. Rubber estates on well-drained foothill locations

with good natural drainage (Fig. 50), but flat swampy areas can be converted into good rubber land by an efficient drainage system. Much of the swampy land along the west coast of Malaya has been rendered suitable for rubber cultivation by careful drainage (Fig. 51). However, rubber trees planted on recently drained peat soils may have their roots exposed through progressive subsidence of the land as the peat dries, and are liable to fall over in a strong wind (Plate 15).

Most of the rubber holdings have been established on land formerly under jungle, though some of the oldest estates are on land previously under other crops such as sugar-cane, gambier, coffee or tapioca. Some of the Malay smallholdings, too, are planted on land formerly under subsistence crops such as padi, coconut or fruit.

The processes involved in establishing a rubber holding have remained substantially the same since the early days of rubber cultivation. The selected site is cleared of its jungle cover and the felled timber left to dry for two or three months. The timber is then

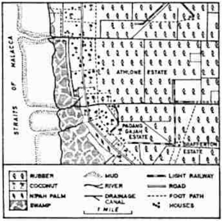


FIG. 51. Rubber estates on coastal, swampy locations

set on fire. The requirements for a successful burn are: (i) a period of three consecutive days without rain immediately prior to the day of the burn, (ii) several hours of sunshine on the day of the burn, to dry off the dew, and (iii) at least a slight breeze to help spread the fire. Burning causes a great loss of organic matter and nitrogen from the soil, although it is the cheapest and most efficient way of clearing the jungle. Soil exposure may be reduced by clearing the site of its vegetative cover without burning. But the advantage of conserving the humic matter is more than offset by the difficulty of movement of labour, the problem of controlling root disease and weeds, and the dangers of pest damage which results from this method.

In the early phase of rubber planting the land was clean-cleared after burning, and the rubber seedlings planted on the bare land. In recent years it has been recognized that cover crops are necessary to protect the soil from excessive exposure and erosion. Apart from affording such protection, cover crops help to aerate and drain the soil, they preserve its structure and enrich it with mineral nutrients taken up from below, or, in the case of leguminous covers, through the fixation of atmospheric nitrogen by bacterial action. There are two types of cover crops employed in estates: (i) leguminous creepers such as *Centrosema pubescens* or *Pueraria javanica* and (ii) indigenous plants, except such undesirable weeds as *lalang* (*Imperata cylindrica*), bracken, stagmoss and Straits rhododendron. However, no cover crops are planted in many of the Chinese and Indian smallholdings. Instead, the spaces between the rubber trees are inter-planted with revenue crops such as gambier, tapioca, pineapple and banana. They are usually grown for two or three years until the rubber trees branch out and form too dense a shade for further successful intercultivation. Apart from cover crops, other methods of soil conservation may be necessary. On steep slopes terracing may be required as well as cover crops, and on moderately steep slopes contour bunding with a cover crop planted on the bunds is common. The cover crops are put in as early as possible after clearing, and after they are established the planting of rubber begins. Another method of soil conservation on slopes is to dig silt-pits. The soil from the pits is placed on the upper edge to check the force of the water running down the slope.

In the first few decades of rubber planting most of the estates and practically all the smallholdings were planted with unselected seedlings. The seeds were either raised initially in nurseries, or in baskets, and then transplanted to the field when they reached a height of about 18 inches. Some were planted directly in the field. Two or three seeds were planted per hole and the weaker seedlings removed after six to nine months, leaving only the most vigorous seedling. But the trees raised from such seed gave highly variable yields. The modern practice is to plant only selected material which has been proved to be capable of high yields. A number of such high-yielding varieties or clones[1] have been developed by the Rubber Research Institute of Malaya, and by similar organizations in the other rubber-growing countries of the world (notably Indonesia). There are two ways in which high-yielding material may be propagated—through clonal

[1] A clone is a group of plants, all the individuals of which are obtained by vegetative propagation from a single parent tree, whether directly or by multiplication.

seedlings or through budded stumps. By the first method the seeds from clones which have been proved to be high yielders are planted and the seedlings used to stock the holding. In the second, a high-yielding clone is grafted on to an ordinary seedling (called the root-stock) to produce a budded stump. This is done in a nursery and the budded stumps are then transplanted into the field.

The policy in the large European estates is to maintain a limited number of trees per acre. The pre-war practice was to plant an initial stand of 120 to 180 trees per acre, and subsequently to thin them out until a final stand of 80 to 100 trees per acre was obtained. The optimum density for high-yielding trees is about 120 per acre, with initial stands of 180 trees per acre for a budded stand, and 200 per acre for clonal seedlings. However, there is no hard and fast rule about the most profitable planting density. In contrast to estate practice, planting on smallholdings is very dense. Initial stands on small holdings are between 300 and 500 trees per acre, with final stands of between 200 and 400 per acre. The aim of the smallholders is to obtain a high yield per acre through dense planting, while the estates aim at high yields per tree.

The smallholder does not normally apply any manure or fertilizer to the growing plants. The general practice in estates is to add fertilizers to most soils at different stages in the growth of the trees. Fertilizers are thoroughly mixed with the top 6–8 inches of soil in the planting hole at the time of transplanting the seedling or budded stump from the nursery, rock phosphate or an organic manure being used. Experimental work at the Rubber Research Institute has indicated that a mixture of phosphate, potash and nitrogen should be given at regular intervals during the growth of the young rubber plants in order to ensure against deficiencies of these elements. With some soils, however, one or more of these mineral elements can safely be omitted without impairing the growth of the trees. Sulphate of ammonia or mixtures containing nitrogen and phosphate are most commonly used in mature rubber holdings. Potash is added to the mixture in areas with very sandy soils. Rubber planted on alluvial clay and soils derived from the Pahang Volcanic Series of rocks requires little or no manuring.

It takes from five to seven years from planting for a rubber tree to attain its tapping age. Tapping is the controlled wounding of the bark of the rubber tree so that the latex vessels are opened and the liquid latex flows out. Latex itself consists of about 60 per cent water, 35 per cent rubber hydrocarbon, and the remainder small percentages of mineral constituents. One of the main steps to the successful introduction of rubber into tropical Asia was the discovery of the proper method of tapping, a discovery made by H. N. Ridley and other pioneers at the turn of the century. The modern method of tapping is to cut a thin shaving of bark (bark excision) from the trunk at regular intervals, the cut being made at an angle so that the latex flows down into a cup placed to receive it (Plate 16). The cut is made with a special tapping knife. The tree is tapped once daily, or once in two, three or four days, by reopening the cut with the tapping knife. There are many different tapping systems practised in Malaya, depending upon the type of tree (whether grown from unselected seedlings, clonal seedlings or budded stumps), the method of cultivation (whether estate or smallholding), the prevailing rubber prices, and on individual preference. The ideal system is one which gives the highest yields at lowest tapping costs with the best growth and bark renewal, and the lowest incidence of brown bast (a disease of the tapping panel). The main systems used are those in which: (i) the cut extends around half the circumference of the tree and the tree is tapped on alternate days; (ii) the cut extends as a spiral around the full circumference and the tree is tapped once in four days; (iii) the cut extends around a third of the circumference and the tree is tapped on alternate days; and (iv) the trees are tapped continuously for six to twelve months and then rested for two to six months.

The yield of latex varies considerably with the type of planted material. Table 27 gives the average yields for estates in Malaya as a whole. The difference in yield between unselected seedlings and high-yielding material is considerable. An acre of high-yielding rubber can produce more than twice as much latex as an acre of rubber grown from unselected seedlings. Experimental trials conducted by the Rubber Research Institute have shown that yields of 1,500 to 2,100 lb per acre per annum can be obtained from the best of the high-yielding material. However, some rubber growers, mainly peasant farmers, continue to plant ordinary unselected seedlings in their new holdings in spite of the obvious advantage of high-yielding material. For example, 49 per cent of the 92,000 acres of rubber planted in 1957 were of unselected seed. Ignorance of the advantages to be gained from cultivating high-yielding rubber, or of the existence of such rubber, accounts for the peasant farmer's failure to benefit from the research work of plant breeders. The national as well as the peasant economies are adversely affected through the planting of unselected seedlings because valuable rubber land is unnecessarily locked up for a considerable period of time under low-yielding rubber, when the same piece of land could be put to more productive use if planted to selected high-yielding material.

In preparing latex for export it is first coagulated by the addition of a small quantity of formic or acetic acid. The smallholder will then pass the resultant coagulum through rollers and dry the final sheet in the sun or by smoking. An estate will treat the coagulum in one of several different ways. It may be passed through rollers and the

TABLE 27. *Yield per Acre for High-yielding Material and Unselected Seedlings, 1955–60*

YEAR	HIGH-YIELDING MATERIAL Yield in lb per acre per annum	UNSELECTED SEEDLINGS Yield in lb per acre per annum
1955	806	355
1956	781	354
1957	806	374
1958	854	404
1959	898	434
1960	927	442

rolled sheets dried in a smoking shed or, it may be passed through a creping machine and air-dried for ten to fifteen days in a drying shed. The final product in the first case is ribbed smoked sheet, and in the second crepe rubber. The rubber is then graded and packed in bales before being exported (Plate 17). Also, some estates prepare concentrated latex for export. This is done by removing some of the unwanted water in ordinary latex by a centrifugal process, or by creaming, or by evaporation, and preserving the concentrated latex through the addition of ammonia. The advantages of concentrated latex lie in a considerable financial saving in connection with preparation and transport, as well as in freight and packing. The export of concentrated latex from Malaya has increased from 40,000 tons in 1948 to 114,000 tons in 1960. Of the 767,000 tons of rubber exported in 1960, 58 per cent was in the form of ribbed smoked sheets, 24 per cent crepe rubber, 15 per cent concentrated latex, 2 per cent raw scrap, and 1 per cent was exported in the form of skim rubber.

The Types and Distribution of Rubber Holdings. The Malayan rubber industry is stratified according to size of holdings and nationality of ownership. The situation with regard to the estates is summarized in Table 28. The larger estates (2,000 acres and above) are controlled mainly by Europeans (including Americans), whilst Asians are predominant as owners of the smaller estates. In general,

TABLE 28. *Nationality of Ownership of Rubber Estates in Malaya, 1960*

Size Group (acres)	European		Asian		Total Acreage
	Number of Estates	Acreage	Number of Estates	Acreage	
Under 500	41	11,030	1,418	273,788	284,818
500–999	69	52,327	211	151,682	204,009
1,000–1,999	172	251,014	105	142,761	393,775
2,000–2,999	79	199,835	23	54,297	254,132
3,000–4,999	86	337,451	14	52,115	389,566
5,000 and over	45	319,174	11	96,698	415,872
TOTAL	492	1,170,831	1,782	771,341	1,942,172[1]

[1] Includes 7,649 acres planted in Singapore.

Europeans own the largest estates, Chinese the medium-sized and Indians the smallest. Malays own less than 2 per cent of the total estate acreage, and Malay estates are usually also small.

Table 29 shows the distribution of the rubber estates. Ninety per cent of the estates are concentrated in western Malaya from Kedah in the north to Johore in the south (Fig. 52). This zone or belt, sometimes referred to as the Tin and Rubber Belt, varies in width from 5 to 40 miles, and covers the coastal plain, inland freshwater swamps and the foothills up to an altitude of about 500 feet. The earliest rubber holdings were developed on the drier sites of the undulating lowlands and the slopes of the foothills. But the great demand for rubber soon led to the reclamation of extensive areas of swamp land.

There is a lack of accurate statistics with regard to the smallholding sector of the rubber industry. A smallholding is defined as 'an area, contiguous or non-contiguous, aggregating less than 100 acres, planted with rubber or on which the planting of rubber is permitted, and under a single legal ownership'. The available statistics indicate that, of the estimated 1,500,000 acres of smallholdings

TABLE 29. *Distribution of Rubber Estates in Malaya, 1960*

STATE	Number of Estates	Total Acreage
Johore	505	550,880
Selangor	326	323,771
Negri Sembilan	270	270,417
Perak	390	261,129
Kedah and Perlis	279	208,715
Pahang	182	116,719
Malacca	138	114,499
Kelantan	62	43,194
Penang and Province Wellesley	59	27,766
Trengganu	37	17,433
TOTAL	2,248	1,934,523 [1]

[1] Does not include the twenty-six estates covering 7,649 acres in Singapore.

roughly 50 per cent are Malay-owned, 30 to 40 per cent Chinese-owned, and the remainder owned by Indians and others. The 1960 Census of Agriculture showed that there were 90,886 rubber smallholdings in Malaya. Thirty-one per cent were in Johore, 18 per cent in Perak, 10 per cent in Kelantan, 9 per cent in Pahang, 8 per cent in Kedah, 7 per cent in Selangor, and the remainder in the other States. Ninety-six per cent of all the small-holdings were less than 25 acres in size, 89 per cent less than 15 acres in size, 76 per cent less than 10 acres in size, and 66 per cent less than 7½ acres in size. The median for the Federation as a whole was in the 5–7½ acre size group.

The marked concentration of rubber holdings along the western littoral of the Peninsula, as illustrated in Fig. 52, is the result of a

FIG. 52. Distribution of rubber

fortuitous combination of circumstances. Given the demand for rubber and its products in world markets, the successful establishment of *Hevea* depended upon three other main factors, namely: (1) suitable conditions of climate and soil; (2) a cheap and abundant supply of labour; and (3) cheap and efficient means of transport.

The natural conditions of climate and soil were found to be well suited for the growth of *Hevea*, especially along the well-drained gentle slopes of the foothills on both sides of the mountainous backbone of the Peninsula, and the undulating land of southern Malaya. Cheap and plentiful labour was available from south India. But the special attraction of western Malaya for the rubber planters was provided by the skeleton network of roads and railways already laid out to serve the tin mining industry of the western foothills. The combination of a good transport system, well-drained sites, and proximity to the deep-water ports of Penang and Port Swettenham as points of entry and exit for labour, materials and processed rubber, probably accounts, more than anything else, for the concentration of rubber cultivation in this part of the country. In addition, many of the earliest rubber estates were planted in the western States on land which had once been under sugar-cane or coffee. Another factor which attracted the planters to the west was the early establishment of political stability in the tin-rich States of Perak, Selangor and Negri Sembilan. The success attending the first ventures at rubber growing gave further impetus to agriculturalists to open up more land for the crop. All these influences have worked to establish the greatest concentration of rubber in the west.

The distinction between the two main types of holdings—estates and peasant holdings—does not lie in differences in size alone. The limits of an estate are usually well-defined. It generally presents a picture of orderliness, with the rubber trees growing in neat rows and the undergrowth kept down by constant cutting. Some estates have little or no undergrowth and in this respect resemble the orchards of temperate lands in appearance. Each estate is served by an internal system of roads or laterite tracks radiating from a focal point (marked by the processing factory) to all parts of the holding, with pathways from tree to tree. There is also direct connection between the processing factory and the nearest main road or railway line. Occupying a central position in the estate is a group of buildings composed of the processing factory and smokehouse, the labourers' quarters and the manager's house. One of the main differences in the functioning of an estate as opposed to a peasant holding is the source of labour. Labour is hired, either directly or by contract. There is also a division of labour within an estate—one group being engaged in tapping and latex collection, another in the preparation and processing of latex, a third in packing the finished rubber, and minor groups in weeding and the general upkeep of the estate. Forty-eight per cent of the 285,300 labourers employed in estates in 1960 were Indians, 30 per cent were Chinese and 22 per cent Malays. Fifty-three per cent of them were male adults, 42 per cent female, and the remainder young persons.

The peasant holding has a very different external appearance from that of the estate. The rubber trees in a peasant holding are often interplanted with fruit, coconut or other trees and bushes. The rubber trees do not always form continuous stands but may be in isolated clumps separated by other vegetation. Beyond the environs of the peasant's house, the mixed stand of rubber and other tree crops usually gives way to a pure stand of rubber growing in the midst of tall undergrowth and rubber seedlings which have taken root from fallen seed. This pattern of mixed stands facing the road, river or railway and pure stands in the interior is a common one. Peasant holdings of this kind may stretch for many miles on both sides of a line of communication, with no clear boundaries between individual holdings. The processing shed is usually near the house and consists of nothing more than an open-sided thatched hut housing a mangle or roller. There is no division of labour, the peasant and his family performing all the tasks of tapping, collecting, processing and drying the rolled sheets. The dried sheets are transported by bicycle and sold as low-grade rubber to the nearest rubber dealer, who is usually also the local shopkeeper.

Problems facing the Rubber Industry. It is difficult to over-emphasize the importance of rubber in the national economy. Malaya regularly produces between 600,000 and 700,000 tons of rubber each year, that is, roughly one-third of the world production of natural rubber. Rubber occupies 64 per cent of the total cultivated area of the country and contributes about 60 per cent of the total export earnings.

In the sixty years since *Hevea* was first introduced into the Peninsula, Malaya has emerged from economic obscurity to occupy the position of a leading supplier of rubber to the international commodity markets. The industry has attracted overseas capital and given impetus to the development of all the States. The attendant benefits of prosperity have in their turn permeated all spheres of life. Public services in the form of roads, railways and harbours, and social welfare amenities including health and education, have expanded accordingly to cover a large section of the population.

The standard of living in Malaya is the highest in South-East Asia.

But the prosperity of the rubber industry was not achieved without a struggle. In the course of attaining its pre-eminent position in the country, the industry had to overcome a number of problems which at times threatened to overwhelm it. These problems were not connected with the actual growing of *Hevea*, for in Malaya there is no disease that threatens the rubber plant in the way that the South American leaf blight devastates rubber holdings in tropical America. One of the most serious obstacles to rubber cultivation in Malaya was malaria. Most of the estates which were started in the early years of the industry were on the gentle slopes of the foothills of western Malaya. The main and most dangerous malaria vector of the Peninsula—*Anopheles maculatus*—has its natural habitat in the clear, sunlit waters of small running streams. This vector was responsible for very high death-rates among rubber estate workers. The clearing of the forest and its undergrowth for rubber created favourable conditions for the multiplication of *maculatus*. The result was an extremely high malarial infection among the susceptible labour force recruited from south India. In 1911, for example, 9,000 out of a total estate labour force of 143,000 died from malaria. Individual estates suffered regular heavy losses from the disease. For instance, the Highlands and Lowlands Para Rubber Limited had a mortality rate of 20 per cent every year during its pioneering phase. Nearly half the labourers of the Midlands Estate died in the three years 1910 to 1912.

The problem of malaria was overcome through the efforts of Ross, Watson and Strickland, who evolved various methods of controlling the vectors by the destruction of their larvae. One very successful method was subsoil drainage, whereby all running water was led into underground drainage pipes out of the reach of the anophelines. Such a method, however, was too expensive for estate application. It was later discovered that a mixture of crude oil and kerosene poured over the breeding locations completely destroyed the mosquito larvae, and this method was widely adopted by the estates. Oiling, together with the increasing use of drug prophylaxis, led to a spectacular fall in the incidence of malaria and by 1935 malaria had ceased to be a major problem both in the estates and in the towns.

Rubber is especially liable to violent fluctuations in price. The rubber planters of Malaya have experienced periods when the price of rubber has fallen far below the cost of producing it, whilst at other times boom prices have prevailed. Figure 53 illustrates the range of average prices for the years 1926–59. Between the average of 7 cents per lb in 1932 and 169 cents for 1951 is a difference of 2,400 per cent. Fig. 53 shows the annual average prices only; the

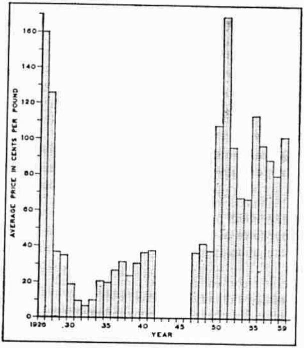


FIG. 53. Average annual price of rubber (No. 1 Ribbed Smoked Sheet), Malaya, 1926–59

degree of fluctuation for monthly prices would be even wider. In seeking the advantages of crop specialization, rubber planters, as well as the country as a whole, have to face the liability of price instability. The problem is one over which the planters have little control, for the price levels are determined by the interplay of international market forces, and are tied in with the general economic as well as political conditions of the world. In some tropical countries, such as those of West Africa, semi-governmental organizations called Produce Marketing Boards help to smooth out the ups and downs of commodity prices by guaranteeing prices for any one season, and taking up all the produce that local growers can supply. The Marketing Boards then sell the produce at the prevailing world prices in the commodity markets, profiting or losing by the transaction as the case may be. There are no such marketing boards in Malaya, and all rubber growers, estates as well as smallholders, are fully exposed to price risks.

The rubber planters of Malaya, as well as the natural rubber producers in other parts of the world, are now faced with serious competition from the synthetic product. Synthetic rubber production expanded considerably during the Second World War. The Japanese conquest of South-East Asia deprived the Allies of most of their natural rubber, and forced them to manufacture the synthetic product on a large scale in order to continue the war effort. The total production increased from a mere 2,560 tons in 1940 to 820,350 tons in 1945. In 1960 the total world output of synthetic rubber was 1,892,500 tons compared with the total output of 1,995,500 tons of natural rubber. Synthetic rubber production is expanding as new factories are set up in an increasing number of countries. New types of synthetic rubber are being made to meet the demand for special purposes rubber. For example, Butyl rubber is less permeable than natural rubber and is therefore more suitable for pneumatic tyres. Moreover, whatever advantages the natural product might have had over synthetic rubber have now disappeared with the discovery of an exact synthetic duplicate of natural rubber. In 1955 the synthetic rubber factories of the United States were denationalized, and the private firms which purchased them have lowered their manufacturing costs to such an extent that the price of synthetics is now lower than that of natural rubber. For these reasons the general expectation is that for some years to come there will be a steady drop in the price of natural rubber.

The Malayan rubber planters can only meet this competition by lowering their costs of production, improving the quality of natural rubber, and increasing output through the planting of high-yielding material. The wages of the tapping force alone are estimated to make up about 40 per cent of the costs of production on an estate planted with unselected seedlings, and it is unlikely that there will be any general reduction in labour costs because of the rising standards of living and resistance from the strong labour unions. The estate sector of the industry must, therefore, cut down on other expenses in order to lower production costs. So far as the smallholders are concerned, their costs of production are negligible, but the quality of rubber produced by them is usually low and commands correspondingly low prices. The scope for improving smallholder rubber appears to be great, and experiments on centralized processing of smallholder rubber into good quality sheets are being carried out.

The best and most practical method by which Malayan natural rubber can be made competitive in price with synthetic rubber is by increasing the yield per acre. As noted earlier, the high-yielding material planted in Malayan estates gives from two to three times as much latex as the unselected seedlings. The best clones are capable of yielding from 1,500 to 2,100 lb per acre per annum as compared with the 350 lb average for unselected seedlings. The policy followed in all estates today is to plant only high yielders in new holdings, but many smallholders, through ignorance, continue to cultivate unselected seedlings in their new holdings. Fifty-eight per cent of the total estate area of 1,934,523 acres in 1960 was already planted with high-yielding material.

The other important problem facing the rubber industry is the replacement of old uneconomic trees with high yielders. Replanting has become an urgent necessity because a high percentage of the rubber acreage in Malaya is composed of trees which are too old to produce economic yields. The productive life of a rubber tree is about thirty-five years. The tree is not tapped until it is six or seven years old. The yield from the seventh year onwards increases rapidly until a peak is reached between the fifteenth and seventeenth year, after which there is a steady decline until the tree ceases to yield any latex. For this reason a rubber holding must be replanted with new stock about once every thirty years in order to maintain continuous production. Unfortunately, because of the Great Depression of the 1930s followed by the Second World War, and because of a lack of foresight, especially on the part of the smallholders, a position was reached in 1952 in which more than half of the total planted acreage, both estates and smallholdings, was composed of trees which were more than thirty-three years old. The backlog of replanting in 1952 has been estimated at 1,500,000 acres, and in order to counter the combined threat of over-aged trees and competition from synthetic rubber, it was necessary to accelerate the rate of replanting.

In order to assist the rubber industry in its replanting programme a special tax was imposed on all rubber exported from Malaya, and funds thus acquired were used to subsidize the cost of replanting in both estates and smallholdings. The smallholders were in a far worse position than the estates as a greater percentage of their acreage consisted of over-aged trees. The Government therefore set a target of 480,300 acres to be replanted by the smallholders between 1953 and 1959. The actual acreage replanted up to 1959 is shown in Table 30. Whilst the rate of replanting on smallholdings has in-

TABLE 30. *Acreage Replanted on Estates and Smallholdings, 1953–59*

YEAR	ESTATES	SMALLHOLDINGS	
		Target	Area actually replanted
1953	29,800	40,000	29,500
1954	39,100	50,300	22,600
1955	57,600	60,000	25,300
1956	78,400	70,000	46,500
1957	76,300	80,000	49,800
1958	64,800	90,000	59,700
1959	68,200	90,000	76,700
TOTAL	414,200	480,300	310,100

creased markedly in recent years, it is still well behind schedule. The estates, aided by the Replanting Scheme and reserve funds of their own put aside for the purpose, have been replanting at a much faster rate than the smallholders. The slow progress in the smallholdings is due to a number of factors. In the first years of the Scheme many smallholders were not aware of their eligibility for a replanting grant, while others were hesitant about applying for assistance until they were fully satisfied that it did not involve governmental control of their holdings. But the main reason for the slow rate of replanting was the reluctance on the part of the peasants to cut down their old trees and thus lose their major source of income for the next six or seven years before the new trees could mature. This reluctance became more pronounced as the price of rubber increased, since the income lost through cutting down the trees would be correspondingly greater.

Table 30 shows that the area actually replanted by the smallholders fell short of the target by 170,200 acres. The gap between the area of land with over-aged trees and the area of newly planted land will therefore grow wider each year. Though the estates are in a better position, both estates and smallholdings will have to speed up their rate of replanting in order to counter the threat from synthetic rubber.

PADI

Padi is the second most important crop of Malaya in terms of area, occupying 17 per cent of the total cultivated area of the Federation. Padi cultivation is entirely a peasant occupation and almost entirely a Malay interest. Ninety-six per cent of the total working population of 398,295 engaged in padi farming in 1957 were Malays, 2 per cent were Chinese and the remainder Indians and others. The padi that is grown in Malaya is mainly of the 'wet' variety and cultivated in flooded fields.

The history of wet-padi cultivation in Malaya is a comparatively recent one, and this may account for the lack of adjustment of planting techniques to the physical environment in some parts of the Peninsula. Although the crop has long been planted in the Peninsula, the varieties grown before the fifteenth century were cultivated in the *ladang* manner without the use of irrigation water. Malay tradition has it that the techniques of ploughing and flooding the fields were introduced from Thailand into the northern Malay States during the fifteenth century. The new method spread slowly along the coast to the southern States during the course of the next century. The Minangkabau who migrated from Sumatra and settled in large numbers in Negri Sembilan also grew wet-padi and worked the land with the methods they brought over from across the Straits of Malacca. From the beginning of the nineteenth century wet-padi cultivation was increasingly adopted by the Malays but did not entirely supersede hill or dry-padi cultivation until the beginning of the present century when the Government discouraged dry-padi cultivation because it led to serious erosion of the hillsides and slopes. Today, in consequence, wet-padi is the dominant form of padi

25. An oil palm estate on flat land in coastal Selangor. The flat terrain makes it possible to use a system of light tramways for the transportation of the fruit to the processing factory.

26. Pineapples being loaded into a lorry from a Chinese smallholding in Pekan Nanas, west Johore. The pineapple is cultivated on peat land formerly planted to rubber. Subsidence due to shrinkage of the peat has exposed the roots of the old rubber trees (background), causing them to lean over.

27. A pineapple canning factory, Johore Bahru.

28. Chinese market gardens in the Kallang River floodplain, Singapore.

cultivation, and hill or dry-padi occupies significant areas only in Kelantan and Trengganu (Table 31).

Although padi is a cereal capable of giving sustained yields without exhausting the fugitive fertility of tropical soils, its cultivation in the Peninsula is at best a risky occupation because of the unfavourable

TABLE 31. *Area, Distribution and Types of Padi Land in Malaya, 1959–60 Season*

STATE	Area under Wet-Padi (acres)	Area under Dry-Padi (acres)	Total Acreage	Percentage of Total Acreage
Kedah	281,330	8,030	289,360	31
Kelantan	159,180	27,000	186,180	20
Perak	114,090	3,740	117,830	13
Perlis	63,130	1,760	64,890	7
Trengganu	49,810	13,780	63,590	7
Selangor	48,960	nil	48,960	5
Pahang	41,530	6,300	47,830	5
Penang and Province Wellesley	39,270	100	39,370	4
Malacca	31,400	nil	31,400	3·5
Negri Sembilan	30,980	120	31,100	3·5
Johore	8,740	20	8,760	1
TOTAL	868,420	60,850	929,270[1]	100·0

[1] Does not include the 12,000 acres of padi cultivated as an off-season crop.

climate, which is more suited to the growing of tree crops than of annuals, the lack of water control over wide areas and the depredations of pests and diseases. Crop failures are common. The process of pioneering for padi is an arduous one, involving the clearing and draining of swamps, the construction of irrigation and drainage works, and often the preliminary burning off of the peat layer overlying the soil. All such work has to be done under water-logged conditions and in mosquito-infested country (Plate 18). The labour of preparing the land for planting, especially where draught animals cannot be used because of excessively soft soils, and of transplanting and weeding by hand, demand considerable physical effort under the hot and saturated atmosphere of the flooded fields.

Moreover, the low economic returns from padi growing compare unfavourably with the returns from almost every other form of agriculture, particularly with rubber cultivation. The smallholder can obtain more rice by purchasing it with the proceeds from an acre of rubber than by growing the rice directly from an acre of land. For these reasons padi planting has never been a popular occupation with the Chinese, in spite of the fact that many of them were padi growers in China before they migrated to Malaya. An indication of this disinterest is the report of Chinese farmers planting tobacco instead of padi on land specially reserved for padi in the Changkat Jong Irrigation Area of Lower Perak. Even among the Malays padi is no longer planted as a matter of course. Because of the hard work involved, the higher earnings from other occupations, the attractions and amenities of town life, many of the younger Malays are drifting from the padi areas and rural kampong in search of other work.

Yet on the whole the padi acreage has increased from an average of 662,000 acres in 1926–30 to 929,000 acres in 1959–60. This represents a net expansion of more than a quarter of a million acres since the 1920s. The increase has come about mainly through the efforts of the Government to lessen the country's dependence on rice imports from other parts of South-East Asia. Up to the end of the First World War the large profits from rubber were responsible for the general disinterest in the growing of other crops. The demand for rice by the rapidly increasing population was met by imports from the rice-granaries of Burma and Thailand. Between 1917 and 1921, however, failures of the rice harvests in Burma and India doubled the price of rice; at the same time rubber prices slumped, and the Malayan Government had to spend one-third of the accumulated financial surplus balance of earlier years on subsidizing rice imports. Home growing of padi was stimulated and production which had stood at 178,000 tons in 1918–19 rose to 309,000 tons in 1925–26 and to 440,000 tons in 1930–31.

The Great Depression of the 1930s brought home with renewed force the vulnerable position of Malaya with regard to her staple food supply and to the over-dependence on rubber and tin for her economic health. A new policy of self-sufficiency was adopted at this critical period. Following the recommendations of the Rice Cultivation Committee of 1931, the Drainage and Irrigation Department (D.I.D.) was established in 1932, and its activities in providing controlled water supplies, in draining swampy coastal lands, and in opening up new land as padi settlement areas up to the beginning of the Second World War did much to turn governmental hopes to partial reality. Production of padi increased to 570,000 tons in 1935–36.

The threat of war and the emergencies that might arise as a result of the rice supplies being cut off induced the Government to adopt a new attitude towards padi cultivation by non-Malays. Up to the 1940s it was the British policy to reserve all potential padi land for the Malays. In 1939 the Government announced that, in view of the dangerous position of the country with regard to its food supplies, the Malay monopoly on padi planting was to be broken and that other Asian races would be allowed to take up new padi land. But in order to safeguard Malay interests short leases were issued, and occupancy by non-Malays was to be confined to newly opened padi land only. A minimum price of $2.50 per *picul* was fixed and guaranteed for all padi produced. Various other measures, such as the distribution of fertilizers and waiving of the water rate, were planned as additional inducements. But these measures were taken too late to be of practical value. Besides, the high prices of rubber and tin lured all available Chinese and Indian labour to these industries, and no one wanted to leave his work for the hard life of padi planting. Not surprisingly, the production of padi fell from 570,000 tons in 1935–36 to 540,000 tons in 1940–41.

The Japanese occupation and the cessation of rice imports coupled with steadily falling home production lowered the nutritional standards of the people to near the danger line by the end of the war. In 1946 padi production was only 375,000 tons and pan-Malayan net imports of rice had fallen from the 659,000 tons in 1939 to141,000 tons. With the restoration of normal conditions in 1948 production returned to its pre-war level. The post-war policy of the Government is 'to make the Federation of Malaya as self-supporting in the production of rice as is economically possible within the limits imposed by local circumstances, e.g. the availability of land, labour, equipment, settlers and finance'.

In spite of the increase in net acreage and production in the post-war period, Malaya continues to depend upon outside sources for nearly half of her rice requirements (Fig. 54). The output of padi is just keeping pace with population growth, and Malaya has to import from 310,000 to 360,000 tons of rice each year to feed the rest of the population. According to the Director of the Drainage and Irrigation Department, Malaya's rice requirements will rise by 15,000 tons annually at the present rates of population growth. These requirements can be met by developing new land at the rate of 30,000 acres each year. The D.I.D.'s programme for 1955–59 planned for the development of 70,000 acres of new padi land. This additional area was enough to support the population increases of

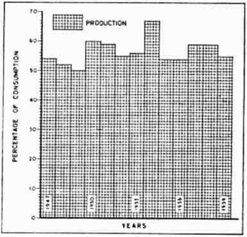


FIG. 54. Production of rice in Malaya as a percentage of total consumption, 1947–59

only two years, but was insufficient to provide for the extra mouths over the remainder of the period. In the opinion of the International Bank Mission anything approaching rice self-sufficiency is not practicable because of 'Malaya's high ratio of population to rice-lands compared with other South-East Asian countries, and its very high rates of population growth'.

Among the other difficulties of increasing the padi acreage are the shortage of technical staff in both the D.I.D. and the Agriculture Department, and the high costs of developing each acre of padi land. In 1949 the costs per acre, including costs of survey, drainage and irrigation, and of settling farmers and providing them with roads, water, schools, medical attention and other facilities, were over $250 in capital charges alone. Without taking into consideration the capital outlay on drainage and irrigation works, padi was twice as expensive to grow in Malaya as it was in Burma or Thailand.

Lack of a long-term policy and the necessary financial resources has resulted in uneven development of Malaya's padi lands: periods of national emergencies such as economic depressions, wars and widespread harvest failures in Burma or Thailand (the main sources of Malaya's rice imports) were followed by short-term governmental

TABLE 32. *Major Padi Settlement Schemes in Malaya*

NAME AND LOCATION OF SCHEME	Area Planted Prior to Scheme (acres)	Additional Area Made Available (acres)	TOTAL ACREAGE
South Perlis, Perlis	14,900	4,000	18,900
Kubang Pasu, Kedah	65,000	10,000	75,000
Krian, Perak	29,259	28,669	57,928
Sungei Manik, Perak	1,249	17,169	18,418
Changkat Jong, Perak	nil	2,434	2,434
Tanjong Karang, Selangor	198	48,763	48,961
Besut, Trengganu	21,600	5,000	26,600
Paya Besar, Pahang	nil	2,917	2,917
Pahang Tua, Pahang	686	2,776	3,462
TOTAL	132,892	121,728	254,620

efforts at producing more rice locally. But these efforts were slackened when conditions returned to normal.

The accumulated result of all these short-term programmes was the addition of 267,000 acres of padi land to the total padi area since the 1920s. The development of new padi areas took the form of settlement or colonization schemes of varying size and importance, scattered throughout the Peninsula (Table 32). These schemes, besides being on a much reduced scale, differ also from the colonization projects of Indonesia and the Philippines in that they are a response to the pressure of population on food resources rather than the overall pressure of population on land.

The Colonization of Padi Lands. The reclamation of an undeveloped piece of swamp land is only the preliminary, though vital, step in the colonization of that area. The settlement schemes in Malaya have from the start, been, only moderately successful, because of a marked lack of response on the part of the population to take up new land for padi cultivation. This is partly due to the fact that pressure of population on padi land is confined to only a few localized regions such as the Kelantan delta, and there is therefore no large surplus agricultural population ready and eager to settle in the newly opened lands. Then, again, pioneer settlement in the humid tropics is always a laborious and difficult process, and the pioneer settler in Malaya has to face several years of hard work with poor returns before his fields can begin to produce a reasonable income. It takes a minimum of three years before the settler and his family can start to plant padi in the fields, for he has first to clear the land, build his house, and construct the *sawah* (wet or flooded fields). During this period he has to find work elsewhere to support his family. Again, the form of tenure also acts as a deterrent to a peasant willing to grow padi in the colonization areas, for land here is granted only on a short-term basis because of the Governmental reluctance to issue long-term or permanent titles until detailed geological surveys have been carried out to determine whether the land is tin-bearing.

The area of land issued to each settler varies from region to region. In Sungei Manik experience has proved that a Malay family could gain a fair livelihood by cultivating 6 acres of padi and planting kampong produce (e.g. fruit, coconut and vegetables) in another 2 acres of non-irrigated land. In many of the other areas, however, the settler is given only 2 acres of padi land, an area too small to provide any surplus above the peasant's bare subsistence needs. In Tanjong Karang the 3 acres of padi land and 1 acre of kampong land allotted to each settler are now regarded as being insufficient for a good livelihood.

Many of the colonization schemes, including large ones such as Sungei Manik and Tanjong Karang, provide only the most rudimentary facilities for the colonists. Up to 1939, settlers were offered no facilities other than a free survey and free irrigation water. After the war the shortage of food led the Government to promise more liberal terms in order to encourage settlement. These included free transport to the colonization area, temporary housing, a $33 to $50 subsidy for each acre of land cultivated, loan of saws, axes, *parang* (long-handled knives), *changkol* (hoes), free seed for the first two years and a guaranteed minimum price for padi. The money subsidy, offered at a time when the cost of living was lower, is now considered to be quite inadequate. The peasant, in trying to provide for his family during the first few years before his crops can be harvested, often has no option but to borrow money from professional money-lenders or shopkeepers at high rates of interest, thus getting early into debt.

Because of the harsh pioneering conditions, it has become increasingly difficult to find colonists to occupy new padi land, especially when other forms of agriculture are much more remunerative and do not entail heavy labour in difficult waterlogged land. Yet simultaneously with the decline of peasant interest in padi growing, the need for more rice to feed the growing population has intensified. In view of the limited extent of potential padi land, the reluctance on the part of the peasants to colonize newly opened areas (especially if they are far from the peasants' original homes), the inadequate financial resources available, and the high cost of developing new land, it would appear that the best prospects of increasing the production of padi lie in increasing the yields of existing land rather than in any large-scale opening up of new areas.

Areas, Farm Size and Average Yields. The main padi areas are located in the northern part of the Peninsula, north of latitude 4° 30′ N. (Fig. 55 and Table 31). There is a small but distinct climatic seasonality here which makes it more suitable for padi cultivation than areas lying nearer the equator. More than 70 per cent of the total production of padi comes from these two northern regions: (i) The north-east coastal plains centred round the Kelantan delta (Plate 20) where padi growing is the main occupation and padi occupies the largest crop areas. This is largely a subsistence region, and little of the padi produced goes beyond the State boundaries. Padi has long been grown here, and up to the beginning of the present century the region has been self-sufficient, producing enough to feed the population. But the increase of population in the last sixty years and the shortage of land for conversion into padi fields have turned it into a rice-deficient area, and a small amount has to be imported annually to supplement the rice produced within Kelantan. (ii) The north-western coastal zone running from Perlis southwards to the Krian district of Perak is the other major padi growing area of Malaya (Plates 19 and 21). The extension of modern drainage and irrigation facilities to a large part of the region, and the opening up of new lands, notably the Krian Irrigation Area, have made this into

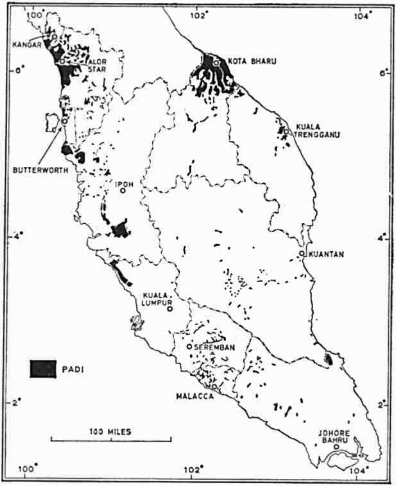


FIG. 55. Distribution of padi

a rice-surplus area, and the annual surplus goes to supplement the requirements of a part of the non padi-growing Malayan population. It has been estimated that the padi planters of Perlis and Kedah retain about half of their crop for their own needs, and sell the other half, whereas the farmers in the other parts of Malaya have on an average only one-third or less of their crop available for sale.

Of the other large coastal plains lying south of the 4° 30′ N. latitude, that of Perak is in the course of development. The Sungei Manik Irrigation Scheme, located between the Batang Padang and Kinta Rivers in Lower Perak, has been in the process of gradual colonization since the 1930s. Up to date four stages covering a total area of 20,000 acres have been developed and colonized. The Trans-Perak Irrigation Project located in the Bruas–Sitiawan plain is at the moment in the planning stage. An area of 180,000 acres will be converted into padi lands when the scheme is eventually completed. In Selangor, part of the 500 square miles of swamps which lie between the Bernam and Selangor Rivers has been turned into padi fields. This developed section, known as Tanjong Karang, is a coastal strip some 3 miles wide and about 27 miles long, and is bounded by a coastal bund on the west and the main irrigation canal on the east. In eastern Malaya, the Pahang and Rompin-Endau deltas remain undeveloped except for small, widely scattered fields and kampong strung out along the levees.

In addition to the large coastal plains, padi is also grown in inland valleys throughout the Peninsula, in small widely scattered fields in rolling country and foothill regions. A typical landscape is one of padi fields occupying the flat, narrow valley bottom on either side of a river, with peasant houses strung out along the break of slope, and tree crops of rubber, coconut and fruit occupying the slopes (Fig. 41). The padi is grown entirely for subsistence, while the tree crops are grown partly for consumption (in the case of coconut and fruit) and partly for sale. This form of land-use is common in the hill and valley regions of Negri Sembilan, in upper Malacca, parts of inland Selangor, upper Perak, and in many parts of central Pahang and Trengganu. The other common type of padi landscape is a variation of the inland valley type, with the difference that the padi fields are generally on both sides of a river, and the houses and tree crops on the drier sites on the levees and river banks. Such a pattern is a typical one along the lower courses of the larger rivers, best exemplified by the Pahang River (Fig. 38). In places the fields and kampong are contiguous with one another and may stretch for several miles to form a linear belt of riverine settlements.

The majority of the padi farms of Malaya are less than 5 acres in size, and more than half of them are less than 3 acres. Of the 132,276 individual farms recorded in the 1960 Census of Agriculture in which wet padi was the main crop, 97 per cent were under 10 acres in size, 78 per cent under 5 acres in size, and 54 per cent under 3 acres in size (Table 33).

Eighty per cent or more of all the padi farms in all the States except Kedah, Perlis and Selangor were less than 5 acres in size. More than half of all the farms in all the States except Kedah, Perlis

TABLE 33. *Number and Size of Padi Farms in Malaya, 1960*

STATE	Total Number of Farms	Percentage						
		Below 1 acre	1–1¾ acres	2–2¾ acres	3–3¾ acres	4–4¾ acres	5–9¾ acres	10 acres & over
Kedah	44,910	8	19	19	12	10	26	6
Perak	20,772	14	26	19	12	9	19	1
Kelantan	20,554	8	26	32	16	10	8	0
Penang & P.W.	11,290	9	31	23	13	11	13	0
Perlis	8,540	3	11	19	16	13	33	5
Selangor	7,996	3	14	5	40	13	23	2
Trengganu	6,966	14	23	29	11	10	13	0
Pahang	3,940	16	38	26	11	5	4	0
Malacca	3,128	21	32	24	7	6	9	1
Negri Sembilan	2,980	38	36	19	4	3	0	0
Johore	1,200	5	60	27	3	3	2	0
FEDERATION	132,276	10	23	21	14	10	19	3

and Selangor were less than 3 acres in size, while more than half of the farms in Negri Sembilan, Johore, Pahang and Malacca were even smaller (less than 2 acres each). The highest percentage of small farms was found in Negri Sembilan: 74 per cent of the farms in that State were less than 2 acres in size, and 93 per cent less than 3 acres in size. In contrast, the highest percentage of large farms was found in Kedah and Perlis, with 32 and 38 per cent of the farms 5 acres or larger. The general overall pattern of small farm size may be due to a number of factors such as the pressure of population on padi land and the lack of suitable areas for expansion, the shortage of draught animals which prevents the farmers from cultivating a larger acreage, the excessively soft nature of the soils in some of the padi areas which prevents the use of the plough, and the subdivision and fragmentation of the land.

Experimental research carried out by the Department of Agriculture indicates that over all the padi lands of Malaya there is a 'bar' beyond which padi yields cannot be raised in spite of liberal applica-

TABLE 34. *Production and Average Yields of Wet Padi, Malaya, 1925–60*

SEASON	Production (tons)	Average Yield per Acre (lb.)
1925–26	283,595	1,089
1930–31	417,113	1,545
1935–36	549,465	1,787
1940–41	511,183	1,512
1945–46	358,258	1,155
1950–51	684,668	1,842
1955–56	644,100	1,754
1959–60	856,570	2,156

tions of manure and fertilizers and of good drainage and irrigation. This bar varies from 400 to 500 *gantang*[1] per acre (or 2,200 to 3,025 lb. per acre). These maximum potential yields, however, are low compared with those actually attained in sub-tropical and warm-temperate regions. Italy, for example, had an average yield of 3,750 lb per acre in 1949–51, and Spain of over 4,000 lb per acre. Yields in Australia, reputed to be the highest in the world, averaged 4,250 lb per acre in a normal year, and may be as high as 6,720 lb per acre in exceptionally good years. In contrast, the actual yields in Malaya, while among the highest in South-East Asia, are far below the maximum potential yield of up to 3,025 lb per acre, as illustrated in Table 34. There is clearly room for improving yields, and because of the limited acreages of potential padi land, the country will have to

[1] See glossary.

depend for part of its food supply in the long run on increased yields as a means of increasing rice production rather than on the opening up of new padi lands.

The average yield for any one year is computed by dividing the estimated annual production by the acreage harvested. These average yields, however, vary greatly from region to region and from season to season, depending on the degree of water control, the planting techniques, the ravages of pests and diseases, and the fertility of the soils. The crop in any one season may be totally or partially destroyed because of late planting, drought, floods or the depredations of pests and diseases. The consequences of the loss of a season's harvest on the padi planter are far-reaching. Although actual starvation seldom occurs, the planter will have to find a means of supporting himself and his family until the next harvest. The usual way out is to obtain an advance in cash and/or in kind from the village shopkeeper-cum-moneylender at an exorbitant rate of interest. The loan is given on the security of the next season's harvest or the mortgage of the planter's land. Since, in view of the small size of the farm, a season's harvest is barely sufficient to cover the subsistence needs of the planter and his family, there is great difficulty in repaying even the interest accumulated on the loan, and the entire debt may never be repaid during the farmer's lifetime.

The Cycle of Padi Cultivation. The overwhelming majority of the padi farmers are Malays. The 1957 Census enumerated 381,593 Malay padi planters, and only 16,702 Chinese, Indian and other farmers. In the north-east and north-west, the cultivation methods employed have been evolved over a long period of time and show an intimate adaptation to local conditions. While the principles are essentially similar throughout the Peninsula, customary methods vary in detail from region to region, due mainly to variations in local conditions. The main factors which influence the methods of cultivation are the nature of the soil, the nature of the water-supply (whether from direct rainfall or from an irrigation canal), the surface relief, and the extent to which the planters of one area are able or willing to modify their techniques to suit the environmental conditions existing in their area.

The cycle of cultivation activities is geared primarily to the annual cycle of rainfall, in Kelantan and Trengganu and other parts of eastern Malaya to the north-east monsoon and in the Port Dickson–Malacca coast to the south-west monsoon. The rainfall in the other padi-growing areas is of the equatorial type, without any distinct seasons. The onset of the rains in most parts of the Peninsula is so uncertain, however, that crop losses through late planting are common in those regions without the advantage of a controlled drainage and irrigation system. The main phases of the cultivation cycle are:

(1) *Preparation of the Land.* The padi season opens with the farmer clearing and cleaning the canals and waterways and repairing the bunds that separate the fields from one another. The bunds are constructed of a mixture of clay, mud and weeds, and are necessary to retain the water in the fields during the growing season. The methods and implements used to prepare the land for the padi seedlings depend mainly on the nature of the soil, the water supply and local custom. The land is usually ploughed in most areas with drainage and irrigation facilities, and ploughing is commonly done in Kedah, Perlis, Penang and Province Wellesley, Malacca and Kelantan. A wooden, single-furrow plough with an iron-shod share is used, and may be drawn by one buffalo or two oxen (Plate 21). The land is flooded to a depth of 1 or 2 inches to render the soil soft enough for the light plough. Cultivation is usually to a depth of 3 or 4 inches. The fields may be ploughed two or three times. The weeds are then left to rot for three weeks to a month. The land is then raked and harrowed until the soil is left in a soft, puddled condition. Raking continues until all weeds are destroyed.

A different method of preparing the land is employed in those areas where the soils are too soft to permit the use of the plough, or where poverty prevents the farmers from hiring buffaloes for ploughing. The fallow vegetation is cut down a little below ground level by means of a scythe-like implement known as a *tajak*. The cut vegetation is left to rot for about two weeks, and is then raked into heaps for a further two to four weeks of decomposition. The rotted growth is subsequently plastered on to the bunds or scattered throughout the fields. This method is practised in Krian, Selangor, Negri Sembilan, Pahang and parts of Province Wellesley and Kedah.

(2) *Sowing*. The usual method employed is to sow the seeds in carefully prepared nurseries and to transplant the seedlings when they have reached the right stage of development. The nursery beds are located on dry land in those areas where the water supply is uncertain and the farmer has to rely on direct rainfall. The advantage of a dry nursery is that the seedlings can remain as long as three months before transplanting, so that the farmer is able to delay transplanting,

if necessary, until field conditions are suitable. In areas with a controlled water supply the nurseries are of the 'wet' type. The seedlings in this case must be transplanted after forty days or they become too mature for the purpose.

(3) *Transplanting*. Transplanting takes place as soon as possible after the final preparation of the fields in order to check weed growth. This phase of padi cultivation is done by the women. The seedlings are pulled from the nursery and tied in small bunches. The roots are washed to remove the soil, and the top few inches of leaves are cut off in order to reduce water loss through evaporation. Transplanting may be entirely by hand, or may be made less laborious by using a two-pronged implement known as a *kuku kambing*. Two to six seedlings are planted in the mud at intervals of between 4 and 18 inches per 'hill', the actual spacing depending upon the variety of seeds used, the local conditions of soil and on custom. The plants are spaced closer in fields where the irrigation water is more than a foot or 18 inches deep, as deep water inhibits tillering. Six women can complete an acre a day with the aid of the *kuku kambing*. A more complex system of multiple transplanting is carried out in Krian. The injury to the root system through frequent transplanting acts as a stimulus to the subaerial section of the plants, resulting in increased tillering and higher yields.

(4) *After-cultivation*. This consists mainly of weeding by hand. In richer soils the plants grow rapidly to form a thick canopy. Weed growth is thus inhibited, and one thorough weeding some six to eight weeks after transplanting is usually sufficient for the season. In poorer soils the land may have to be weeded twice or even three times in order to control excessive weed growth and encourage tillering. The plants begin to tiller about a month after transplanting, each plant sending up anything from two to fifty tillers, depending on the fertility of the soil, the depth of water and the distance of planting.

(5) *Harvesting*. The fields are gradually drained of water as flowering becomes general, and should be completely dry by the time the grain has 'set' and begins to ripen. The varieties commonly planted take from five to eight months to mature, and short-maturation varieties are sown only in the lighter soils where retention of water presents a difficult problem. Because of the different maturation periods and different planting dates, harvesting is generally going on in some part of Malaya between November and May. The threshing

methods employed are simple but laborious. By far the most common method is to harvest each ear separately by means of a small knife known as *pisau menuai* or, in Selangor, as *tuai*. The other method is to harvest by means of a sickle (*sabit*). The grain together with about two feet of straw is cut in armfuls and laid on top of the stubble to dry before threshing. The crop is threshed by treading on the ears (in the case of padi reaped by the *pisau menuai* method), or by beating the sheaves against a wooden tub (in the case of padi reaped by the *sabit* method). Winnowing is also done by hand (Plate 22).

The cycle ends with the harvest and the land is laid fallow until the beginning of the next season. In some areas the land is put to some other use after the harvest. In parts of Penang and Province Wellesley some 10,000 acres of land are cultivated to a second crop of padi, the farmers using short maturation varieties in order to fit two padi crops in one year. A more widespread practice is to plant off-season crops such as vegetables and other food crops after the padi harvest. In Kelantan short-term crops such as maize, tapioca, peppers, chillies, beans, sweet potato and vegetables are planted in fields close to the farmer's house. However, the total area thus utilized is less than 10 per cent of the total padi acreage of the State. The practice of off-season cropping is best developed in the *mukim* of Tranquerah and Lorong Pandan in Malacca. The farmers here grow vegetables for the Singapore and Kuala Lumpur markets and have been doing so for the past thirty years. A short-term padi strain is used so as to leave sufficient time after the harvest for the vegetable crop. Most of the farmers are Chinese, although there are also some Malays who grow off-season crops during the fallow period. But for best results and high yields the land must be heavily manured, and while the Chinese are able to use the droppings from pigs, the Malays are prevented from so doing by their Muslim beliefs. Apart from pig manure, the Chinese farmers also employ prawn dust, rotted fish and buffalo dung. The main crops grown are leafy vegetables, radish, tomato, beans, gourds, cucumber, ginger, sweet potato, yam, onion and tapioca.

Some Major Problems of Padi Cultivation: (I) Water Control. The distinguishing feature of wet-padi cultivation is the fact that the plants grow in a field of standing water. The basic need of wet-padi is a large and assured supply of water during the greater part of the growing season. There is a definite relationship between water supply and crop yields, and within the tropics yields are higher in artificially irrigated lands than in lands which depend on direct rainfall for irrigation water. The quantity of water necessary for optimum yields depends on the soil characteristics, the evaporation rate, the variety of seed planted, the method of planting, and the level of the water table. The minimum quantity necessary has been estimated to be about 143,000 cubic feet per planted acre. About 2 inches of water should cover the field immediately after transplanting in order to check weed growth. This is later increased to 4 inches, and, in the final stages of growth, to about 8 inches.

Drainage is as important to high yields as irrigation. Excess water must be drained from the fields if the grains are to ripen properly. There must be provision for getting rid of unwanted water which may flood the fields as a result of unusually heavy rainfall or through the encroachment and infiltration of water from adjoining swamps. Lack of drainage in peaty lands causes the soils to become water-logged and excessively sour. Padi planted on such soils cannot retain a firm hold and the plants are liable to fall over with the first heavy windstorm, especially after they have flowered. A period of drainage between the harvest and the next planting is essential for soil aeration. Drainage also affects the nitrogen supply of the soil. In adequately drained fields the nitrogen is released by anaerobic decomposition and becomes available to the growing plants during the early and middle stages of growth when it is most needed. In poorly drained areas the nitrogen becomes available only late in the growing season when it causes grain lodging, late ripening and renders the plants more susceptible to disease.

Water control is therefore essential to successful padi cultivation. The Malay padi planters in historical times used various ingenious means of regulating the water supply. The most common system employed for fields which bordered streams was to raise the water level of the stream by means of dams constructed of brushwood, tree trunks, bamboos and boulders. Such dams were small and weak, and often gave way at a critical period and ruined the crops. Where the river was large and the banks too high to allow for dams, water-wheels were used to lift the irrigation water to the fields on one or both banks. The water was conducted by troughs to the fields, but the waterwheels could not rise or fall with the river levels, and were easily destroyed in floods. They were capable of lifting 1,500 gallons of water per hour, sufficient to irrigate 3 acres of land. In the largest rivers with well-developed levees such as the Perak and Pahang

Rivers, irrigation by gravitation presented considerable difficulties as the river levels in many parts were lower than the levels of the fields and the levees were too high to permit the efficient working of the waterwheels. The farmers had to rely entirely on local rainfall for their water supply in swampy locations, and the areas they were able to plant each year varied with the amount and incidence of rain that season.

The successful cultivation of padi under such conditions was difficult. While they were effective under ordinary conditions, dams and waterwheels were small and capable of irrigating only small acreages. They could not act as reservoirs when the rainfall was deficient, and were liable to be destroyed during floods. Failures of crops through floods or drought were therefore common.

The development of modern methods of water control based on concrete reservoirs, dams, weirs, canals, pumps, etc. began in Malaya soon after the establishment of British rule. The first major attempt was the Krian Irrigation Scheme, which was completed in 1906 and brought adequate water control facilities to some 56,000 acres of land on the north-west coast of Perak. But Governmental interest in padi flagged as rubber came into the agricultural scene, and for the next twenty-five years no attempts were made to extend modern drainage and irrigation facilities to other parts of the Peninsula.

The Great Depression revived Governmental interest in increasing the home production of rice. A Rice Investigation Committee was set up. Its report stated that the basic need of padi farmers in all the States was for better water control facilities, pointing out that, apart from the Krian Scheme, no such facilities existed anywhere else in Malaya. The Committee recommended that the work of water control should be pan-Malayan and accordingly recommended the formation of a new department to be called the Drainage and Irrigation Department (D.I.D.).

Between the formation of the D.I.D. in 1932 and the outbreak of the war, the department set about restoring padi lands that had been abandoned because of silting, and also initiated the development of two large padi colonization schemes—the Pachang Bedina Scheme in Selangor and the Sungei Manik Scheme in Lower Perak. A number of small riverine areas were also provided with proper water control facilities. In the ten years of its existence up to the Second World War, the D.I.D. provided modern methods of drainage and irrigation to some 120,000 acres of existing padi land, and opened up an additional 53,000 acres of new padi land. Altogether about 23 per cent of the total padi acreage of 743,000 in 1940 was provided with some form of water control.

Considerable damage was done to irrigation and especially to drainage works during the Japanese occupation. The D.I.D. had to repair this damage and at the same time increase the tempo of its activities because of the serious shortage of rice in the post-war period. The padi acreage was expanded to 803,000 in the 1947–48 season, but only 237,000 acres or 30 per cent of the total acreage had proper drainage and irrigation facilities. Between 1949 and 1954 the area of padi increased to 846,000 acres, of which 37 per cent had water control facilities. The programme of the D.I.D. for the period 1955–59 planned for the construction of thirty-four irrigation projects to affect an estimated 206,000 acres of existing padi land and bring into cultivation an additional 70,000 acres of new land. Owing to the shortage of experienced engineers, among other factors, the target was not realized, and at the end of 1960 the total area with proper drainage and irrigation facilities increased by only 80,000 acres over that in 1954.

The need for modern drainage and irrigation facilities remains as great as ever, although the situation has improved substantially since the pre-1930s. Damage to crops because of floods or drought is common in those areas without a controlled water supply. It is estimated that an increase of at least 25 per cent in yields can be achieved in Malaya by just guaranteeing the water requirements of the padi plants.

(2) *Manuring of Padi Soils.* Manuring of padi land, whether for the main crop, for off-season crops, or for double-cropping, is influenced by the type and characteristics of the padi soils, and these in turn have an important bearing on yields. Padi soils are generally classified according to the percentage of clay they contain. In Malaya wet padi grows best on clay loams (containing 15–25 per cent clay), clay soils (25–30 per cent clay) and heavy clay soils (more than 35 per cent clay). The critical factor affecting yields is the sand component—the higher the percentage of sand, the less valuable is the soil because plant growth on such soils tends to be retarded. Yield variations of padi are determined more by the mechanical composition of the soils and their physical structure than by their chemical and nutrient content which is satisfactory for normal plant require-

ments. The composition and quality of some common padi soils as worked out by Jack are shown in Table 35.

The first class soils have an organic matter content of 3–8 per cent, clay content of 25–65 per cent, fine silt 20–60 per cent and sand 2–10 per cent. The quality of the soils deteriorates where the sand content increases to 20–40 per cent, and such soils are classified as second class. Under ideal conditions of water supply, first class soils can

TABLE 35. *Mechanical Composition and Quality of Representative Padi Soils in Malaya*

Locality	Organic Matter (per cent)	Clay (per cent)	Fine Silt (per cent)	Silt (per cent)	Sand (per cent)	Class of Land
1. Krian	4·0	57·7	20·9	15·3	2·1	First
2. Kedah	nil	28·2	58·1	10·5	3·2	"
3. Kedah	nil	31·1	31·7	27·2	10·0	"
4. Kuala Kangsar	nil	26·2	50·4	16·3	7·1	"
5. Jelebu	4·0	17·5	32·8	16·3	29·4	Second
6. Kuala Pilah	nil	17·6	28·1	16·6	37·7	"
7. Kuala Kangsar	nil	18·6	27·4	14·0	40·0	"
8. Jelebu	1·6	19·1	30·2	7·3	41·8	"
9. Kuala Kangsar	nil	6·9	10·2	14·0	68·9	Third
10. Krian	12·8	28·9	34·6	15·6	8·1	"

produce up to 2,750 lb of padi per acre, and second class soils from 1,375–1,925 lb per acre. Where the sand content is above 40 per cent, the soil is very poor and produces very poor crops, as exemplified in Soil Sample No. 9 (Table 35). Soil Sample No. 10 has first class qualities but its peaty nature with toxic humic and other acids is detrimental to the padi plants. Three or four inches of peat are sufficient to reduce good padi land to very poor land. Soils with a peat layer composed of organic matter derived from the *gelam* tree (*Melaleuca leucadendron*) occur widely in low-lying swampy riverine and alluvial lands in Malacca, Perlis, Kelantan and Trengganu, and are avoided by the padi farmers because of their excessive acidity.

Most of the padi lands are cultivated year after year without any systematic manuring. Regular manuring is practised only in Kedah, and, to a lesser extent, in Province Wellesley, where the farmers apply heavy dressings of bat guano to their fields. The average rate of dressing is equivalent to 50 lb of phosphorus per acre per annum, and the resultant increase in yields is about 186 lb per acre. In Kelantan and Malacca the farmers dip the padi seedlings into a mixture of cow manure and wood ash before transplanting.

Experiments conducted by the Department of Agriculture have shown that manuring can only increase padi yields in those areas where the normal yields are considerably below the average because of poor soils. In western Malaya where yields are high by Malayan standards, applications of fertilizers were found to be uneconomic in proportion to the slight gain in production as the soils did not give good responses. In eastern Malaya, however, where padi yields are usually very poor, good responses to fertilizers have been obtained. During the 1951–52 season 316 manurial trials were held on padi land in Kelantan and Trengganu, and the results indicated that an application of 200 lb of a balanced standard mixture of fertilizer gave a yield increase of 440–550 lb per acre. The cost of the fertilizer then was equivalent to the value of 275 lb of padi, so that there was a net gain of between 165–275 lb of padi per acre. Altogether about 200,000 acres of light soils in eastern Malaya have been found to be deficient in soluble phosphates and nitrogen, and these are the only soils in Malaya that would benefit from fertilizer applications.

The problem for the Government is how to popularize the use of fertilizers among farmers who have never applied them in their fields. In 1952 a fertilizer campaign was launched in Kelantan. Half the cost of the fertilizers purchased by the farmers was subsidized by the Federal Government, while the Rural and Industrial Development Authority provided free transport. The minimum dressing was 200 lb per acre, and the peasant had to pay $48 to manure 3 acres of land. Although yield increases of 30–400 per cent were recorded by those who applied the fertilizers to their fields, only 210 tons were bought by the farmers during the 1952–53 season, whereas the requirements were estimated at 40,000 tons. In 1953 720 tons were sold, and in 1954 only 296 tons. The reasons advanced for the poor response were the shortage of ready money, the reduction in the subsidy rate, and the conservative attitude of the farmers to the use of fertilizers. However, there has since been a gradual increase in the use of commercial fertilizers throughout Malaya, and in 1959 some 10,000 tons were bought by farmers for use in the padi fields.

(3) *Mechanical Cultivation of Padi Land.* The possibilities of introducing mechanical methods of cultivation are being explored. Padi production and average yields may be increased if the work of cultivation is accelerated by mechanization so as to take advantage of favourable weather conditions and eliminate late planting, or so that a sufficiently long off-season remains for double cropping. Production will also be increased if mechanization enables the farmer to work a larger acreage of land. The mechanical and agronomic problems of cultivation methods as well as the problems of adapting tractors, ploughs, harrows and other tools to suit local conditions must first be solved before the question of costs and final application can be considered.

One of the main technical problems in Malaya is the mechanical cultivation of flooded fields. In Australia and the United States where cultivation is highly mechanized and the water supply efficiently controlled, the land is usually drained dry before ploughing begins. In Malaya, however, as in most South-East Asian countries, such drainage methods as exist are rarely capable of removing the large quantities of rainwater that may fall within a short period and flood the land. Ploughing in the dry is often impossible. Lands with a firm bottom have been successfully ploughed by tractors in Province Wellesley and Kelantan. But areas with peaty and very soft soils are very difficult to plough as the tractors cannot retain their grip and are bogged down. Tractor ploughing on such land depends on the use of low-pressure-bearing tractors and on favourable weather conditions. Progress is also often impossible in peaty land because of hidden stumps and sunken timber.

The mechanization of the other cultivation operations also presents considerable technical difficulties. Special wheels must be fitted to the tractors to enable them to draw the harrows and rollers over the ploughed and flooded land, but the technique has not yet been perfected for final application over wide areas. The seeding and transplanting operations have still to be accomplished by machines, and the problem of mechanical weeding has yet to be solved.

Speedy mechanical harvesting would seem to offer great scope as a means of indirectly increasing padi production by lessening the chances of an untimely rainstorm ruining part of the ripened crop. The Malay method of *tuai* harvesting in which one head of padi is reaped at a time is slow and laborious. The advantages of *tuai* harvesting are: the unevenly ripened grains or grains of mixed varieties can be harvested separately; only one simple tool is required, and only the crop weight and not the stalks are handled. The main disadvantage is that the slowness of this method tends to increase the likelihood of crop damage through adverse weather during the harvesting period. But mechanical harvesting experiments have not been encouraging, and tests have shown that the work performed was not much quicker than that done by traditional methods. Moreover, extra labour was needed to separate the ears from the stalks. In 1954 a combine-harvester which could reap half to three-quarters of an acre of padi was successfully tested in Malaya, but the poor drainage conditions of the fields are likely to hamper its practical application.

The question of costs is the critical and decisive factor in the introduction of machines for cultivating padi. Costs are determined by the types of machines used and their availability, the availability of spare parts and workshop facilities, the running expenses and the length of time in which each machine would be employed in a season and the length of time it is forced to be idle during the off-season. Experiments in Kelantan have shown that all the machines were expensive to run and required a disproportionate amount of labour to operate. Working the whole day in mud was too exhausting for a single operator, and a team of extra men was necessary if the machines were to be used to their maximum capacities. Running costs were much higher because of the wet ground. Experiments in the Pahang Tua and Langgar Mukim padi areas of Pahang demonstrated that when the surface was dry a tractor could plough 8 acres of land in a working day of eight hours. A wet surface reduced performance to as low as 4 acres a day, though the fuel consumption was not reduced. The running costs per acre per day under dry conditions were $3.06, while under wet conditions the costs were exactly doubled. When transposed from experimental to actual field conditions, the total cost of tractor cultivation in 1952 was $7.50 an hour. This was the amount charged by the Rural and Industrial Development Authority for the hire of its tractors on a non-profit basis. The farmer must therefore expend $20 in cash to cultivate a holding of about 3 acres, but this is a sum of money usually beyond his means to spend.

Again, the fact that equipment and machines may either have to stand idle for long periods during the off-season or else be transported over great distances to areas with a different planting season, would tend to increase the overall costs. Wear and tear are greater because of the prevailing rough conditions of work.

The mechanical cultivation of existing padi lands demands the consolidation of small, fragmented fields so as to render tractor working more efficient. In the usual Malay padi landscape, the overall pattern is a chequered one composed of tiny, individual rectangular or square fields, each separated from the other by a raised bund or *bata*. The Malay laws of inheritance tend to reduce progressively the size of the fields through a process of subdivision. Mechanization would therefore involve upsetting the system of land tenure, and would probably encounter resistance everywhere if introduced too rapidly.

The main reason for the investigations into the possibilities of mechanical cultivation in Malaya in 1948 was the high cost of agricultural labour and the fear of a labour shortage in future years. But because of the very rapid rate of population growth, the expected labour shortage did not develop, and today there is not only an adequate labour force, but a surplus. For these reasons, mechanization in lands already occupied by farmers is not likely to supersede the traditional use of human and animal labour.

Mechanization has also been advocated as a means of opening up undeveloped swamps. The total area of low, swampy land available for padi development has not been accurately determined as yet. Post-war surveys have shown that about 313,000 acres of swampy jungle could be developed for padi, with a further 450,000 acres remaining as possible padi land. The main areas are, however, located in the southern half of the Peninsula, which is less suitable for padi cultivation because of unfavourable climatic conditions. The latest information indicates that over half of the total of 763,000 acres is peat-covered and unsuitable for padi. The most promising locations for large-scale mechanization are the large continuous plains in the lowlands, such as the Bruas–Sitiawan plain where 180,000 acres of swamp are being developed for padi. But mechanization is likely to prove expensive in view of the fact that these swamps contain tree stumps and submerged timber which have to be removed before the tractors can work without interruption.

The mechanization of padi lands in Malaya appears to hold only limited possibilities for practical application, particularly in view of the fact that it is not possible to use machines efficiently without complete water control at all stages of cultivation.

COCONUT

The coconut palm (*Cocos nucifera*) is ubiquitous in the Malay kampong of the Peninsula. A few coconut trees are planted as a matter of course wherever the Malays have settled. The palm has played an important part in the domestic economy of the Malays since early historical times, providing them with food, drink, and many of the necessities of life. The palm was widely distributed in the Malay Archipelago long before the first Europeans came to this part of the world. Coconuts were originally planted in locations near the sea, but experience has shown that they will grow and fruit successfully in areas remote from the sea.

Coconuts were cultivated in plantations in Penang and Malacca at the beginning of the nineteenth century. Planting began along the south-east coast of Singapore soon after it became a British colony in 1819. The nuts were sold for domestic use, and it was not until about 1850 that copra from Malaya was exported to Europe. The failure of the nutmeg industry in Penang in 1846 and the expansion of the export markets for copra and coconut oil brought about an increase in coconut planting in the island and, later, in Province Wellesley. Planting was extended into the Federated Malay States at the end of the nineteenth century, and was greatly stimulated when the price of nuts doubled. The Malays, too, began to plant the palm as the main crop in smallholdings, and peasant interest in coconut cultivation increased to such an extent that by 1917 61 per cent of the 180,000 acres under coconuts in the Federation Malay States were in smallholdings of less than 100 acres each. The rapid rate of extension of the coconut acreage in Malaya was checked temporarily during the First World War, but the Western industrial demand for vegetable oils for the manufacture of margarine, lard substitutes, cooking and edible oils, and soap and toilet preparations stimulated further planting at the end of the war. By 1935 the total area under coconut had increased to 606,000 acres.

Some areas of coconut were cut down during the Japanese occupation of 1941–45, and many of the larger estates suffered badly from neglect and had to be rehabilitated before normal production could be resumed. In 1961 the total area under coconut was 519,573 acres, of which 79,706 acres were in seventy-four estates ranging in size from 100 to over 3,000 acres each, and the remainder in smallholdings of under 100 acres each. Smallholdings where coconut forms the main cash crop are usually between 1 and 8 acres in size. The crop is also grown in mixed stands. The average area under the palm in such holdings is generally less than 2 acres. The smallholdings acreage has remained constant in the post-war years, but the estate acreage has fluctuated from year to year.

TABLE 36. *Area under Coconut, by States, 1961*

State	Acreage			
	Estates	Smallholdings	Total	Percentage
Johore	939	142,552	143,491	27·6
Selangor	22,675	88,118	110,793	21·3
Perak	44,006	52,167	96,173	18·5
Penang and P.W.	9,453	35,271	44,724	8·6
Kelantan	nil	40,497	40,497	7·8
Kedah	373	29,925	30,298	5·9
Trengganu	1,260	17,159	18,419	3·5
Pahang	1,000	14,296	15,296	3·0
Malacca	nil	11,444	11,444	2·2
Negri Sembilan	nil	5,200	5,200	1·0
Perlis	nil	3,238	3,238	0·6
TOTAL	79,706	439,867	519,573	100·0

Most of the large coconut holdings are located in western Malaya (Fig. 56 and Table 36). Nearly all of the large estates are in Selangor, Perak, Penang and Province Wellesley. Table 37 shows distribution of the estates by size group. Eighty-five per cent of the total estate acreage is composed of estates of 1,000 acres and over. Nearly all of the twenty-seven estates of 1,000 acres and over are owned by Europeans, and worked by a labour force almost entirely Indian, mainly Telegu and Tamil. The estates of less than 1,000 acres are largely Asian. Johore, Selangor and Perak have large areas under coconut, the bulk of the Johore acreage being composed of smallholdings rather than estates as in the other two States. One-quarter of the total Malayan acreage is found along the coastal plains of west Johore. Smallholdings also predominate along the eastern coast

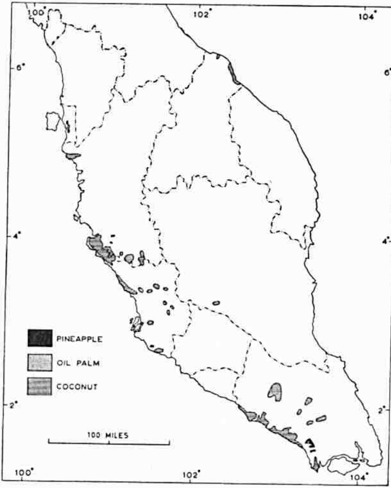


FIG. 56. Distribution of coconut, oil-palm and pineapple

of Johore and in the eastern States of Pahang, Trengganu and Kelantan.

Throughout Malaya the palm is cultivated mainly on coastal locations, the principal areas of concentration being Penang, Province

Wellesley, Krian, the Dindings, the Bagan Datoh area of Lower Perak, the coastal districts from the Bernam River to Sepang in Selangor, and the coastal districts of Pahang, Kelantan and Johore. There are also fairly extensive smallholdings along the banks of the larger rivers, particularly the Pahang, Perak and Kelantan Rivers. In eastern Malaya it is also cultivated in a narrow coastal strip which is almost continuous in Trengganu and fans out in the Kelantan delta. Except for parts of central Johore, there are few large coconut areas in interior Malaya. Most inland planting consists of a few

TABLE 37. *Distribution of Coconut Estates by Size, 1961*

SIZE GROUP	No. of Estates	Planted Acreage
100– 499 acres	44	8,954
500– 999 „	3	2,454
1000–1999 „	15	21,299
2000–2999 „	5	13,036
3000 acres and over	7	33,963
TOTAL	74	79,706

palms around the peasant kampong. Although individually insignificant, such plantings go far to satisfy the domestic requirements for the nut and its products, thereby releasing a larger quantity for the export market.

The coconut palm is a tropical plant which requires a mean annual temperature of about 75–85° F for successful growth. It can be cultivated anywhere in the Peninsula up to an altitude of about 2,000 feet, but it will not fruit when cultivated on steep slopes with gradients of more than one in fifteen. It requires moisture at the crown such as afforded by sea breezes, but proximity to the sea itself is not a necessary requirement for growth, though the largest coconut areas are near the coast. The palm grows best in localities with heavy (over 75 inches a year) and evenly distributed rainfall and high humidities. It is usually cultivated on light, well-drained soils in south India, Ceylon and the Philippines. In Malaya, however, commercial cultivation on the west coast and in the inland areas is limited to heavy, clay soils, and it is only along the east coast that cultivation is on sandy soils. The palm does not grow well on soils with a thick peat layer, but will thrive in areas where the peat layer, after drainage, is less than one foot.

The successful cultivation of coconut on the heavy clay soils of the coastal plains of Malaya depends to a large extent on careful drainage which must be so arranged that there is free movement of water in the soil, and that the water table is not lowered more than 3 feet from the soil surface as the main feeding roots of the palm are in this 3-foot zone. Apart from the usual drainage canals, estates near the sea must be protected from brackish tidal water by water-gates and sea-bunds. Many of the smallholdings along the Johore and Selangor coast have deteriorated considerably because of inadequate drainage. The high costs of drainage construction and upkeep are lowered in those estates which use the drainage canals as transport lines by which the nuts are moved from the field to the factory.

Two main types of coconut are cultivated in Malaya—the talls and the dwarfs. The dwarfs can further be subdivided into three varieties—the green, the red and the yellow. The dwarf coconut (Malay: *nyor gading*) was introduced into Malaya from Indonesia in the nineteenth century or earlier, but was not grown commercially for copra until 1912. It is more sensitive to unfavourable conditions than the tall palm and requires a heavy clay soil with good drainage and a regular water supply for high returns. Many estates are replacing the original tall varieties with the dwarfs with satisfactory results. The talls, however, still form the foundation of the coconut industry in Malaya, being planted in most smallholdings and estates. They are much more hardy and tolerant of poor growing conditions, although they show much diversity in their growth and fruiting characteristics.

The seedlings are raised in nursery beds until they are between five and seven months old, when they are transplanted to the fields. The planting density is usually 50 palms per acre for the tall varieties and 108 palms per acre for the dwarfs. Smallholders generally adopt a closer planting density of about 70 tall palms per acre. Some smallholdings have densities considerably above that of the optimum recommended by the Departure of Agriculture. A dwarf palm reaches fruiting age in its fourth year and produces its best yields towards its fifteenth year, while a tall variety begins to fruit in its fifth year and reaches its best towards the thirtieth year. Most trees produce good yields up to their sixtieth year. Yields vary considerably according to site and care of cultivation. In the better estates yields vary from 1,600 to 2,000 lb of copra per acre with the best estates producing up to 3,300 lb per acre. Yields in smallholdings may be as low as 500 lb. The ideal harvesting procedure is to collect the nuts as they fall from the tree, when the highest yield of copra and oil is obtained. But most estates harvest the nuts once a month, every six weeks, or every two months, while smallholders generally harvest once a week. The excessive frequency of smallholder harvesting leads to the collection of a high percentage of unripe nuts. Smallholders often sell their crop forward and the buyer then gathers every nut visible, including the very unripe ones. Because of the high percentage of unripe nuts and the poor methods of preparation, smallholder copra is usually of low quality.

The marketable products are fresh nuts, copra, coconut oil, copra cake, coir, toddy and coconut shell by-products. The most important of these is copra, the dried kernel of the nut. Smallholders usually prepare copra (Plate 23) by sun-drying the kernel, but kiln-drying is the normal method of preparation in estates. Kiln-drying, being independent of weather conditions, is a more reliable process than sun-drying, and enables the estates to produce a standard quality product. The total drying period varies between one and seven days, and averages three days. In favourable weather, the kernel may also be sun-dried either before or after kiln-drying. An average of about 4,500 nuts is required to yield one ton of copra. Malaya produces between 160,000 and 180,000 tons of copra a year, most of which production is converted locally into oil. Post-war estate production has been maintained fairly steadily at between 34,000 and 40,000 tons annually, but smallholding production has fluctuated from 120,000 tons in 1951 to 73,000 tons in 1958, and 140,000 tons in 1960. Malaya also imports copra from the neighbouring territories for milling, and the gross imports may in some years exceed the gross exports.

The coconut oil industry has expanded steadily since the war, and net exports reached a high of 80,000 tons in 1956, but have since fallen to about 40,000 tons in 1961. Malayan copra contains from 64 to 66 per cent of oil, but the average oil recovery obtained in local mills is 55 per cent. The residue after oil extraction is marketed as copra cake, a valuable cattle and pig food. Production of cake averages over 50,000 tons a year. Besides copra, coconut oil and copra cake, Malaya exports about nine million coconuts a year. There is also a considerable trade in fresh nuts for home consumption.

OIL-PALM

The oil-palm (*Elaeis guineensis*) was introduced into Malaya in the 1850s but the palm was cultivated only as an ornamental plant until 1917 when the first plantation was started in Kuala Selangor. Very little progress in the cultivation of the crop was made until 1926 when the area under oil-palm increased by nearly 2,000 acres over that of the previous year, to 12,000 acres. The acreage after 1926 steadily expanded as more planters began to take an interest in the crop in response to attractive prices for palm-oil. In 1933 the total area was 63,646 acres and by 1940 it had increased to 78,300 acres. The post-war period was spent in extensive rehabilitation of the estates and the total acreage remained unchanged until after 1948 when slow but steady increases were recorded. In 1953 the total area under oil-palm was 108,365 acres, in 1959 128,532 acres and in 1960 an estimated 135,000 acres. Table 38 shows the distribution by States in 1959. Most of the plantations are distributed in inland and coastal locations along western Malaya, from central Johore to Perak (Fig. 56). The Johore plantations are in rolling country, concentrated in three main areas—the Kluang area, Labis and Layang Layang (Plate 24). There is one large estate near Semana Halt in the Kuala Pilah district of Negri Sembilan. In Selangor the main areas are along the coast between Batu Laut and Kuala Sepang, to the south-east of Port Swettenham, north of Batu Tiga between Klang and Kuala Lumpur, at Merbau Sepak, and on the upper reaches of Sungei Selangor. The Perak estates are on the right bank of the middle and upper reaches of Sungei Bernam, with part of these estates in Selangor territory, and south of the Perak River mouth. There is also one large estate in Mentara Halt, on the northern borders of Kelantan and Pahang.

The estates vary considerably in size, but the majority are between 1,000 and 5,000 acres. Most of the estates are owned by Europeans and the control of the industry is almost entirely in European hands. There are also some Chinese-owned estates, but most of them are small and the total acreage under Chinese ownership is insignificant.

There were sixty-two estates in Malaya in 1959, but only fifty-seven of them were in production (Table 38). The largest estates are in Johore and Perak. Selangor has the largest number of estates, but the total acreage under oil-palm in that State is less than that of Johore, and only slightly larger than that of Perak.

The palm requires a warm climate, abundant sunshine and an annual rainfall of 60 inches or more. It is sensitive to drought and the rainfall must be evenly distributed throughout the year with no

TABLE 38. *Distribution of Oil-palm, 1959*

STATE	NUMBER OF ESTATES		TOTAL PLANTED ACREAGE
	Total	Number in Production	
Johore	9	8	57,947
Selangor	32	31	33,035
Perak	8	8	29,725
Pahang	4	3	3,406
Negri Sembilan	4	4	2,786
Penang and Province Wellesley	5	3	1,633
TOTAL	62	57	128,532

marked dry season. It grows best at altitudes below 1,000 feet. The Malayan climate is highly favourable to good palm growth.

The palm grows in a variety of soils, from moist, peaty coastal alluvium to the drier inland soils derived from sandstone and granite. Good drainage is essential in all cases. The best soil for the palm in Malaya is alluvial loam overlying a friable clay subsoil which will allow for easy root penetration and at the same time retain soil moisture. Coastal and riverine alluvial soils which are properly drained support very good stands of the oil palm. The palm will not grow well on deep peat, on soils with impervious hardpan layers, on very sandy soils, and on black soils with a high percentage of carbonaceous matter.

There are four main types of *Elaeis guineensis*: (1) the Congo type (var. *macrocarya*) from the Belgian Congo, is thick-shelled; (2) the Lisombe type (var. *tenera*) has fruit with a thick shell and 80 per cent pericarp; (3) the Pisifera type (var. *pisifera*) has fruit with no nut shell but a very well-developed pericarp with a high oil content; and (4) the Deli type (var. *dura*) which is extensively grown in Malaya, has fruit with a medium-thick shell and 35–55 per cent pericarp by weight. The Deli type is normally tall, but a short-stemmed 'dumpy' or dwarf palm has been developed in Malaya which holds promise of high yields, more convenient harvesting and long economic life. However, a major defect of the dumpy palm is the high percentage of infertile fruits in a bunch.

The palms are raised from seed in a nursery until they are from twelve to eighteen months old, when they are transplanted to the field. The usual planting distance is 32 by 32 feet, which gives a density of forty-nine palms per acre. Some estates adopt triangular planting of 28 by 32 feet, which gives a density of fifty palms per acre. The period of transplanting is timed to coincide with the beginning of a period of higher rainfall, usually either in March or September. It is usual to plant a leguminous cover-crop in order to suppress the growth of weeds, prevent soil erosion, and to keep the soil temperatures down. Malayan soils cannot meet the heavy requirements for plant food made by the crop, and some form of manuring is necessary in order to obtain high yields over a sustained period.

The palm begins to fruit during its third year in the field, but regular harvesting is normally postponed until the end of the fourth year. Full production is reached when the palms are about nine or ten years old, and such production is maintained for at least twenty years. The yields depend on the genetic constitution of the palm, on drainage, manuring, planting distance, and rainfall conditions. There is a close relationship between rainfall and yields, low yields usually following on spells of dry weather. There are also annual variations in yields caused by rainfall variations. Maximum yields occur during April, May and June in Johore, but during November and December in the other parts of Malaya. Table 39 below sets out the average yields of oil-palms in Malayan estates.

The quality and price of palm-oil decrease with increases in the free fatty acid content, which may be caused by cracking, bruising or over-ripening of the fruits. In order to produce high quality oil, the fruit bunches must be harvested when they are just ripe and

29. A Chinese market garden on Singapore Island. This farm specializes in the production of green, leafy vegetables, mainly *choy sam* (*Brassica chinensis*), for the local markets. Drainage conditions are poor, and soil aeration has to be improved through the use of raised beds and through frequent cultivation. The farmer is seen here turning over the soil of one of the beds, while a member of his family hand-waters the vegetables, using a two-bucket watering apparatus. Coconut fronds are used to protect the young plants from the direct effects of sun and shower. The small depression (right, centre) is the pond from which water is drawn. Sugar-cane and fruit trees are shown in the background.

30. Chinese market gardens on a terraced hillside, Cameron Highlands. Temperate vegetables such as cabbage, lettuce and spinach can be successfully cultivated in the cooler climate of the highlands. The vegetables are sent by road to the large towns in the lowlands.

31. A tea plantation in the Cameron Highlands. Tea bushes cover the steep slopes of the hills in the middle foreground.

32. A market scene at Kota Bharu, Kelantan. The Malay woman at right is holding up bunches of *buah petai*, edible pods from a jungle tree—*Parkia speciosa*. The oval, thorn-covered fruit is durian.

transported to the factory for immediate processing. The harvesting intervals are from five to ten days. On an average, the palms increase in height at the rate of 1 foot a year, and harvesting becomes more difficult and expensive as the palms grow taller. Harvesting 25–30 foot palms may cost four times as much as harvesting 10 foot palms. For this reason, among others, great efforts are being made to develop the 'dumpy' palm for estate cultivation.

Accessibility to all parts of an estate is important as the fruit bunches must be transported quickly to the factory for processing. Delay in processing increases the acidity of the oil. Transport systems in an oil-palm estate are therefore elaborate and are based on laterite

TABLE 39. *Average Yields of Oil-palm per Acre per Annum*

AGE OF PALMS (Years)	YIELD OF PALM-OIL (lb.)	YIELD OF DRIED KERNELS (lb.)
4	330– 385	120–140
5–6	660– 790	200–240
7–8	1,000–1,310	250–340
9–10	1,500–1,760	340–400
10 and over	1,760–2,280	400–455

roads or, if the estate is on suitable flat land, on light tramways (Plate 25). The running costs are lower in the case of the rail system, which has the additional advantage in that the rail trucks can be run directly into the factory for processing, with minimum handling and consequently reducing oil acidity to a minimum.

The fruit bunches on entering the factory are initially steam-sterilized to arrest enzymic degradation of the oil into free fatty acid. The oil is then extracted by a centrifuge or hydraulic press, the usual recovery rate being about 90 per cent. The oil is purified before it reaches the market. After oil extraction, the nuts are separated from the pulp, cracked and the kernels separated from the shell. The kernels are exported after being dried.

The oil produced in Malayan estates is of high quality with a low free fatty acid content of 2 to 3 per cent. Production for 1960 was 90,300 tons of palm-oil and 23,700 tons of kernels, while net exports were 90,500 tons of oil and 25,200 tons of kernels. Except for about

6,000 tons of oil used by Lever Brothers Malaya Ltd in their oil and soap factory in Kuala Lumpur, the rest of the Malayan palm oil and the entire production of kernels are exported. The oil-palm industry contributed 2·5 per cent by value of the total exports of Malaya in 1960.

PINEAPPLE

The pineapple, *Ananas comusus*, indigenous to South America, was introduced to the Far East by the Portuguese and the Spaniards, and was a common fruit by the end of the sixteenth century. It was widely cultivated in the Malay Peninsula but only for the local market. In 1890 some Chinese in Singapore began canning the pineapple as a 'shop-house' industry. From this humble beginning, the Malayan pineapple canning industry has grown to be one of the largest fruit-canning industries in the Commonwealth.

The rise of the pineapple industry was closely linked with the expansion of rubber cultivation in the Peninsula. Pineapple was interplanted with young rubber to provide a cash income until the rubber reached maturity. As the rubber acreages increased large surpluses of cheap pineapples were available for canning, and canning factories sprang up in Singapore, Johore and Selangor. By 1930 the export of canned pineapples was 57,960 tons. Paradoxically, the Great Depression of the 1930s marked the real beginning of the modern pineapple industry. Pineapple could no longer be cultivated as a catch-crop because the Depression put a stop to further rubber planting, and the fruit had to be grown as a sole crop if the canning industry were to survive. Large areas of land were therefore opened up for pineapple growing, and the area under pineapple as a sole crop increased from 3,000 acres in 1929 to about 40,000 acres in 1941.

The industry suffered heavy losses and damage during the Japanese occupation. Out of seventeen pre-war canneries only one remained intact, and only 6,000 acres of land were under pineapple at the end of the war. The rehabilitation of the industry was slow due to difficulties in the supply and marketing of the fruit. In 1949 the total exports of canned pineapple were 8,137 tons valued at $6.3 million, increasing to 17,372 tons in 1953 and to 32,831 tons valued at $26 million in 1960.

The total area under pineapple in 1961 was 42,248 acres, of which 30,379 acres were devoted to fruit grown for canning (Table 40).

About half the acreage of pineapple grown for canning purposes was in estates, and the other half in smallholdings. The largest areas are in Johore and Selangor (Fig. 56). The area in which pineapple was cultivated as a sole crop formed 85 per cent of the total acreage. The elimination of the catch-crop system and the fact that many canneries have their own pineapple estates have brought some stability to the supply side of the industry. Pineapple is also grown for the local fresh fruit market throughout Malaya. The largest acreages are in Kelantan (3,165 acres in 1959), Trengganu (2,475) and Perak (2,213).

TABLE 40. *Area under Canning Pineapple, 1961*

STATE	Total Acreage
Johore	24,363
Selangor	5,785
Pahang	83
Malacca	80
Perak	68
TOTAL	30,379

There are three main varieties of pine grown in Malaya—the Singapore Spanish, the Mauritius and the Sarawak. Each variety has various strains. The principal canning variety is the Singapore Spanish and its mutant, the Selangor Green. The fruit is golden yellow when ripe and weighs from 2 to 4 lb. The Mauritius and the Sarawak pines are cultivated for the fresh fruit market. The ideal pineapple for canning is one which has eyes as shallow as possible to reduce loss in cutting; a diameter of 4–5 inches; a fairly long fruit with a small core; a fair degree of acidity; low fibrous texture; as few air cells (flecks) as possible; a good colour; and a tendency to have some flavour as the colour changes over before the final ripening stage. The Singapore Spanish and the Selangor Green fulfil enough of these requirements to satisfy the canneries.

The climatic conditions under which the plant is cultivated vary. In Hawaii pineapple is grown in areas with about 30 inches of rainfall and a mean shade temperature of between 70° and 75° F. The equatorial climate in Malaya appears to be more favourable to pineapple cultivation, since two fairly large crops are harvested a year, in contrast to the one large and one small crop a year common in higher latitudes. The nature of the harvests in Malaya permits smaller factory units to be employed and makes for economy in labour in that a small labour force can be employed over a longer period of time.

Good drainage is essential for pineapple cultivation, and open, free-draining soils on slopes as found on the inland quartzite and granite areas of the Peninsula were used extensively for the crop until 1938, when legislation was passed restricting pineapple cultivation on hilly land because of the widespread erosion caused by the growers. As a result the growers migrated to the peat lands of west Johore. Pineapple has been grown successfully on peat soils for forty to fifty years. The present policy is to restrict pineapple cultivation to the peat lands of Malaya, and all the major pineapple areas are today found on deep peat (Plate 26). There are about one million acres of peat in Malaya, most of which are in west Johore, Selangor and Perak. The peat layer may be a few inches to 40 feet thick, and apart from shallow rooted vegetables, pineapple is the only economic crop that can be grown on deep peat.

Preparation of the land for cultivation consists of clearing and burning the swamp forest, and the laying down of a drainage system. The land is then cleaned and levelled and the pineapple slips planted in rows. The total number of plants may be 7,000 or more to an acre. The area is kept clear of weeds. The crown that develops after flowering is removed to increase the fruit size. The first harvesting period falls in May, June and July and the second in October, November and December. The best quality canned pineapple is produced from fully ripe pines, which have been handled and transported carefully to the factory and canned immediately. Careful and frequent harvesting is therefore necessary. Proximity of cannery to growing area is also an added advantage.

The pineapples are canned in seven canneries: two in Johore, two in Selangor, one in Perak and two in Penang (Plate 27). Most of the canned pineapples are sold to Singapore exporters who in turn export them to the United Kingdom (Malaya's main market), Canada, the United States and the Middle Eastern countries.

The pineapple industry faces a serious crisis due to severe competition from other producing countries, notably South Africa and Australia. These two latter countries produce canned pines comparable in quality with the Malayan products. With their two or three well-known labels and better advertising (compared with the 150 different labels and poorly advertised Malayan pines) the Australian and South African canners have captured a large share of the United Kingdom market. As a result, local canneries have been left with large stocks, and two of the canneries closed down at the end of 1959. In an attempt to clear these surpluses the canneries have reduced the prices of their products and curtailed production. The smallholders who cultivate pineapple for the canneries have been seriously affected by the price reductions and the fact that the factories could not offer them more than a nominal price for their pines. The problem is a long term one, and has its roots in the inefficient set-up of the industry, in labour troubles within the factories, and the lack of progress in modernizing the factories and organization. Recovery and stabilization of this important industry depends on lowering costs of production while maintaining quality, better advertising, and the reorganization of the industry and regulation of marketing arrangements.

SECONDARY AND MINOR CROPS

Apart from the five major crops of rubber, padi, coconut, oil-palm and pineapple, a very large number of secondary and minor crops are cultivated in Malaya. These can be classified under four main categories: Food Crops, Fruit, Spices and Miscellaneous Crops.

Food Crops. Table 41 shows the area and distribution of food crops. The largest areas are occupied by vegetables and the rice-substitute crops of tapioca, sweet potato and maize, and the beverage crops—coffee and tea. The other minor crops together occupy about one-sixth of the total area under food crops. All the food crops except tea are produced for home consumption only, and do not enter the export market.

The vegetables that enter the local market are from Chinese market gardens. The Malay peasant farmer does not cultivate vegetables for sale but may have a small vegetable plot in his kampong for his home supplies. The vegetables cultivated by the Malays are usually herbaceous plants such as *Basella rubra* (Malay: remayong), *Amaranthus gangeticus* (bayam merah) and *Sauropus androgynus* (asin asin). In addition, the Malay peasant may have a few trees such as *Morinda*

TABLE 41. *Acreage under Food Crops, 1958*

STATE	Tapioca	Vegetables[1]	Sweet Potato	Coffee	Maize	Tea	Other Food Crops[2]	TOTAL
Perlis	100	100	100	nil	100	nil	600	1,000
Kedah	5,800	1,500	1,400	900	1,300	nil	2,600	13,500
Kelantan	5,100	5,600	3,100	100	3,100	nil	6,300	23,300
Trengganu	1,000	400	700	100	500	nil	2,000	4,700
Penang and P.W.	3.900	1,300	1,200	nil	nil	nil	400	6,800
Perak	5,600	4,400	7,400	800	2,200	700	4,700	25,800
Selangor	4,600	3,900	2,400	10,700	2,100	3,400	1,800	28,900
Pahang	2,000	3,200	1,200	100	1,400	5,600	1,100	14,600
Negri Sembilan	1,600	700	900	200	200	900	900	5,400
Malacca	1,200	3,300	1,600	100	100	nil	1,600	7,900
Johore	4,900	2,400	3,200	1,800	200	nil	3,600	16,100
TOTAL	35,800	26,800	23,200	14,800	11,200	10,600	25,600	148,000

[1] Green leafy vegetables, root vegetables, vegetable fruits such as brinjals, tomatoes, cucumber, etc.
[2] Sago, groundnuts, water melon, colocasia, sugar-cane, sugar-palm, pulses, cocoa, and yam.

citrifolia (mengkudu), *Claoxylon longifolium* (salang) and *Phaeomeria speciosa* (kantan) which supply him with green foodstuffs. These home-grown vegetables may be supplemented by wild vegetables such as *Athyrium esculentum* (puchok paku), *Polygonum minus* (kesom), *Centella asiatica* (pegaga) and *Portulaca oleracea* (gelang pasir), gathered from the neighbourhood. It is also customary among the Malay padi growers in Kedah, Penang, Selangor, Malacca and the east coast States of Kelantan and Trengganu to cultivate small selected areas of the padi fields with food crops such as maize and groundnut and vegetables such as chili, cucumber, beans and Chinese radish during the annual fallow.

Chinese market gardens are of two types: (1) the ordinary mixed farm, raising pigs, chickens and some crops, including vegetables, for sale, and other crops such as tapioca, for stock-feed, and (2) the vegetable farm specializing in the intensive cultivation of vegetables for sale. The techniques and principles of intensive market-gardening are similar to those practised in ordinary market-gardening. The vegetable farm is common only in Penang and Singapore, and is a response to the great demand for leafy vegetables generated by the large urban populations in these two islands (Plate 28).

Chinese market gardens are usually located on the outskirts of towns and villages, most of them being found in western Malaya where the demand among the urban population for fresh vegetables, pork, freshwater fish, chickens and ducks is greatest. The 1960 Census of Agriculture showed that there were 4,040 vegetable farms (a vegetable farm is defined as a farm in which three-quarters or more of the total cultivated land is under vegetables) in Malaya. Eighty per cent of them were under 2 acres in size, and 48 per cent under 1 acre in size.

The principles and methods of market-gardening as practised by the Chinese in Malaya are basically similar to those of farmers in China, and they appear to be as suited to the tropical conditions of the Peninsula as to the temperate regions where they were evolved. These techniques enable the farmers to cultivate vegetables successfully in an environment where natural soil fertility is low, soil aeration inadequate, rainfall irregular and sometimes insufficient, insolation often too intense, and harmful organisms too numerous to allow anything more than a low yield. The efforts of the farmer are directed towards overcoming these unfavourable conditions, and making the most of the favourable ones.

Water is the essential factor in the production cycle, and in the selection of a suitable site for his garden, the Chinese farmer is more concerned with obtaining a flat, low-lying piece of land near a water body (usually a stream) than with the natural fertility of the land. For optimum growth and to prevent wilting, the vegetables must have adequate soil moisture at all times. Rainfall alone, high as it is in Malaya, cannot provide this, being too irregular, and coming in too brief and violent showers. The deficit is supplied by hand-watering, and it has been calculated that hand-watering supplies the equivalent of 36 inches of rainfall per annum for every acre devoted to intensive market gardening. For this reason, a farm that is too far away from a suitable stream always has one or more ponds as a source of water. The ponds are usually stocked with fish, thereby serving two purposes—as a source of water and a source of income from fish.

The Chinese market gardener can grow vegetables successfully on a variety of soils, and even on mined-over land which has no nutrient content and provides little more than the physical medium for plant roots. However, a well-balanced alluvial soil is considered best for vegetable cultivation, and very light or very heavy clay soils less suitable. Generally the best soils are those that are well aerated and at the same time have sufficient water-retaining properties to facilitate the intake of moisture by the shallow-rooted vegetables. The farmer ensures that the soil is well aerated by careful and frequent cultivation and through the use of raised beds (Plate 29).

The nutrient content of Malayan soils is usually low. Vegetables need considerable quantities of plant foods, and the farmer must apply large amounts of manure, both solid and liquid, in order to obtain high yields. The Chinese market-gardener uses organic manures, the most common being pig dung, sometimes mixed with night soil to form a liquid manure. The farmer who specializes in the intensive cultivation of vegetables utilizes prawn dust or cattle dung as primary manure, with supplementary liquid dressings of groundnut cake, soya bean cake, stale fish and sometimes, in spite of government regulations banning its use, night soil. Pigs are an essential complement of the farm economy in an ordinary market garden, their droppings being used to fertilize the vegetable beds and fish ponds. The pigs are fed on mash prepared from vegetable waste, chopped banana trunks, and sometimes also on cooked water-hyacinths from the ponds. A pig-vegetable nutrient cycle is thus

33. A Trengganu fishing boat homeward bound. The Malay fishermen usually sail out with the land breeze in the early morning and return with the sea breeze in the evening. Many of the boats are now powered by small outboard motors.

34. Logs being floated down the Kelantan River.

35. Logs from the forests of Johore being transported to the sawmills in Singapore. Timber is normally moved by road and rail and only occasionally by river.

36. Cleaning rattan (cane) in the Rompin River, Pahang. The rattans are collected from the jungle by aborigines. They are then cleaned by Malay women before being sent by motor launch to Singapore.

established, and the symbiosis of soil, plant and animal is so balanced that the whole system can be carried on indefinitely without soil exhaustion or deterioration.

The vegetables commonly cultivated are the green, leafy vegetables such as Chinese cabbage, spinach, cress, lettuce, mustard leaf, Chinese kale, vegetable fruits such as cucumber, bitter gourd, snake gourd, tomato, brinjal, pumpkin, root vegetables such as potato, sweet potato, carrot, lobak, and the beans and nuts such as four-angled bean, French bean, string bean and groundnut. Chinese market gardens in Cameron Highlands are run on the same lines as those in the lowlands, the manures used being prawn dust and fish waste. The vegetables cultivated are those which cannot be produced commercially in the lowlands, and include green peas, beetroot, parsnip, radish, turnip, vegetable marrow, celery, lettuce, mustard, watercress, capsicum, asparagus, cabbage, cauliflower, shallot, spinach, horse-radish, mint, parsley, sage and thyme. These grow well in the cooler environment of the highlands (Plate 30).

Production from the 26,800 acres under vegetables (including 1,200 acres in Cameron Highlands) in 1958 was insufficient to satisfy the needs of the country's population, in spite of the fact that an acre may yield up to 8 tons of vegetables annually. Imports of vegetables in that year totalled 52,200 tons, made up of 35,800 tons of fresh vegetables (Chinese cabbage, potatoes, onions and garlic being the main items) and 16,400 tons of dried and preserved vegetables (including canned vegetables, pickled cabbage, dried mushrooms, lily roots, turnips, bamboo shoots, lily flower and radish).

Tapioca occupies the largest area under food crops. Although now grown in every State, *Manihot utilissima* (Malay: ubi kayu) is indigenous to South America, and was introduced into Malaya little more than a century ago. Many varieties are cultivated, but all contain prussic acid in all parts of the plant. The varieties in which the acid occurs mainly in the rind of the tuber are classed as 'sweet' and those in which it is more evenly distributed throughout the root are classed as 'bitter'. Tapioca is a tropical plant that will grow on almost any soil, provided it is well drained. Because of its drainage requirements, it is usually cultivated on undulating or hilly land. Before the war, it was widely grown as a catch-crop with young rubber, but Government legislation stipulated that no more than two crops of tapioca could be planted on land alienated for rubber or other permanent form of cultivation. This restriction was necessary as tapioca on undulating or hilly land caused considerable soil erosion, not because it was an extremely exhausting crop (as it was so reputed), but because no soil conservation measures were taken. Moreover, Chinese planters often dig drainage trenches up and down hill, and this, coupled with the disturbance of the soil when cultivating and lifting the crop, led to serious soil erosion during heavy rain.

The main areas of tapioca are in Kelantan, Kedah, Penang and Province Wellesley, Perak, Selangor and Johore. Of the 35,800 acres in 1958, 20,600 acres were under tapioca as a sole crop. It is widely cultivated by the Chinese as pig food, while the lower income groups of all races use it occasionally as a rice-substitute, or in the preparation of cakes. There are also factories in Perak which manufacture pearl tapioca for the local market and for export.

Of the other important food crops, sweet potato is cultivated in Chinese market gardens for pig food and to meet a small local demand for a cheap rice-substitute. The main area under the crop is in Perak. Maize occupies the largest areas in Kelantan, Perak and Selangor, and is grown mainly for sale, either to be eaten on the cob or as a vegetable in curries.

Except for tea and coffee, all the other food crops are of minor importance and occupy only small areas: sago (6,500 acres in 1958), groundnut (4,600 acres), water-melon (4,100 acres), colocasia (4000, acres), sugar-cane (2,300 acres), yam (1,600 acres), cocoa (1,600 acres), pulses (600 acres), and sugar-palm (400 acres). Sago is obtained from two species of the sago palm—*Metroxylon sagus*, common in western Malaya, and *M. Rumphii*, found more abundantly in eastern Malaya. The palms grow in a half-wild state in swampy land along river banks and low-lying riverine areas. They are harvested when about twelve years old, when they are cut into 4-foot logs and floated to the processing shed where the raw sago is extracted from the logs. The yield of raw sago varies with the size of the palm, averaging between 250 and 650 lb per palm. The raw sago is sent to factories, most of them in Singapore, where it is processed into 'pearl' sago or flour, similar to tapioca flour. Each 100 lb of raw sago yields about 58 lb of sago flour. The main sago areas are in Johore (Batu Pahat) and Perak.

Groundnut or peanut is cultivated on a small scale in every State, with Perak and Kelantan having the largest acreages. The nuts are either eaten whole after roasting or frying, or expressed to produce oil. Groundnut oil is used extensively by the Chinese as a cooking oil, and as local production is insignificant large quantities are imported to meet the demand. Water-melon is an important seasonal crop in the northern States experiencing monsoonal conditions. Half the total planted acreage is in Kelantan. Colocasia (Malay: keladi) is a herbaceous plant with edible tubers. It is cultivated mainly by the Chinese, who use it for feeding pigs. The tubers are eaten boiled or fried and the large leaves may be used locally for wrapping packets. Sugar-cane was cultivated on a commercial scale up to 1913, when the last sugar factory closed down. The cane is now grown as a backyard crop, and is used as chewing material. Yams (Malay: ubi) are of minor importance, except in Kelantan where about 900 acres are cultivated. Pulses are planted as off-season crops in the padi areas of Kedah and Perlis. The sugar-palm, *Arenga pinnata* grows semi-wild in Malay kampong, and provides a local source of sugar.

The beverage crops—coffee and tea—are cultivated on a small scale. Coffee, except for one estate in Selangor, is grown on smallholdings. The only type planted is 'Liberica' coffee (*Coffea liberica*), a variety which does not enter the international market. The plant grows best in alluvial clay soils which are well drained. It is grown without shade, and gives high yields—from 650 to 800 lb of prepared beans per acre per annum from well-maintained holdings. The bushes flower in their second year, and a small crop is obtained during the third and fourth years, the size of the crop increasing with the age of the plant. The bushes will live from twenty to thirty years when cultivated on coastal clays. Of the 14,800 acres under coffee in 1958, 10,700 were located in the coastal lowlands of Selangor. The total acreage is increasing slowly as some of the smallholdings under old rubber are replanted with coffee. There is still room for expansion of local coffee production, as shown by the fact that net imports of coffee into Malaya in 1958 totalled 4,450 tons.

Tea (*Thea sinensis*) or *Camellia sinensis* had long been planted on a small scale by the Chinese in Malaya, and there were several estates growing tea on a commercial scale in 1893. However, interest in the crop waned as rubber began to dominate the agricultural scene, and by 1936 only 3,000 acres of tea had been planted. In the post-war years the area expanded to 9,000 acres in 1949, 10,600 in 1958 and 16,000 acres in 1959. Of this total, over 10,000 acres are upland tea grown in Cameron Highlands, (Plate 31) and the remainder lowland tea grown in Selangor, Negri Sembilan and Perak. Yields of tea are much higher in the lowlands than in the highlands. Average yields for lowland tea vary from 800 to 1,600 lb of made tea per acre per annum, and for upland tea from 250 to 1,000 lb per acre. The quality of upland tea, however, is better. In general, yields of both upland and lowland tea in Malaya are higher than those obtained in India and Ceylon, as the heavy rainfall, which is fairly evenly distributed throughout the year, leads to frequent and heavy 'flushes' of leaves. Production of Malayan tea in 1958 was 4,878,000 lb, and in 1960 5,483,000 lb, of which 5,138,000 lb were exported.

Fruit. Tropical fruits in great variety grow well in the Malay Peninsula. Many of these are indigenous while others are introduced from other tropical countries. Indigenous fruits may be wild or cultivated. A catalogue of Malayan fruits lists thirty-nine principal varieties commonly cultivated, forty-seven varieties of lesser importance, forty-four indigenous varieties not commonly cultivated but collected and eaten by the local population, and five varieties which only grow at high altitudes. In spite of this great variety of fruits, cultivation is only of local importance, and canned pineapple is the only fruit regularly exported in large quantities. Local production of fruit is insufficient to meet demand and, in 1960, 16,410 tons of fresh fruit valued at $17·6 million were imported. Most of these are varieties which cannot be grown in Malaya. Apples, oranges, pears and grapes are the fruits most commonly imported. Large quantities of preserved and canned fruits are also imported.

Table 42 shows the area and distribution of cultivated fruits, most of which are grown in mixed stands in Malay kampong. Of the total area of 170,200 acres, only 24,870 acres were in holdings where different types of fruit were grown as sole crops. The most important of these were banana (10,050 acres in 1958), rambutan (6,120 acres), citrus (4,620 acres) and durian (2,820 acres). In the areas of commercial monocultivation, fruits form the main source of income. In contrast, fruits in the kampong holdings are grown for home consumption, and the income from the sale of any excess is supplementary to that from the main crop, usually rubber, padi or coconut.

Practically all Malay smallholdings have some fruit trees. The characteristic feature of the dusun (fruit) areas in the kampong is the haphazard and casual way in which the trees are planted. There is no systematic cultivation, manuring or selection and the trees are usually self-sown. Seedlings once established are left to grow as best they can, the only assistance provided by the smallholder being that of cutting back excessive undergrowth. Sporadic attempts are made to limit the ravages of pests such as squirrels and flying foxes. Some fruit, mainly for home consumption, is also grown in Chinese market-gardens, the popular varieties being banana, papaya, lime, pomelo and jackfruit.

Fruit is grown on a variety of soils. In general, the best soils are alluvial soils which are well-drained and do not contain too much

TABLE 42. *Acreage under Fruit, 1958*[1]

STATE	Banana	Durian	Rambutan	Mangosteen	Citrus[2]	Other Kampong Fruit[3]	TOTAL
Perlis	1,800	700	300	nil	nil	1,300	4,100
Kedah	5,500	6,300	2,400	800	800	3,500	19,300
Kelantan	4,500	1,100	1,400	300	300	1,600	9,200
Trengganu	3,700	6,200	2,900	700	100	1,800	15,400
Penang & Prov Wellesley	1,100	700	2,400	600	100	600	5,500
Perak	11,700	8,000	4,800	2,200	4,200	7,100	38,000
Selangor	6,400	2,700	2,400	1,400	400	1,000	14,300
Pahang	16,000	2,900	1,700	400	400	5,100	26,500
Negri Sembilan	3,300	1,900	900	600	200	1,000	7,900
Malacca	4,300	1,400	1,000	800	500	1,700	9,700
Johore	6,100	3,500	4,000	1,100	700	4,900	20,300
TOTAL	64,400	35,400	24,200	8,900	7,700	29,600	170,200

[1] Excluding pineapple.
[2] Mandarin oranges, limes, pomelo and other citrus.
[3] Papaya (paw-paw), mangoes, duku and langsat, chiku, rambai, champedak, jackfruit, cashew nuts and other fruits.

clay. Heavy, impermeable clay soils restrict root growth, but some Malayan fruits such as the mangosteen can tolerate such soils. Peat lands can only support pineapple. In spite of the equatorial climate, the principal Malayan fruits, except the banana and the papaya, are markedly seasonal and come into the market at well defined periods of the year.

Banana is the most widely cultivated fruit in the country, and almost every smallholding, whether Chinese, Malay or Indian, has a few plants to supply fruit for home consumption. A large number of varieties are grown, some of which bear large coarse fruit which are only eaten cooked. But most of the bananas planted are dessert varieties for which there is a greater demand. The principal commercial dessert varieties are Pisang Embun, Pisang Mas and Pisang Rastali. Pisang Embun is identical with the Jamaican or Gros Michel banana, and the best variety established in Malaya. Banana is sometimes grown as a catch-crop in young rubber areas. It is common in all Chinese market-gardens as the Chinese use banana stems as pig fodder.

Durian enters the market in larger quantities than any other seasonal fruit (Plate 32). The durian tree, *Durio zibethinus*, is probably indigenous to Borneo, but has spread in its cultivated form throughout the Malay Peninsula. It grows to a height of 80 to 100 feet, and fruits in its seventh to eighth year. There are two fruiting seasons a year, the main crop being produced in June to August, and a subsidiary crop towards the end of the year. In the north-west and north-east, however, where monsoonal influence is more pronounced, only one crop is produced, around August. Durian is found in most kampong areas and also some aboriginal jungle clearings.

The rambutan tree, *Nephelium lappaceum*, is indigenous to Malaysia, and cultivated throughout the Malay Peninsula. It is second in importance to the banana as a commercial crop under monocultivation. The fruits are variable in quality and flavour, ripening in August and September, with a secondary crop towards the end of the year. The mangosteen, *Garcinia mangostana*, comes into bearing only after its fifteenth year, but in spite of the long period between planting and fruiting, it is very widely distributed throughout the rural areas. It is usually interplanted with other fruit trees in the kampong, and grows best in low-lying, well-drained alluvial soils.

The *Citrus* genus as cultivated in Malaya includes the lime *C. acida*, lemon *C. limon*, orange *C. aurantium*, mandarin orange *C. nobilis*, and pomelo *C. maxima*. Of these the mandarin orange is the most important, occupying 5,580 acres of the total of 7,700 acres under citrus in 1958. More than 80 per cent of the area under mandarin orange is sole-cropped, mainly along the Perak River near Telok Anson. The pomelo is the largest of the citrus fruits, and grows well in districts with low-lying alluvial soils. The lime, too, is fairly widely distributed. There were 800 acres of pomelo and 1,000 acres of lime in 1958.

Of the other kampong fruits, duku and langsat (*Lansium domesticum*) occupy the largest area (7,100 acres in 1958), with smaller areas under champedak (*Artocarpus champeden*, 3,900 acres), rambai (*Baccaurea motleyana*, 3,000 acres), mango (*Mangifera indica*, 2,800 acres), chiku (*Achras sapota*, 2,000 acres), jackfruit (*Artocarpus integra*, 1,700 acres), papaya (*Carica papaya*, 1,000 acres) and a great number of minor fruits which are planted mainly for home and local consumption.

Spices and Miscellaneous Other Crops. Table 43 shows the area and distribution of these crops. Arecanuts and pepper are the only spices exported, the net exports amounting to about 10,000 tons and 3,000 tons respectively. The betel-palm, *Areca catechu*, is grown everywhere in the lowlands, with the largest acreage in Johore and the northern states of Kedah, Kelantan and Trengganu. Chillies, *Capsicum annuum*, are grown in Chinese market-gardens and Malay kampong for home and local consumption. The sireh plant, *Piper betle*, is grown on a small scale in most Malay kampong, the leaves being used for chewing. Pepper, *Piper nigrum*, is the most important of the other spices. It has been cultivated in Malaya since the nineteenth century, although only on a minor scale. Pepper cultivation has been responsible for much of the soil erosion in Johore and Singapore in the past, due to the clean-weeding practised by the Chinese farmers on the hill sites in which the crop was grown. In recent years, the high prices for pepper have stimulated some expansion in acreage. Practically all of the 630 acres under the crop are in Johore. Clove and nutmeg were once export crops, but are only of local importance today, most of the 470 acres under these spices being in Penang and Province Wellesley. Tumeric and ginger are also grown only for the home market, occupying 700 acres in Kelantan and 600 acres in Malacca, as well as smaller areas in most of the other States.

The Nipah palm, *Nipa fruticans*, grows wild in tidal locations along the coast of the Peninsula, mainly in estuaries where there is the brackish water necessary for its growth. The leaves are much used as thatching material (atap) by the Malays for the roofs as well as walls of their houses. The leaves are also used for making baskets and mats, and the young leaves for cigarette-wrappers. Supplies from the

TABLE 43. *Acreage under Spices and Miscellaneous Other Crops, 1958*

STATE	SPICES					MISCELLANEOUS OTHER CROPS			
	Arecanut	Chillies	Sireh	Others[1]	Total	Nipah	Tobacco	Others[2]	Total
Perlis	900	200	200	nil	1,300	500	500	100	1,100
Kedah	8,300	800	800	200	10,100	4,900	200	300	5,400
Kelantan	3,300	1,000	600	800	5,700	1,300	800	100	2,200
Trengganu	2,800	100	300	100	3,300	2,200	400	700	3,300
Penang and Province Wellesley	1,100	100	200	500	1,900	2,800	nil	nil	2,800
Perak	2,200	800	100	300	3,400	7,300	2,600	2,300	12,200
Selangor	100	800	100	200	1,200	4,200	700	100	5,000
Pahang	600	400	200	300	1,500	4,500	1,000	3,800	9,300
Negri Sembilan	200	200	100	100	600	400	nil	100	500
Malacca	300	300	200	600	1,400	900	nil	100	1,000
Johore	20,700	300	100	800	21,900	2,500	100	200	2,800
TOTAL	40,500	5,000	2,900	3,900	52,300	31,500	6,300	7,800	45,600

[1] Ginger, tumeric, pepper, nutmeg and clove.
[2] Kapok, ipecacuanha, patchouli, citronella, gambier, derris, gutta percha.

wild palm are limited, and supplementary supplies are obtained from palms planted along the coasts of all the States.

Tobacco is usually grown in rotation with market-garden vegetables or as an off-season cash-crop in padi areas. The variety commonly planted is the large-leaved Deli type which yields a low quality tobacco. Yields vary from 650 lb to 1,000 lb per acre. Home-grown tobacco finds a ready sale, and planting has been stimulated as a result of increases in duty on imported manufactured tobacco. The largest areas are in Perak and Pahang. Gutta-percha is obtained from the sap of a forest tree, *Palaquium gutta*, indigenous to the Peninsula. There are about 1,800 acres of gutta-percha forest in Perak and 2,000 acres in Pahang, these two States being the main sources of the gum. The only other crop of some importance is derris (tuba root), the main areas being in Pahang.

CHAPTER 10

LIVESTOCK REARING, FISHING AND FOREST PRODUCTION

LIVESTOCK REARING

As in other parts of the wet tropics, climatic conditions in the Malay Peninsula are not conducive to pastoralism, and there is no tradition of cattle-rearing amongst the indigenous aboriginal groups or amongst the lowland Malays. The Malays, however, use the buffalo for ploughing padi fields, but the animal does not play more than this subsidiary role in their predominantly agricultural economy. Buffaloes are occasionally slaughtered for meat, but milking is not general except in parts of Kedah and Province Wellesley.

Available evidence indicates that the tropical environment is not suited to cattle rearing. The hot, wet climate induces hyperthermy in cattle and causes them to lose their appetite. Cattle are not indigenous to Malaya, and those that are reared in this country have been introduced from India, Thailand and other neighbouring territories. Indiscriminate breeding and the general lack of interest in quality have resulted in a cattle population that is undersized, weedy and degenerate. Although Malaya remains free from the major cattle diseases of rinderpest, foot-and-mouth, anthrax, blackwater and tuberculosis, many other diseases, especially those caused by parasites and nutritional deficiencies, are common among the livestock population.

The potentialities of livestock rearing are limited by the fact that there are no natural pastures in the Peninsula. Grass of one kind or another is the basic foodstuff of the local swamp buffalo, cattle and goats, but the natural vegetation of Malaya is deeply shaded forest where the sun-loving grasses cannot grow. Grasses can only be established where the forest has been felled, and the development of pastures from primary and secondary jungle is a costly affair in a region where climatic and other environmental conditions are continually working towards the reversion of these cleared areas to jungle. Furthermore, noxious and rapidly-growing weeds such as *lalang* (*Imperata cylindrica*) and *pokok kapal terbang* (*Eupatorium oderatum*) soon invade any pasturage or grazing area that is not continuously tended. The conversion of forested land into pastures is therefore economically impractical, the corollary to this being that cattle and sheep rearing cannot be developed on any large scale. There is scope, however, for expansion of livestock farming based on buffaloes, pigs, goats and poultry.

Tropical pastures are of poor nutritive value. The highly nutritious leguminous plants used for feeding livestock in temperate lands cannot be established in the tropics because of the low fertility of the soils. It has been established that the higher rate of photosynthesis under tropical conditions tends to produce rapidly growing herbage with low protein and mineral content, the content becoming progressively poorer during growth because of a dilution effect. The poor quality of tropical pastures causes grass-eating livestock to grow slowly. In Malaya the growth rate of cattle is only half that in Britain. The poverty of tropical grasses is such that a larger area is needed to support one head of cattle than is necessary in temperate lands. For example, an acre of tropical pasture can feed only 48 lb of live weight, whilst the same area in Europe can feed 480 lb.

All livestock in Malaya, except pigs and poultry, depend to a large extent on such pasturage as is available on grazing reserves, forest clearings, vacant and waste land, roadsides and bunds, and on padi land during the fallow period. Much of the grazing land is ill-kept and inadequate, often reverting to scrub. There is no deliberate or planned attempt at pasture management. The grass common to all grazing lands except padi land under fallow is *lalang*. Although *lalang* is tough and of low nutritive value, young *lalang* (up to a month old) is palatable and fairly nutritious, and because of its ubiquity it forms the basic foodstuff of much of the livestock population. Grasses superior to *lalang* which are found on some grazing lands are mixtures of local grasses such as savannah grass (*Axonopus compressus*), carpet grass (*A. affinis*) and cow grass (*Paspalum conjugatum*). In addition to the feed obtained from grazing cattle, especially milch cattle, including the Indian milch buffalo, are fed with cut fodder and a variety of supplementary feeding stuffs such as bran, coconut cake and gingelly cake. Apart from those Indians who raise milch cattle and buffaloes for a living, the people who are engaged in livestock rearing regard it as a supplementary occupation. There is therefore no livestock industry as such in Malaya, and the population in general have little interest in livestock rearing. The position is also complicated by racial prejudices and religious taboos. Pig-rearing, for example, is exclusively in Chinese hands as the Malays regard the pig as an unclean animal. Many Chinese and some Indians will not include beef in their diet because of their religious beliefs. Mutton is only very occasionally found in Chinese meals. In fact, the only animal foods regularly eaten by all the communities are poultry and fish.

Table 44 shows the livestock population of the Federation. Singapore has only about 11,000 head of buffaloes, cattle and goats,

TABLE 44. *The Livestock Population, Malaya, 1960*

Buffaloes	269,000	Goats	271,000
Other Cattle	308,000	Sheep	37,000
Pigs	455,000	Poultry	13,000,000–16,000,000 (estimated)

but a large pig population of over 400,000. Large numbers of livestock are imported into the country each year for meat, the net imports for Malaya amounting to 55,000 sheep, 41,000 pigs, 8,000 buffaloes, 2,000 cattle and 3,700 goats in 1960. In addition, between one-and-a-half and two million live and dead poultry are imported each year, as well as over 100 million eggs.

There are more than half a million buffaloes and other cattle in Malaya, of which about two-fifths are in the north-eastern States of Kelantan and Trengganu. Most of them are work animals, beef and milk being produced only on a very small scale. Cattle dung as a manure is only of minor and local importance in the agricultural economy of the Malays. Most of the work done by the draught animals is in the cultivation of padi land, the ploughing period lasting for two months. A few are also used by the Chinese for hauling timber. In Kelantan buffaloes are preferred for ploughing the wetter and more clayey lands, while oxen are used on the less soggy fields.

These draught animals are a problem to feed. There is abundant grazing in the padi fields during the four or five months fallow, but once the padi seedlings are planted, grazing is restricted to vacant, waste and village grass-lands, to roadsides and the sides of irrigation canals and drains. During the six or seven months between planting and harvesting of the padi crop the cattle cannot obtain sufficient feed and consequently lose condition. This hunger season occurs regularly each year, and is a major problem in the more densely settled padi areas such as Kelantan and Kedah.

Experiments in Kelantan conducted by the Department of Agriculture over the last ten years indicate that the answer to the fodder problem may be found in *Stylosanthes gracilis*, a fodder plant introduced from tropical Australia. This plant grows very vigorously in all types of soils including *bris* but not swampy soils, is drought-resistant, and will yield from 20 to 30 tons of green matter per acre per annum for the first two years. The yield falls thereafter, but the crop persists for three to six years. The fodder is palatable and very nutritious, and is acceptable to all classes of ruminants. Up to September 1959, Kelantan farmers had planted some 600 acres of *S. gracilis* on numerous small plots, and the area was increasing rapidly. The general practice is to feed the cattle with this green fodder in conjunction with other available natural rough grazing.

There are two types of buffaloes in Malaya, the wide-horned Kerbau or Malayan water-buffalo and the curly-horned Indian Surti or Murrah buffalo. The Malay farmer may own a few Malayan water-buffaloes, using them mainly for ploughing the padi fields, and only occasionally for meat and milk. They are swamp-loving animals and are therefore well suited to working in the soft ground of the padi fields. They are also used to haul timber in the jungle; such buffaloes are usually better cared for by their Chinese owners. The Malayan water-buffalo make up 98 per cent of the buffalo population in Malaya and are distributed in the main padi areas.

The Indian buffaloes are exclusively dairy animals kept by Sikhs in the vicinity of the larger towns of Perak and Selangor. There are about 5,000 of these buffaloes. In contrast to the water-buffalo, the Indian type requires dry grazing grounds. In addition to grasses, the buffaloes are fed on concentrates made up of rice bran, broken rice, sesame cake and salt. Yields of milk average from 20 to 30 pints per day, these gradually diminishing as lactation advances. Surplus milk is converted into ghee, and a small supplementary income is derived from the sale of manure.

There are also two main types of cattle in Malaya, the common draught cattle bred from Thai-Kedah stock, and milch cattle of mixed Indian Zebu breeds. The draught cattle are, as in the case of the Malayan water-buffalo, used mainly for ploughing, only occasionally for meat, and still more rarely for milk. They form the majority of the cattle in the country. Their distribution is closely related to that of the padi-growing areas, most of them being found in the north-western and north-eastern States of Perak, Kedah, Perlis, Kelantan and Trengganu. In the Kelantan delta pressure of population and the long history of land subdivision have resulted in a large number of individually small padi holdings. Ploughing is commonly practised, and cattle are used in preference over the water-buffalo in all areas except low-lying swampy land. Although the cattle are hardy and well-adapted to local conditions, they suffer from a seasonal lack of forage during the period when the padi plants are growing in the fields. Overstocking here, as in Kedah, contributes to the problem of pasture shortage.

Milch cattle are mainly of mixed Zebu breeds originally imported from India. There are about 87,000 such cattle distributed in the neighbourhood of towns, largely along western Malaya. They are reared by Indian dairymen chiefly for milk, with surplus animals, especially males and culls, sold for beef and sometimes for draught purposes. Some cattle are also reared by Indian labourers in the rubber and coconut estates. Cattle in the suburban areas are fed on such fodder as is available on waste and vacant land, and only cows in milk are supplied with additional foodstuffs in the form of concentrates. Inadequate feeding and indiscriminate breeding methods have resulted in cattle that are poor milk producers, and the average lactation yield is only about 1,000 lb. Yields are increased to as much as 3,000 lb in well-managed herds.

The local goat is bred by Malay smallholders and Tamil labourers for meat, and by the latter for milk also. The local population prefers goat flesh to mutton, and there is a constant demand for goats. The majority of the herds are small and large herds are seldom encountered. The goats are fed exclusively on the natural herbage and foliage of the neighbourhood.

Sheep rearing on a large scale is impracticable because of the unfavourable climatic conditions, but small flocks of sheep are found in those areas with a long dry season—Kelantan, Trengganu and Pahang—and also in parts of Negri Sembilan where the average rainfall is the lowest in the Peninsula. The sheep are well adapted to the unfavourable environment and low level of nutrition. They are bred for meat only.

Pig rearing is an integral part of the Chinese market-gardening economy. Most of the market gardens and, therefore, the pig population are distributed in the suburban areas and New Villages in western Malaya. Pig rearing is also frequently associated with coconut and fishing districts along the coast, the pigs being fed on copra and fish waste. The industry received a severe setback during the resettlement campaign when thousands of Chinese squatter farmers were evicted from their farms and resettled in New Villages. High prices for tin and rubber also tend to attract labour and interest away from pig rearing. Conditions have now returned to normal, as indicated by the fact that the pig population is now larger than that recorded in 1949 (455,000 in 1960 as compared with 250,900 in 1949). However, the pig population is still some 150,000 head smaller than that of 1940.

The local pig is a black, grey or white Chinese breed. Originally a temperate climate animal, the pig has adapted itself successfully to tropical conditions. In contrast to the practice in most European countries, the local farmers do not include milk in the diet of piglets. The Chinese feed pigs on a soft diet composed of boiled succulent vegetable foods—sweet potato haulms and tubers, tapioca leaves and tubers, keladi (*Colocasia*) leaves and tubers, banana stems, kangkong (*Ipomea reptans*) and yams (*Dioscorea*). Concentrated foods are included in the diet when the pigs reach a marketable age, the most common foods being rice bran and broken rice, coconut cake and some fish meal.

Poultry is the only livestock commonly raised by all races, in rural as well as urban areas. No complete census has ever been taken of the poultry population, but a recent estimate puts the total between 13 and 16 million. The threat of Ranikhet disease has been removed by an intensive vaccination programme, thereby providing a stimulus to poultry raising. In recent years some large farms carrying from 1,000 to 6,000 and even up to 10,000 birds have been established. However, the majority are raised on a small family scale in backyards and kampong, and the birds are usually underfed and badly housed. Poultry in rural areas are allowed free range, scavenging such food as they can in the form of insects, grass, seeds, household refuse. Occasionally the owner may throw them a handful of broken rice or padi. Ducks are bred extensively by the Chinese in some coastal areas where large amounts of fish refuse are available. They are also common in some localities where irrigated padi is cultivated. Geese, turkeys and pigeons are reared only on a minor scale.

The International Bank Mission estimated that with existing pasturage, fodder, food residues, management and advisory services,

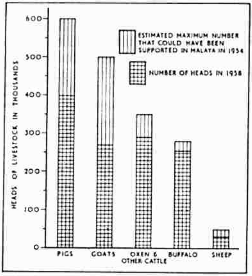
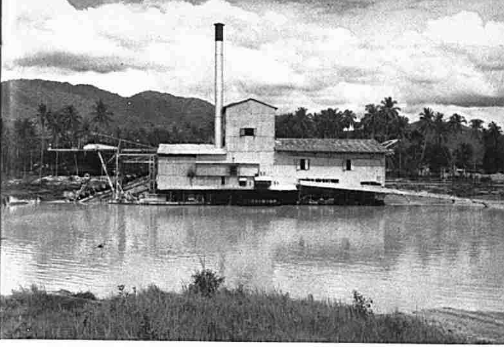


FIG. 57. Potentialities for increasing the livestock population

TABLE 45. *Per Capita Consumption of Meat, 1955–56*

Fresh Beef	5·5 lb per annum
Pork	25·5 " " "
Mutton	3 " " "
Poultry	5 " " "
Eggs	30 per annum

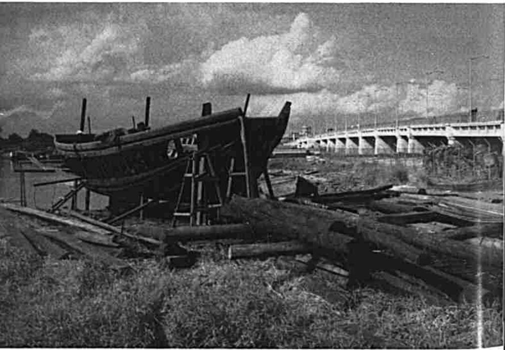
Malaya could support a total of 280,000 buffaloes, 350,000 other cattle, 500,000 goats, 50,000 sheep and 600,000 pigs. Figure 57 and Table 44 show that there is some room for expansion of the population of buffaloes and other cattle as well as sheep, and considerable room for expansion of the goat and pig population. At present the consumption of meat per capita is very low (Table 45), especially



37. A tin dredge in the Klang Valley, Selangor. The dredge floats on a pond which is constantly being enlarged by the mining operations. Crude ore is recovered from the material excavated by the endless chain of buckets (left). The tailings are deposited on the pond at the back of the dredge.

38. A gravel-pump tin mine in the Kinta Valley, Perak, with limestone hills in the background.

39. A gravel-pump tin mine near Kota Tinggi, east Johore. Mining operations are extending towards the cleared land on the right. The white expanse is the tailings from the mine. The effective disposal of the great amount of tailings from alluvial tin-mining in Malaya is always a problem.



40. A Chinese boat under construction on the right bank of the Kallang River, Singapore. Many such boats are used as lighters, ferrying goods between the boat quays of the Singapore River and the ships at anchor in the Roads. On the right is the Merdeka Bridge.

among the non-Chinese and the usually non-pork-eating sections of the Asian population. The need for increasing the per capita consumption of meat is great in a country where a large proportion of the population is undernourished. Any positive measures for expanding the livestock population of the country would not only be valuable from the nutritional point of view, but would also lessen Malaya's dependence on imported sources of animal protein.

FISHING

Part-time fishing and the main occupation of padi cultivation have always formed the traditional bases of the subsistence economy of the coastal Malays. Living in an environment which does not encourage livestock rearing, the diet of the Malays is essentially vegetarian. The main source of animal protein is fish. Fish—fresh, dried or salted—forms the second staple food not only of the Malays, but also of the immigrant Chinese and Indian population. Although fish is the cheapest of the animal protein foods, the per capita consumption is only between 60 and 70 lb per annum, an amount insufficient to maintain a balanced diet in the absence of other protein food intake.

Because of its cheapness and relative abundance compared with meat, fish has always been a popular food with people of all races, and the influx of the immigrant population generated an increasing demand. In response to this demand, most of the fishing communities along the 1,200 miles of coasts began to specialize in catching fish for the local markets, and fishing became a regular full-time occupation. The number of people engaged in fishing has increased steadily over the years, reaching a peak of 77,700 in 1950, but declining, due partly to poor fishing seasons, to a total of 53,784 in 1960. Of these 70 per cent were Malays, 29 per cent Chinese, and the remainder of miscellaneous other races. Slightly less than half of the total fishing population is in the east coast States of Trengganu, Kelantan and Pahang.

The importance of the fishing industry is illustrated by the fact that the gross value of fish production is nearly equal to that of rice. After an initial period of post-war rehabilitation, production rose to 105,000 tons in 1949, and annual production since then has varied from 108,000 tons to 120,000 tons. Production has increased in recent years, to 139,000 tons in 1960 and 151,000 tons in 1961. In addition, about 25,000 tons of freshwater fish are produced annually, mostly for home consumption. Catches are affected by seasonal weather conditions, and the high seas and heavy weather of the north-east monsoon result in low landings in the months of December to February, particularly along the east coast. Catches in Perlis and Kedah also decline during the south-west monsoon in July and August. Periods of peak production usually occur during May–June and September–October.

Marine Fishing. The fishing industry of Malaya is based largely on the intensive fishing of shallow inshore waters, centred around the South China Sea, the Straits of Malacca, the Straits of Singapore and the easternmost parts of the Indian Ocean. The Malay Peninsula forms part of the Sunda Platform, a drowned plateau linking the Peninsula to Borneo and Sumatra. The seas around the Peninsula are shallow, seldom exceeding 200 feet in depth. The nutrient level and hence the productivity of these seas is low, for a number of reasons:

(1) In an equatorial environment where solar radiation and temperatures are high throughout the year, the metabolic rates also tend to be high, with the result that there is no seasonal check to growth which might permit the accumulation of nutrients. The utilization of nutrients goes on as fast as they are produced. Such nutrients, mainly phosphates and nitrates, are essential for the growth and maintenance of the plankton pastures which are the bases of fish food.

(2) Oceanographical research has shown that the surface waters of tropical seas are generally poorer in phosphates and nitrates than the surface waters of temperate and arctic seas. However, it is also known that the deeper layers of tropical seas contain large amounts of nutrients released through the processes of decomposition of waste matter. In temperate seas, where the surface layers may be colder than the underlying layers in winter, such nutrient accumulations are brought up to the surface by convection currents, but in tropical seas the surface water is always warmer than the underlying layers, so that the nutrients are locked up in the lower layers.

(3) In other parts of the tropics such as the western South American coast and the west coast of Africa, the stocks of nutrients locked up in the deeper layers are brought up to the surface by the process of upwelling of deep sea water. Such a process does not occur in the shallow Malayan seas. However, research has suggested that a process similar to upwelling takes place during the intermonsoon

periods when the current drifts of the South China Sea and the Singapore Straits are reversed in direction. These intermonsoon periods have been found to be periods when large numbers of diatoms (microscopic algae) prevail in Singapore Straits.

(4) The movements of water around Malaya are largely conditioned by winds, tides and currents from neighbouring seas. No high latitude cold currents intrude into this region to displace the lower layers of water and enrich the seas.

Under such circumstances the richest areas are those fertilized by drainage water from the land carrying terrestrial detritus of all types as well as dissolved mineral salts. Here, again, the value of this discharge depends upon the physical composition of the land from which it comes. For example, the water which drains off the volcanic rocks of Java and Sumatra is richer in dissolved salts than that which drains off the old sedimentaries and granite of the Malay Peninsula.

Thus the physiography of the coasts and the nature of the tropical waters around Malaya account largely for the importance of inshore fisheries, and the major catches are taken from the narrow Straits of Malacca and a belt 10–20 miles wide bordering the east coast. But the form and nature of fishing activities are also conditioned by climate, technology and tradition. In many parts of the Peninsula where winds provide the main motive power for fishing boats, the daily cycle of fishing activities relates closely to the incidence of land and sea breezes (Plate 33). Superimposed upon this is the seasonal cycle along the east as influenced by the north-east monsoon, and along the west coast as influenced by the south-west monsoon, although the south-west monsoon is not strong enough to hamper fishing to any great extent except in north-western Malaya which lies unprotected by the Sumatran land mass. There is also a close correlation between tides and fishing. The largest catches are made when the tidal rise and fall is greatest, during the spring tides which occur at the periods when the moon is new or full. At neap tides (first and last quarter of the moon) the tidal flow is small, and fish shoal movements are reduced, with the result that fishing activity is also reduced. Still less fishing takes place during the few days between each tide when tidal flow is practically absent.

The use of traditional craft propelled by oars and sails restricts fishing to a narrow zone and reduces the quantity and variety of fish caught. It is only in recent years that mechanization of fishing boats has become important, and in 1960 61 per cent of the 14,608 boats were powered. Mechanization has reduced the dependence upon sails and made the fishermen more mobile. However, it has not extended the range of fishing operations to any significant extent, one major reason being that the fishermen, especially the Malays, are reluctant to remain at sea for more than a day.

In view of the fact that the intensive commercial operations along the coasts of Malaya over the last half century are leading to over-fishing, the future of the marine fishing industry depends on the extension of the fishing range to cover new grounds. Four potential fishing grounds have so far been discovered. Three of them are off the east coast: one running across the mouth of the Gulf of Siam, the second running east–west 20 miles off the Pahang coast, and the third extending north–south off the Trengganu coast. The other grounds extend in an arc between the Langkawi Islands to north of Penang and the northern tip of Sumatra.

The number of species of fish so far recorded in this region exceeds 1,000, but only some 250 are food fish, and only twenty main varieties are commonly caught and enter the market. The fish that are commonly found in Malayan markets are catfish (Malay: *keli*, *bagok*, *bakap*), sea bream (*batu*), pomfret (*bawal*), grey mullet (*belanak*), anchovy (*bilis*), whiting (*bulus bulus*), horse mackerel (*kembong*, *chincharu*, *selikor*), jewfish (*gelama*), grunters (*gerut gerut*), sea perch (*kerapu*), snappers (*kerisi*), thread-fins (*senangin*, *kurau*), red snapper (*ikan merah*), stingrays and skates (*pari*), sprats, pilchard and herrings (*tamban*), Spanish mackerel (*tenggiri*), sharks (*yu*), and the Malayan shad (*terubok*). A survey carried out in the Straits of Singapore established that the greater part of the fish population consisted of small fish. But such small fish which would be regarded as non-edible in other countries are widely consumed by the Asian population, and even those that are not normally eaten by the population are used as duck food. On an average, the non-edible fish make up 40 per cent of the annual catch.

A wide range of fishing methods is employed by Malayan fishermen to catch the great variety of fish in these waters. To the indigenous methods have been added methods introduced by Chinese as well as Japanese fishermen. The Japanese drive-in net or *moro-ami* is especially useful for fishing in coral reefs where the more usual nets cannot be used. For each of the main methods—line, nets and traps—there is multiplicity of equipment, and the fishermen display great ingenuity in the construction of such equipment from locally available material such as wood and bamboo. The most important traps employed in the shallow coastal waters are the fixed fishing stakes. There are several types of stakes, but the commonest are the *kelong*, constructed of nibong palms and erected in waters up to seven fathoms deep. There were 3,733 fishing stakes in Malaya in 1957, located mainly in Johore and the protected waters of the

TABLE 46. *Average Production of Fish per Fisherman, 1960*

STATE	Total Production (tons)	Number of Fishermen	Production per Fisherman (tons)
Perlis	4,197	1,127	3·72
Kedah	13,636	5,093	2·68
Penang and Prov. Wellesley	10,002	5,342	1·87
Perak	52,059	7,442	7·00
Selangor	16,429	4,652	3·53
Negri Sembilan	339	513	0·66
Malacca	2,579	1,640	1·59
Johore	12,750	5,889	2·17
Pahang	8,863	2,791	3·18
Kelantan	4,075	6,486	0·63
Trengganu	14,540	12,809	1·13
TOTAL AND AVERAGE	139,469	53,784	2·59

Malacca Straits. These brought in one-third of the total catches for Malaya.

The output of the Malayan fisherman is low. Firth estimated a prewar annual average of 1·5 tons, a very low figure when compared with the output of the British fisherman, which was six to eight times larger in bulk and twelve to fifteen times higher in value. Production per fisherman was 2½ tons in 1960, with wide differences in output in the different States (Table 46). It is significant that Perak, with the highest output per man, was also a State where mechanization of fishing boats was most advanced. Conversely, Kelantan and Trengganu with few powered boats had very low *per caput* production. An enquiry by the Fisheries Department into the working efficiency of motorized and non-motorized fishing units revealed that the former could maintain a high and steady rate of production which could only be achieved by the non-motorized units at peak periods. But it is evident that the output of the fishermen also depends on other factors such as weather conditions, tides, the presence of fish shoals, and the skill and efficiency of the fishermen themselves. Fishing has always been an uncertain occupation, and production fluctuates from day to day, season to season, and year to year.

There are more than 300 landing points for fish along the entire coastline of Malaya. Apart from what is retained by the individual fisherman for his own consumption, the catch goes to the nearest market. Spoilage takes place very rapidly in the tropics, and some form of preservation is necessary while the fish are being transported to market. In western Malaya where the main towns are near the coast and there are adequate transport facilities, the bulk of the catches are packed in ice and reach the markets in a fresh condition. But along the east coast communications between the fishing villages and the main roads are very poor, except for north-east Johore (Mersing and Endau) which is connected to Johore Bahru and Singapore by good roads. Distance from markets and poor transport facilities reduce the amount of fresh fish supplied by east coast fishing villages, and a high proportion of the catch is dried and salted. From 15,000 to 20,000 tons of salt fish are produced annually, and a considerable proportion was exported to Indonesia until recently, when the Indonesian government put a complete stop to the trade. These restrictions have now been relaxed, and the salt fish trade with Indonesia is slowly recovering. Malaya also exports large quantities of fermented shrimp paste (Malay: *belachan*) to Thailand.

Freshwater Fishing. The division between marine and freshwater fishing in Malaya is a sharp one, in contrast to Singapore where brackish-water prawn culture in reclaimed mangrove swamps (similar to the brackish-water fish pond culture of Indonesia and the Philippines) may be regarded as a transition or bridge between the two main forms. At the moment the only economic use made of the brackish-water zone in Malaya (corresponding roughly to the mangrove belt along the west coast) is the culture of the Malayan cockle, *Anadara granosa*. Cockle culture was started experimentally in 1948, and has proved to be a success in the mangrove areas of the west. Most of the cockles produced are from the 2,000 acres of muddy foreshore in the districts of Gula, Larut and Matang of Perak, the

700 acres of grounds in Penang, and the natural beds off the Selangor coast around Beting Gopal. The annual production is about 165,000 lb.

The possibilities of developing prawn ponds in the brackish-water zone are being explored. The potentialities are great in view of the fact that such ponds have been successfully established on a commercial scale in Singapore. A further possibility is stocking the ponds with *Tilapia mossambica*, a fish indigenous to East Africa. *Tilapia* thrives in both fresh and brackish water, and experiments conducted in a brackish-water pond in Singapore have shown yields of 1,300 lb per acre per annum.

TABLE 47. *Utilization of Inland Waters in Malaya*

	ACRES
Fish ponds (a) freshwater	over 3,000
(b) salt water	negligible
Artificial lakes, reservoirs, etc.	1,235
Salt or mangrove swamps suitable for pond construction	740,000
Padi fields with fish culture	868,000

Whereas marine fishing is a self-contained industry providing full-time work for a large number of people, fresh-water fishing is only a complementary facet of the Malay padi-growing economy and Chinese market-gardening. Throughout Malaya, padi fields, rivers, ponds, lakes, catchment areas, freshwater swamps and abandoned mining pools are fished regularly by Malay peasants as well as Indian estate labourers. The catch seldom goes beyond the home or the nearest village market. The single largest source of freshwater fish is from the padi fields. Considerable potentialities exist for the extension of piscicultural operations to the other areas of inland water, as Table 47 indicates. In addition, there are extensive areas of freshwater swamps which are at present only casually fished by the rural Malays and by Indian labourers. Many of the inland valleys with perennial water supply from springs and small streams offer possibilities for the culture of suitable fish such as the common carp and *Tilapia*.

The flooded padi fields of Monsoon Asia have always been the source of home-table fish for the farmers. In Malaya freshwater fish for the home and for the market are caught in the fields, irrigation canals and drains of the padi growing areas. In general fish from the small and discontinuous fields characteristic of the south Malayan padi landscape are for subsistence only, and it is only in the large extended plains of north-west Malaya that there are substantial surpluses above subsistence needs. The four most important varieties of padi field fish are *Trichogaster trichopterus* (Malay: sepat ronggeng), *T. pectoralis* (sepat siam), *Ophiosephalus striatus* (aruan) and *Claricas batrechus* (keli). All are labyrinth fish, capable of absorbing atmospheric oxygen when their gills are wet and of surviving extremes of temperature and oxygen availability. These qualities of hardiness are necessary for the fish to survive in fields which are flooded for only part of the year. There is always a sufficient number of fish left in the drains and canals to supply the next season's fry, so that no restocking is necessary. No deliberate efforts are made by the padi planter to encourage the growth of these fish, which are left to forage for themselves.

Except for the *sepat siam*, the padi field fish are consumed locally as fresh fish. The *sepat siam* is exported in salted form. A prolific and hardy fish, it was introduced into the Krian Irrigation Area in about 1921 and has since spread to other padi areas. Feeding on silt, algae and other vegetable matter, the fish enter the fields when these are flooded for transplanting, and they mature there after four months. When the irrigation water is drained off before the harvest, the fish collect in the specially dug sump-ponds at the lowest part of the fields. Each pond may drain two or three acres, and in rich localities may yield from 700 to 1,300 lb of fish, though in fields where there is poor growth of the fish's main food—algae—the catch may be as low as 40 lb per pond. There are about 14,500 sump-ponds in Krian, and the area produces most of the salted *sepat siam* exported each year. The surplus fish sold are an important source of extra income to the padi planters. But Krian offers exceptionally good breeding conditions for the fish; elsewhere production is barely sufficient for subsistence.

Chinese participation in freshwater fishing is confined to carp-rearing in artificially constructed ponds. Fish culture here forms part of the Chinese market-gardening-cum-fish-rearing landscape. This form of pisciculture which had its origins in the warm temperate environment of South China was introduced successfully into the tropical setting of Malaya without substantial modifications. However, except for the common carp, the other species—the grass carp, the big head, the silver carp and the mud carp—do not breed locally, and over a million fry have to be imported each year from China through Hong Kong to stock the ponds. Over 3,000 acres of ponds produce a few hundred tons of carp for the local markets.

Carp rearing depends on the careful division of the available food resources among the different species. Usually the grass carp make up half or more of the total in a pond. Their food is any succulent grass that may be placed in the pond. The droppings from these fish help to raise the fertility of the waters thereby encouraging the growth of the algae and plankton upon which the big head and the silver carp feed. The mud carp depends on food at the bottom of the pond, while the common carp is a general scavenger. Where intensive methods are employed, the yields may be as high as 4,000 lb of fish per acre, but the average is low because most of the farmers rear carp only on a part-time basis, in conjunction with market gardening.

FOREST PRODUCTION

Of the 36,590 square miles of forested land in Malaya, 12,710 square miles are forest reserves under the control of the Forest Department (Fig. 58). About one-third of these reserves is forests over 1,000 feet in elevation, and are maintained for the purpose of protecting the head-waters and catchment areas of the rivers and streams from erosion and ensuring that the water in them is free from silt. These are therefore unproductive forest reserves. The other two-thirds of the reserves are composed of productive forests which are managed by the Forest Department for the purpose of producing a continuous supply of timber to meet the requirements of the country. Such forests may be likened to estates and plantations, except that here the crop is timber and forest products and not rubber or coconuts. It is estimated that the productive forests of Malaya yield between 200 and 500 cubic feet of timber per acre, though the yield may sometimes be considerably more. The yields of timber per acre are very poor compared with the 5,000 cubic feet in the forests of Northern Europe and the 15,000 cubic feet in the forests of the Pacific seaboard of North America. This disparity in yields may appear surprising in view of the greater luxuriance of the tropical rain forests when compared with the coniferous forests. However, although there are more than 2,500 species of trees in Malaya, only a few of these produce timber which is commercially acceptable.[1]

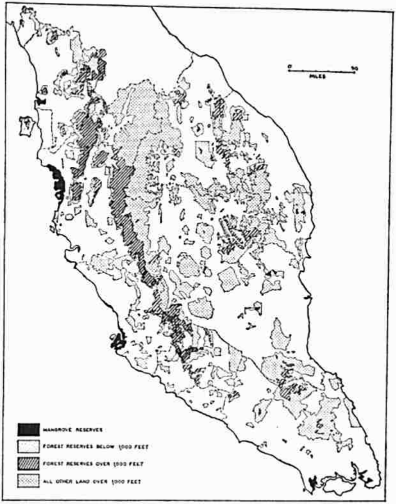


FIG. 58. Forest reserves

Again, the commercially valuable trees are the large, top-storey dominants, and there are fewer such trees per unit area in the rain forest than in the temperate forests, and these are also generally

[1] See Chapter 3 on vegetation.

smaller in size and produce less timber than the giant conifers. Another cause of low yields is the greater susceptibility of tropical timbers to decay and insect depredations in the living trees, so that the final recovery of saleable wood is significantly lower.

The major forest products are timber, poles, firewood and charcoal. Table 48 shows production in 1961. Half the total annual yield

TABLE 48. *Production of Timber and Fuel, 1961*

STATE	SOLID CUBIC FEET				
	Round Timber	Poles	Firewood	Charcoal	Total
Johore	20,251,800	158,000	1,782,000	1,048,600	23,240,400
Perak	12,510,100	1,108,500	2,027,700	7,550,600	23,196,900
Pahang	18,759,100	53,400	258,300	225,100	19,295,900
Negri Sembilan	11,139,900	106,700	5,900	243,700	11,496,200
Selangor	4,324,300	682,300	2,429,800	400,600	7,837,000
Kedah	4,869,700	87,000	121,900	575,300	5,653,900
Trengganu	3,630,700	10,500	1,437,100	197,000	5,275,300
Kelantan	2,128,600	6,800	75,300	199,600	2,410,300
Malacca	425,800	8,100	11,600	27,900	473,400
Perlis	127,200	55,900	19,100	900	203,100
Penang and P.W.	5,800	800	3,700	nil	10,300
TOTAL	78,173,000	2,278,000	8,172,400	10,469,300	99,092,700

of these forest products is from Forest Reserves and half from unreserved forests. Production has increased steadily since the war, and present production is three times that of 1946.

The exploitation of timber in Malayan forests is difficult because of the great number of different species of trees of various sizes scattered over a wide area. It is not unusual to find an average of only one tree of commercial value in several acres of forest. This is particularly so where the heavy hardwoods are concerned; patches of 20 to 100 acres in extent in eastern Malaya may have only two or three trees of marketable size in them. There are also some species that yield second-class timber which could be sold locally if they could be extracted without too much expense. Most of the remaining trees have wood so soft as to be worthless even for firewood or pulp. The practical exploitation of such forests is therefore very much dependent upon accessibility and cheap transport. The more remote areas will be uneconomical to exploit because of excessive transport costs. Nor is it always possible to reduce costs by floating logs down-river as the working areas may not be near a suitable river, and also because many tropical hardwoods are not buoyant. In eastern Malaya logs are floated down in large rafts, but the rivers of western Malaya are little used for log transport (Plates 34 and 35). Poles are floated down in large quantities.

Although the Government exercises control over the forests, the actual exploitation of the timber resources is in the hands of private enterprise. Timber from Forest Reserves and State land is extracted by independent loggers who sell the round logs to sawmillers for conversion into sawn timber. Some sawmills have their own logging areas and obtain their round logs direct from the forest. Sawmilling is one of Malaya's important industries. The first sawmills were established in the 1920s, and by 1940 there were 80 mills. The post-war period has seen a very rapid expansion of the industry, and there are now 400 mills employing 6,000 men, mostly Chinese. Expansion has in fact been over-rapid, with the result that some mills are as far as a hundred miles away from the source of logs. The Emergency has also had adverse effects on the industry, and security considerations have led to the siting of mills in towns rather than near forests, with resultant increase in costs. There have also been fluctuating and regional shortages of logs. Many of the mills are undersized, and there has been no increase in efficiency in terms of output per labourer or per horsepower in the post-war period. The output of sawn timber from all mills in 1961 was 711,100 tons of 50 cubic feet, and the net exports of sawn timber totalled 308,200 tons of 50 cubic feet.

The mangrove forests are intensively worked to produce firewood, charcoal and poles. There are 463 square miles of mangrove reserves, of which 346 square miles are productive. Small areas are clear-felled each year on a rotation of forty years. Felled areas are naturally regenerated and are ready for further felling at the end of the rotation period. There has been a marked decline in the demand for and the production of firewood and poles in recent years. Poles are used mainly in the tin mines, but due to changes in mining methods and restrictions on tin production the demand has fallen. Firewood production has declined steadily in face of competition from more efficient fuels, especially oil. There is, however, still a substantial demand for charcoal, sufficient, in fact, to boost production from 84,000 tons in 1952 to about 200,000 tons in 1961.

Apart from the major products of timber and fuel, the forests also yield a number of minor forest products which are collected in small amounts and sold or bartered. The most important of these in terms of value are nipah (the leaves of which are used in the manufacture of *atap* thatch), rattan (used for making baskets, mats, rattan furniture, etc.), jelutong, gutta-percha and other gums and resins collected by tapping species of trees of the families *Sapotaceae* and *Dipterocarpaceae*, and a large number of miscellaneous products such as incense wood, tanning and dyeing material, fibres, derris, medicinal plants, and a variety of food plants (Plate 36). The total annual revenue from such minor forest produce is less than 5 per cent of the total revenue from all forest products. Collection of minor forest produce has declined during the 1950s due to the Emergency, but production is gradually recovering with the ending of the Emergency.

CHAPTER 11

THE MINING ECONOMY

Gold, tin and iron-ore have been mined in Malaya for centuries, though on a small scale, and mostly for local use. As in many other parts of the tropics, mining provided the initial impetus to the development of Malaya, and was in one way or another responsible for the evolution of the economic and social landscapes of the country. Mining has been and still is centred largely on tin, and it was the discovery of rich deposits of alluvial tin in the Larut valley of Perak during the middle of the nineteenth century which led to the first 'tin rush'. New tin-fields were subsequently discovered in the Kinta Valley and in the Klang Valley of Selangor. The exploitation of these fields was largely in the hands of the Chinese who streamed into Malaya from south China.

Mining operations gained momentum with the establishment of British rule and production rose to 40,000 tons in 1898 and then to over 50,000 tons in 1913. The pioneers of the tin industry were the Chinese, but towards the end of the nineteenth century European capital entered the field. The Chinese tin monopoly was gradually broken: in 1910 78 per cent of the total production came from Chinese mines, and the rest from European mines. By 1930 European mines were producing 63 per cent and the Chinese only 27 per cent. The Europeans continue to dominate the post-war mining scene, and in 1961 produced 66 per cent of the tin in Malaya.

Tin has long been one of the major sources of the government's revenue. In 1899 the export duty on tin provided nearly 46 per cent of the total revenue, and although the relative contribution of tin has since fallen with the rise of the agricultural sector of the Malayan economy, its absolute contribution remains significant. Thus while tin contributed about 12 to 15 per cent of government revenue in the post-war period, the absolute contributions in the boom years of 1951 and 1952 alone came to over 76 million and 69 million dollars respectively. Tin mining employed four-fifths of the mining industry's labour force of 40,365 in 1961. About two-thirds of the labour force were Chinese, and the rest Indians and Malays.

The mining economy of Malaya is still primarily based on tin, but over the last half century a number of other minerals, notably iron-ore and bauxite, have been discovered in commercial quantities and mined. Table 49 shows the main types of minerals produced. The outstanding position of tin in the mining economy is clearly revealed by the fact that it contributed three-quarters of the total value of the minerals exported in 1961. The keen demand for iron shown by Japan has greatly stimulated the production of ore from

TABLE 49. *Mineral Production, 1961*

MINERAL	PRODUCTION (Tons)
Tin	56,028
Iron-ore	6,733,520
Bauxite	409,881
Ilmenite	106,975
Raw Gold (in Troy oz)	12,486
Manganese	6,366
Monazite and columbite	791
Wolframite and scheelite	31

the richer deposits. All the other minerals combined contributed less than 3 per cent of the total value of all minerals produced. Over half a million acres of land are alienated for mining, of which slightly over 80 per cent are under tin lease.

TIN

The tin fields of the Malay Peninsula belong to the large metallogenetic tin province of South-East Asia, which includes Burma, Thailand, the Malay Peninsula and parts of Indonesia. This tin province, centred in Malaya and extending for hundreds of miles northwards into Thailand and lower Burma, and southwards to the islands of Singkep, Banka and Billiton (Fig. 2), is the richest and most extensive in the world, contributing for the last half century the bulk of the world's supply of the metal. Primary tin deposits always occur in, or near to, an acid igneous rock, usually granite or granitic rocks, although only a small fraction of the world's granite masses are stanniferous. Thus, for example, while the Main Range of Malaya is highly stanniferous, tin has not been found in the neighbouring granite range—the Benom.

It is believed that the batholith of which the granite ranges of the Malay Peninsula are weathered remains was intruded during crustal movements in the Cretaceous period. As the magmas cooled and crystallized, cracks, fissures and faults were formed in the consolidated granites as well as in the adjacent sedimentary rocks. Highly mobile fluids, representing the last of the original magmas and

TABLE 50. *Modes of Occurrence of Cassiterite* (*after Scrivenor*)

CONTAINING FORMATION	MODE OF OCCURRENCE
1. Granite	In veins, pipes and disseminated throughout the granite.
2. Limestone hills	In caves and fault-fissures. Often cemented by calcite to form a hard rock.
3. Limestone beds and valley floors	In pipes, veins, and as detrital ore in caves.
4. Shales, schists and quartzites	Near the junction with the granite, and in veins connected with it.
5. Recent deposits	Derived from 1, 2, 3 and 4 as a result of weathering, erosion and deposition.

containing cassiterite (tin-ore) among other minerals, found their way into these fissures and faults. Primary tin deposits were formed when the fluids cooled and the tin minerals separated out from the other minerals, crystallizing usually into small grains which might be black, colourless, or different shades of brown, red, grey and yellow. The most common locations of these stanniferous veins were the margins of the granite masses, in the contact zone between the granite and the sedimentary rocks. There is therefore a close relationship between the distribution of the granite masses and the tin-fields of Malaya. None of the major tin deposits occur far from granite, but not all of the granites are tin-bearing.

While the cassiterite mined in Malaya had its origin in the primary deposits that were genetically connected with the granites, the actual modes of occurrence of the mineral are varied, as seen in Table 50.

Most of the tin-ore mined today occurs as secondary deposits in alluvial flats in the river valleys and coastal plains or as eluvial deposits on the slopes of hills.[1] Existing evidence points to the fact that during the Pleistocene age sea-level was several hundred feet lower than at present. Fluvial erosion went on rapidly, stripping weathered material from the ridges and highlands and laying them down in the valleys and plains. In the process the rocks containing the primary tin deposits were also eroded away and subsequently laid down as alluvial material with a high percentage of cassiterite. Most of the alluvial tin of Malaya was deposited during the very long period of time between the Pleistocene and comparatively recent times. The tin-bearing zone varies in depth from a few feet to over 100 feet, with some of the alluvium lying too deep to be mined economically by present-day methods.

Another type of secondary tin deposit is found where limestone containing veins and pipes of cassiterite adjoins granite. Such limestone commonly underlies the alluvium. Percolating ground-water easily dissolves the limestone, especially when it is fissured by fault planes, bedding planes and cleavage planes. The effect of solution is to hollow out and enlarge such fissures to form cups and cavities. Over a period of time deep solution troughs and innumerable pinnacles develop, with rich eluvial and sometimes alluvial tin-ore accumulating in the troughs. The nature of the limestone surface poses a problem in the extraction of the ore, the only practical solution being gravel-pump mining using water pressure to flush out the hidden deposits.

An indication of the wide distribution of tin in Malaya is the fact that every one of the major geological formations is stanniferous to a greater or lesser extent. Tin mining takes place over a vertical range extending from well below sea-level to (at one time) heights of 4,000 feet, although there are now no highland mines. Scrivenor has divided the tin areas of Malaya into two zones—the western tin-belt and the eastern tin-belt. The western tin-belt lies along the flanks of the Main Range and on either side of the subsidiary granite ranges west of the Main Range. The largest and most famous of the tin-fields along this belt is the Kinta Valley (Fig. 59). It has been estimated that about 45 per cent of Malaya's past production of tin has

[1] Eluvial deposits are those formed by the weathering and decomposition of stanniferous rocks and lodes *in situ*. No mechanical transport except soil creep is involved, so that the detrital deposits overlie the rocks from which they are derived. When such deposits are transported and re-deposited by water they become alluvial deposits. The same methods of mining are used for both types.

FIG. 59. Distribution of tin fields

been derived from the Valley. Most of the rich alluvial deposits in the Valley occur along the valley margins close to the granite contact zone. The floor of the Valley is of limestone of Carboniferous age, and has been extensively metamorphosed by the granite of the Main and Kledang Ranges. Interbedded with the limestone are schists, phyllites, quartzites and indurated shales, all also metamorphosed by the granite, and occasionally carrying tin-ore. The granite and the metamorphosed sedimentary rocks have been weathered and decomposed to considerable depths, and are the source of the tin-ore which is found as residual and eluvial deposits.

The second major area of mineralization occurs south of the Kinta Valley, mainly in Selangor and Negri Sembilan, and parts of south-western Pahang. Here, primary and secondary tin deposits are scattered over an area nearly 90 miles long by 50 miles wide, covering the Main Range and its flanks. Most of the present-day production comes from alluvial deposits in Selangor.

Deposits are found in numerous other localities along the western tin-belt. The limestone caves of northern Perlis contain residual and alluvial deposits, now being mined by underground methods. Minor deposits of tin occur in shallow water along the sea coast of the Dindings area of Perak and in Malacca. These deposits extend beyond low-water mark, the ore being derived from local granitic rocks and concentrated by wave and tidal action. In all, more than 90 per cent of the tin produced in Malaya comes from the western belt. Most of the surface mines and all of the dredges in the country are located there.

The eastern tin-belt is less continuous and less rich than the western. It includes the deposits in the eastern parts of Kelantan, Trengganu, Pahang and Johore (Fig. 59). The richest field is in eastern Pahang, where primary deposits are mined by underground methods. This area of mineralization extends northwards for about 50 miles, covering part of southern Trengganu. Two extensive areas of mineralization occur in eastern Johore, one north-west of Kota Tinggi and the other south of Jemaluang. Minor deposits are also found in northern Trengganu and Kelantan.

Methods of Mining. Three main stages are involved in all forms of tin mining: excavation of the *karang* (ore-bearing ground), separation of the ore from the waste material, with water as the separating agent, and concentration of the crude ore. About 95 per cent of the total output of tin is from alluvial and eluvial deposits, but because of the different modes of occurrence of the deposits, a variety of mining methods is employed. The principal methods are dredging and gravel-pumping, normally accounting for more than 80 per cent of the total output. Other methods include hydraulicking, open-cast mining, underground mining, and *dulang* washing.[1] Table 51 shows

[1] For a description of *dulang* washing, see p. 303.

the number of mining units and production by methods of mining. Of the 696 mining units, 122 were European, together with some Australian, New Zealand and American concerns, consisting of all the 72 dredges, 33 gravel pumps, 10 hydraulic mines, 5 open-cast mines, 1 lode mine, and 1 small mine. The other mines were Asian, mainly Chinese.

Dredging lends itself to the systematic and thorough exploitation of large areas of suitable mining land, with little or no loss of tin in

TABLE 51. *Number of Tin-mining Units and Production by Methods of Mining, 1961*

METHOD	MINING UNITS	PRODUCTION (Tons of tin content)
Dredging	72	29,627
Gravel-pumping	572	19,339
Hydraulicking	10	1,347
Open-cast mining	5	1,413
Underground mining	21	2,320
Dulang washing	nil	1,041
Miscellaneous	16	941
TOTAL	696	56,028

the mining process. It is the only practical method of working deposits in swampy or very wet ground, and it has the decided advantage of being able to treat low-grade ground at a lower cost per cubic yard than is possible by any other method. As a result of the introduction of dredging in 1912, extensive areas of land formerly considered too poor in tin to be worth working, or which had previously been mined by other methods but still contained sufficient ore for profitable dredging, were opened up. But the capital cost of installing a dredge is very high, so that a dredging property must be extensive and have a working life long enough for costs to be recovered as well as profits made. Depending on the grade of ground and the capacity of the dredge, the mining company must acquire sufficient land for mining operations to be carried on for a period of fifteen to twenty years to make dredging worthwhile.

A dredge consists of an excavator and a concentrating plant mounted on a floating platform in an artificial pond or paddock formed by the dredge itself as it digs up the ore-bearing ground (Plate 37). The excavator is made up of buckets mounted on an endless band, the ground being excavated by successive 'bites' of the buckets. The digging capacity of dredges vary from 90,000 to 480,000 cubic yards per month, and the depths to which they can dig vary from 40 to 135 feet, although the latest dredges can dig to depths of 160 feet. The excavated material is washed and screened, and the crude ore recovered by means of *palong* (see below) and/or jigs. The ore is then further washed and cleaned to a marketable product in a treatment plant on shore. The waste material (tailings) is passed to slimes-retention areas behind the dredge. The dredge is continuously moving forward as it digs and extending the area of its paddock. Over two-thirds of the dredges are electrically-powered, the rest being driven by steam using coal, oil or wood as fuel.

Dredges operate best over level areas with soft bedrock which permit the total excavation of the tin-bearing ground. The rate of ore recovery varies from as low as 0·28 lb of tin concentrate per cubic yard to as high as 0·97 lb, with an overall average of 0·46 lb per cubic yard. The recovery rates are lowered in cases where the deposits are clayey, while the efficiency of the dredge is still further reduced where the bedrock is of limestone and pinnacly in nature, and the ore inaccessible in pockets between the pinnacles. As the richer deposits are rapidly being exhausted the future of the dredging section of the industry would appear to lie in treating the lower grade deeper ground which constitutes the bulk of the reserves.

Gravel-pumping is the method most commonly used to mine all types of alluvial deposits, particularly by the Chinese section of the industry. Its scale of operations is small compared with dredging, but it is well adapted to recovering ore lying in hard, uneven bedrock such as pinnacly limestone where dredging is not practicable. In this form of mining, the ore-bearing ground is broken down by a high-pressure jet of water from a monitor nozzle. The slurry bearing the tin-ore flows down to the bottom of the mine or mine sump, and is then sucked up by a gravel pump to the head of a *palong* or sluice. The slope and flow of the *palong* allow the waste material to pass over the baffles which trap the heavier tin-ore. When a sufficient amount has been trapped, the low-grade concentrate is cleaned against an inflowing stream of clean water, and the product taken to a treatment shed for final dressing. The waste is discharged from the lower end of the *palong* to the tailings area (Plates 38 and 39).

Owing to their short life and the large number of workers employed, the costs of production of gravel-pump mines are higher than those of dredging. Gravel-pump mines employ more than half the total labour force engaged in tin mining. The fall in tin prices, the high cost of labour, and the progressive deterioration in the yield of tin concentrate per cubic yard of ground due to the exhaustion of the richer deposits have contributed in recent years to the closing down of many gravel-pump mines, while a substantial number are working on a very narrow margin of profit. In some cases the small producer continues to operate even at a loss because complete closing down would lead to flooding of the mine and the dispersal of the specialized labour forces. Once a mine has closed down, subsequent re-opening would be a very costly affair, and would only be economically feasible if prices were high enough.

Hydraulicking is very much like gravel-pump mining, with the exception that water under pressure to the monitors is supplied by natural head obtained by damming a stream some hundreds of feet above the mine. The slurry is elevated from the sump to the *palong* by a hydraulic elevator instead of a gravel pump. The subsequent processes of separation of ore from the waste material are similar to those described for gravel-pumping. Hydraulicking is only possible in mines located near a suitable source of water-power. It produces a considerable quantity of tailings, the disposal of which constitutes a problem.

In open-cast mining the ground is excavated in the dry state by mechanical means. The material is then mixed with water in puddling machines and led to *palong* or jigs. The Hong Fatt mine at Sungei Besi, Selangor, is the largest open-cast mine in Malaya.

Underground mining includes small-scale alluvial shafting operations, and cave workings in the limestone hills of Kaki Bukit, Perlis, for the ore in pockets of detrital alluvium. The only conventional underground mine is the large mine at Sungei Lembing, Pahang. Tin has been worked in the lode mines of the Pahang Consolidated Co. at Sungei Lembing since 1888. Up to 1950 80,000 tons of tin concentrates had been produced from this mine, the production since the First World War amounting to 5 per cent of Malaya's total output. The lodes are in sedimentary rocks near a granite mass, and all the lode mines are within an area of about 6 square miles. Mining takes place at depths of a few hundred feet to 1,200 feet below sea-level.

The other miscellaneous methods of mining include ground sluicing and open-cast mining, but with little or no machinery. *Dulang* washing is a method of recovery rather than of mining. It is similar to gold-panning and is carried out by individual operators, always women. The tin concentrates produced in Malaya are smelted by the Eastern Smelting Company at Penang and by the Straits Trading Company at Butterworth. The ore is mixed with limestone and anthracite and smelted at high temperatures in furnaces. The resultant metal is then refined and moulded into 100 lb ingots of 99·9 per cent purity.

Problems facing the Tin-mining Industry. (1) *Market Instability.* The market prices for tin, in common with those of other primary raw materials, are subject to violent fluctuations. Changes in price levels reflect changes in supply and demand. Since Malaya has no tin-consuming industries but exports its entire output, it must face competition from other producers at prices determined in the open market. From the beginning of the present century to 1929 the world production of tin rose from 85,400 tons to 193,600 tons. Consumption of tin also increased during the period as a result of the general industrialization of the world and, in particular, the development of the use of tinplate for canning. Then the Great Depression of 1930–34 brought about a serious drop in consumption with the result that large stocks of surplus tin accumulated, leading in turn to low prices. The average price of tin fell from £227 per ton in 1928 to £118 in 1931, while stocks rose simultaneously to 55,000 tons.

A voluntary restriction scheme failed to check the fall in prices and in 1931 an international tin control scheme was brought into force, the object being 'to regulate the production . . . with a view to adjusting production to consumption, preventing rapid and severe oscillations of price, and maintaining reasonable stock'. The scheme was implemented in three Agreements: 1931–33, 1934–36 and 1937–1941. An International Tin Committee allotted to each tin-producing country a standard tonnage of possible production, and decided the percentage of this tonnage which it was permitted to export each quarter. But while the restriction scheme was successful in raising the price levels, it was unable to check violent short-term fluctuations caused by rapid increases and decreases in consumption. To correct these fluctuations, the Buffer Stock Agreement was brought into force in 1938 as an adjunct to the restriction scheme. The Buffer Stock operated effectively, buying and selling tin in the market and keeping prices between £200 and £230 per ton.

The overall effect of these schemes on the Malayan industry was an adverse one. Restriction benefited the high cost producers more than it did low cost producers such as Malaya. It was also widely held that Malaya's international standard tonnage was under-assessed, being only three-quarters of its actual productive capacity. Restriction also raised the average costs of mining and discouraged capital investment in the industry. Another effect of restriction was to discourage prospecting for new tin areas at a time when many of the known reserves were being exhausted.

The post-war market for tin has remained uncertain for a number of reasons. The tin shortages during and after the war have forced the tinplating and other tin-consuming industries to cut down their consumption of tin, and at the same time stimulated the use of tin substitutes such as aluminium, plastics and cellophane. The introduction of electrolytic tinning, which only requires about half the tin to produce the same amount of tinplate as in the older process, has meant a corresponding decrease in world tin consumption. The cumulative result has been a drop in world consumption of tin, from an average of 165,000 tons in the period 1935–39 to 136,000 tons in 1954.

Although world production has exceeded consumption since 1948, the surplus stocks were absorbed by the United States stockpiling programme. The buying of tin for strategic stock-piling resulted in boom prices during the Korean War, peaking at £964 per ton in 1952, but subsequently dropping to £731 in 1953. The boost to prices during the Korean War was only temporary, and with the sharp reduction in stockpiling purchases, a surplus of tin began to accumulate. A new International Tin Agreement was signed in 1953 by six major producing countries—Malaya, Indonesia, Bolivia, the former Belgian Congo and Ruanda Urundi, Thailand and Nigeria—with the objectives of preventing or alleviating excessive fluctuations in the price of tin and of ensuring adequate supplies at reasonable prices at all times. The Agreement called for the creation of a Buffer Stock of 25,000 tons to act as a damping agent. The Buffer Stock Manager was authorized to buy tin when prices fell below a set minimum, and sell when prices rose above a set maximum.

In addition to the Buffer Stock, the production and export of tin was brought under control with effect from December 1957. The effects of the Tin Agreement on the Malayan industry were serious. In the first year of control (1958), Malayan producers were permitted to operate at only 43 per cent of their assessed productive capacity. When control came into force in December 1957, there were 738 tin mines operating with a labour force of 36,585. By December 1959, the number of active mines had dropped to 483, and the number of labourers to 23,778. Production of tin fell from 59,293 tons in 1957 to 38,458 tons in 1958 and to 37,525 tons in 1959. Thus by the end of 1959 255 mines had been closed, and 12,807 labourers laid off, and total production of tin was 21,768 tons less than when restriction came into force in 1957. This period of restriction came to an end in October 1960 as a result of the improved world tin situation. Production has now recovered to the pre-restriction level.

The history of the tin-mining industry in Malaya has been a turbulent one since the 1930s. Market and price instability has always been a major problem over which Malaya has had little control. Excessive price fluctuations have tended to create an unfavourable climate for capital investment. Many mines working marginal land suffered heavy losses when the price ruling at the time dropped below current costs.

(2) *Exhaustion of Reserves.* There is increasing difficulty of finding commercial deposits of tin-ore to replace those that are being worked out. Tin-ore, like all other mineral resources, is a wasting asset and, once exhausted, cannot be replaced. It is necessary that Malaya continues to be a low-cost producer in order to meet competition from overseas. To achieve this end there must be a continuing process of replacing exhausted mining land with new and proved reserves.

A 1939 estimate by Fermor put the total reserves at about one million tons of tin. Since then over half a million tons have been recovered. But a 1952 estimate put the total reserves at 1½ million tons. However, these are estimated and not proved reserves, and the actual amount of tin left in Malaya is still unknown. The only method of uncovering new tin fields is by prospecting.

Prospecting for new deposits has been severely restricted from the 1930s up to the last few years as a result of an unfortunate combination of circumstances. During the Great Depression restrictions were placed on the alienation of land for mining. Restrictions continued until just before the outbreak of war in 1941, when every effort was made to maximize production, but from existing fields and reserves rather than by prospecting for new ones. The four years of the Japanese occupation were years of stagnation, with only limited mining activity and no prospecting. Post-war attention was focused on rehabilitation, and mining companies were not in a position to undertake any long-term prospecting. The alienation of land up to September 1947, was limited to that required for the maintenance of existing undertakings, or to the granting of pre-war applications. Only at the close of this period of rehabilitation was prospecting attempted, but the declaration of a State of Emergency throughout Malaya in 1948 brought such activities to an abrupt end. It is only in recent years that the security position has improved sufficiently to allow the search for new deposits to continue. The indications to date have been disappointing, with no new deposits being discovered. The opinion of the Mines Department is that 'unless and until evidence to the contrary is produced . . . the discovery of further, extensive, tin fields is unlikely'.

The problem is an acute one. The average grade of ground now being mined has deteriorated, and many mines are now falling back on marginal land containing low-grade ore. A number of mines, particularly dredges, are now idle because of the lack of suitable mining land. However, the position is not entirely irrecoverable, for the mineral potentialities of large tracts of the country, especially east of the Main Range, have not yet been fully explored.

(3) *Land Competition*. The difficulties and slow progress of prospecting arise in part from the conflict between mining and other forms of land-use, especially agriculture and forestry. Mining is a destructive form of land-use, and in Malaya where alluvial mining is the general rule, not only are the mining sites laid waste after the ore has been extracted from the ground, but in the past before the Mining Enactment was passed requiring proper control schemes, large expanses of agricultural land were damaged, either directly through the encroachment of the tin tailings, or indirectly through flooding as a result of silted rivers (Plate 39). Deforestation of the mining sites is also a natural corollary of mining.

Experiments have been conducted on the rehabilitation of mined-over land. The difficulties of reconditioning mined land vary with the type of mining methods used. Where land has been worked at the surface, whether for gravel-pumping or hydraulicking, the resultant landscape consists of a series of abandoned mining pits filled with water. It is economically impracticable to restore such land to its original level by filling up the pits. Where dredging has been employed, the slimes are accumulated in separate paddocks, and the final result after mining is a series of small, flat terraces of varying levels. Such land contains very little vegetable matter and no humus, and is therefore agriculturally useless unless intensively manured. Thorough drainage is also a necessary prerequisite to reconditioning. Experiments at rehabilitation of such land by reafforestation have shown that it is both expensive and difficult. So far the only practical use to which mined-over land has occasionally been put is for Chinese market-gardening.

For all practical purposes, then, land which is alienated for mining will be land lost to agriculture and forestry. The problem is whether mining should take precedence over all other forms of productive land-use, and whether such precedence will be in the interests of the country as a whole. The argument in favour is that tin mining brings in greater revenue than can be derived from any other alternative use to which the land can be put. The argument against is that tin is a wasting asset, and the revenue derived from mining a piece of land accrues once only, whereas the same piece of land if cultivated or under productive forest will continue to accrue revenue for the country in perpetuity. Again, mining may cause pollution of streams and rivers used for irrigation, as well as soil erosion. Moreover, the Forest Department is reluctant to sacrifice valuable forests under intensive treatment and for which large sums of money have been spent.

For these reasons the process of obtaining prospecting permits and new mining titles is not always an easy one. Some titles are granted under restrictive conditions which make mining economically unattractive. The progress of the tin-mining industry is dependent, among other things, upon the solution of this problem.

IRON

The economic exploitation of iron-ore dates from 1921, when 74,250 tons were produced and exported. Iron mining in Malaya has since its start been closely associated with the iron and steel industry of Japan, with Japan providing the capital for the development of the iron-ore resources of Malaya, and absorbing most of the ore produced. In 1921 the Ishihara Sangyo Company started mining operations in Johore, extending them a few years later to Trengganu. Other Japanese companies began mining deposits in Johore, Trengganu and Kelantan. Production of ore increased steadily and reached the highest pre-war total of 1,962,000 tons in 1940. During the Japanese occupation only the Bukit Besi mine was worked until shipping difficulties forced it to shut down in 1943. After the war the mines were taken over by the Custodian of Enemy Property and later sold to other companies. In the immediate post-war years some 462,000 tons of ore stockpiled by the Japanese were exported, but large-scale mining operations did not take place until 1950 when the revival of the Japanese heavy industries created a demand for Malayan ore. The Bukit Besi mine at Dungun, bought over by the Eastern Mining and Metals Company, resumed operations in that year, and by the end of 1950 its production was 498,530 tons. Production since then has steadily increased as other mines came into operation. In 1959 the Malayan production reached the figure of 3,760,000 tons, and in 1961 it reached the record total of 6,733,520 tons.

The main iron-bearing minerals are haematite, magnetite and limonite. They are classified according to their mode of occurrence into (a) *in situ*, including vein ore, and (b) boulder ore, generally containing some adherent clay and therefore of lower grade than (a). Another source of iron is ferruginous laterite, a product of tropical laterization, occurring widely over parts of the Peninsula. It is unlikely that this will become of economic importance because of its superficial mode of occurrence.

There is as yet no general agreement on the origin of many of the iron-ore deposits. All of them, except Ulu Rompin and Temangan, occur within sedimentary rocks close to granite, and are therefore likely to be genetically related to the intrusion of granite. The rocks with which the ores are associated are of Triassic age. The distribution of the known deposits is less well marked than that of the other minerals. In general, most of the deposits occur in two broad zones, one running the length of the east coast, and the other, less important, belt along the west coast (Fig. 60). No significant deposits have so far been discovered in central Malaya. The percentage of iron varies from 50 in the case of the deposits near the Kedah Peak to 68 for the Tambun deposits. Mining in most mines is by the opencast method, but a gravel-pump and dragline shovel are used in the Gunong Rapat

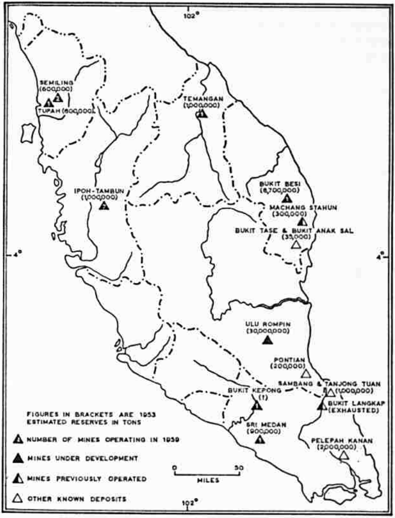


FIG. 60. Distribution of iron-ore deposits and iron mines

mine. The largest mine—at Bukit Besi—is highly mechanized. The ore is transported from the mine by a narrow guage railway to Dungun, 17 miles away, where it is loaded by conveyor belt into lighters and finally transferred to the ore-ships anchored off-shore.

Table 52 shows production details for 1959. The current boom in the iron-mining industry has stimulated production throughout the country. Perak, which in 1953 exported only 9,000 tons of ore, now lies second only to Trengganu in terms of total exports. The number of mines in the State has increased to seven, all located in the Ipoh–Tambun area (Fig. 60).

TABLE 52. *Production of Iron Ore, 1959*

STATE	Name of Mine and Locality	Production (tons)
Trengganu	1. Eastern Mining & Metals Co. Ltd, Bukit Besi, Dungun	2,116,200
Perak	2. Malayan Mining Co. Ltd, Gunong Panjang, Ipoh	25,108
	3. Malayan Mining Co. Ltd, Gunong Rapat, Ipoh	49,820
	4. Malayan Mining Co. Ltd, Suvla Land, Ipoh	108,132
	5. Ipoh Mining Co. Ltd, Gunong Rapat	130,363
	6. Tambun Mining Co. Ltd, Ipoh	199,225
	7. Kinta Mining Ltd, Gunong Bercham, Ipoh	14,830
	8. Ah Kee Iron Mines Ltd, Gunong Idong, Ipoh	87,760
Johore	9. Malayan Miners Co. Ltd, Sri Medan	335,446
	10. Kepong Mines Ltd, Bukit Kepong	122,969
Kelantan	11. Oriental Mining Co. Ltd, Temangan	402,751
Kedah	12. Malayan Mineral Development Corp., Ltd, Tupah	42,493
	13. South Island Mining Kongsi, Semiling	68,972
	14. Warren Mining Ltd, Semiling	56,615
	TOTAL	3,760,684

High prices for ore have made feasible the development of deposits with small reserves, such as those in the Ipoh–Tambun area. Such mines will have only a short working life before the reserves are exhausted. At the same time, the proved reserves in the larger mines such as Bukit Besi and Sri Medan are rapidly being exhausted at current rates of production. The future of the industry therefore, depends on tapping the mining possibilities of new deposits. The largest of these deposits is at Ulu Rompin (Fig. 60), with proved reserves of 20 million tons and hidden reserves estimated at another 10 million tons. The ore contains 56 to 66 per cent iron. Steps are being taken to mine this rich deposit. A major problem is transport.

Although the deposit is 40 miles in a direct line from Kuala Sungei Rompin, the actual distance by river is 100 miles. River transport is slow and uncertain, as the river is very winding and subject to wide seasonal fluctuations in level. Rail construction is hampered by the great expanse of swamp between Ulu Rompin and the sea.

The prospects and prosperity of iron-mining will continue to be closely linked with the progress of the iron and steel industry of Japan, Malaya's main customer for iron-ore. High freight rates preclude the export of ore to European furnaces. The small market for iron and steel and the lack of coking coal, among other factors, make difficult the establishment of any large iron and steel works in Malaya, and the iron-mining industry will continue to depend on the Japanese export market.

COAL

Coal, intermediate in properties between typical lignite and sub-bituminous coal, is the only solid mineral fuel of economic importance in Malaya. Coal seams have been found in five localities—at Bukit Arang on the Perlis–Thai border, at Enggor in Perak, Batu Arang in Selangor, and at two other localities in Johore—but only the Perak and Selangor deposits have proved workable (Fig. 61). All of the deposits are associated with Tertiary rocks believed to be of Miocene or younger age. The Enggor coalfield contained two seams, an upper seam 3 foot thick separated by a thick bed of shales from the 4-foot thick lower seam. Mining started in 1925 but the deposit proved to be uneconomical to work, and operations ceased in 1928 after a total of only 28,500 tons of coal had been extracted. There are about 180,000 tons of coal left in the Enggor coalfield. but it is unlikely that these will prove economically profitable to exploit.

The Batu Arang coalfield was developed by the Malayan Collieries Ltd in 1915. The coal measures consist of two main coal seams, the upper seam averaging 30 feet in thickness but attaining a thickness of up to 45 feet in places, and separated by about 200 feet of shale from the lower seam which averages 25 feet in thickness. The upper seam extends for 3½ miles, and the lower for almost 1½ miles. The seams are worked by both open-cast and underground methods. The quality of the coal is poor, being non-coking and very friable. The coal is liable to spontaneous combustion, and one of the main problems of mining underground is to dissipate the heat through

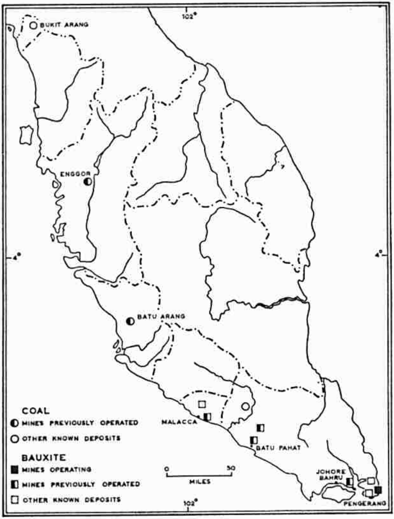


FIG. 61. Distribution of coal and bauxite

air circulation in order to prevent the coal igniting. The heating value of typical Batu Arang coal is only 9,000 B.T.U.

From its modest beginnings in 1915, coal-mining at Batu Arang developed into a large-scale enterprise, employing a large labour force. Production increased steadily, reaching a maximum of 781,509 tons in 1940. Between 1915 and 1948 nearly 13 million tons of coal were obtained from this field. The output was sold locally, the Malayan Railway, power stations and tin-mines being the main consumers. Post-war production reached a peak of 416,000 tons in 1950, but declined rapidly in subsequent years to 206,000 tons in 1955, and 75,600 tons in 1959. Part of the decline in output was due to labour troubles, but the main cause was the reduction in demand for coal in competition with imported fuel oil. On the basis of calorific values, fuel oil is cheaper than Batu Arang coal, and the latter lost its main consumers when the Malayan Railway and the Central Electricity Board switched to oil. The mine finally ceased operations in 1960.

There are still extensive reserves of coal at Batu Arang. A government geologist estimates that there are about 32 million tons of coal remaining in the field in seams 3 feet and over in thickness, of which about 16 million are probably extractable and another 5 million might possibly be extractable. Production, however, depends entirely upon demand, and present indications are that there is little likelihood of the mine being re-opened.

OTHER MINERALS

Bauxite, an hydrated aluminium oxide, is the only commercial source of aluminium. It occurs widely in Malaya, notably in the southern half of the Peninsula (Fig. 61). The ore is a product of tropical weathering of a variety of rocks, ranging from shale and acid volcanic rocks (Johore), to basic volcanic rocks (Pahang), granite (Trengganu), and possibly also pegmatitic rocks (Malacca). The best conditions for its development are found in low, undulating country with marked seasonal variations in rainfall. Ore developed from acid rocks tends to have too high a silica content to be commercially acceptable. Bauxite deposits are generally superficial, and occur as a mantle up to 25 feet thick covering the tops and slopes of small hills.

Bauxite was first mined at Bukit Pasir near Batu Pahat in 1936. Two other mines were opened before the war—one at Perigi Achih, east of Johore Bahru, and the other at Sri Medan, the latter associated with iron-ore. Both these ceased operations in 1941, but the Bukit Pasir mine produced an estimated 150,000 tons during the Japanese occupation. The Japanese also worked the deposit at Telok Mas, Malacca (estimated production 1942–45, 100,000 tons), and started mining at Telok Ramunia on the south-east coast of Johore.

The total production of bauxite from all mines in Malaya up to 1952 was only about 580,000 tons, of which an estimated 10,000 tons came from the Telok Ramunia mine. The Telok Ramunia mine, which started operations in 1952, and the adjoining smaller mine of South East Asia Bauxites Ltd, are the only two active mines at present. The bulk of the post-war production has come from Telok Ramunia, and average production at this mine is between 300,000 to 350,000 tons annually. After the overburden has been removed, the ore is excavated by mechanical shovels and transported by trucks to three washing plants where it is washed and screened. The final product averages about 58 per cent aluminium oxide and less than 4 per cent silica. The ore is loaded into lighters which transfer it to ships anchored off-shore. The known reserves are 12 million tons. Most of the bauxite is exported to Japan; some ore is also sent to Australia and Formosa. Total production increased from 381,747 tons in 1959 to 409,881 tons in 1961.

Gold has been mined in Malaya for several centuries. There is evidence of the Chinese mining gold as early as the sixteenth century. European participation did not begin until the 1890s, but except for the Raub Australian Gold Mining Company's underground mines all the European workings failed. The Raub mine was the only important gold-mine in Malaya, having produced 700,000 ounces of gold in fifty years since production started in 1899. Other lode deposits that have been worked in the past include those at Selensing, Buffalo Reef, Kechau, Punjum and Sungei Muntan in Pahang, Batu Bersawah and Sungei Luit in Negri Sembilan, and the Kedana mine at Mount Ophir in Johore. However, as with the tin deposits, most of the gold deposits are alluvial. Again, the primary deposits of gold are about the same age of those of tin, and are also derived from granite. But the two minerals have different distribution patterns. Most of the gold is irregularly distributed in a belt extending from south-east Thailand, Kelantan, Pahang, Negri Sembilan to Mount Ophir in Johore. But the deposits are neither extensive nor rich. Apart from small quantities of gold obtained as a by-product of tin mining, almost the entire 1961 output of 12,486 Troy ounces came from the Raub lode mine (Fig. 62). The Raub mine has now found it uneconomic to carry on production and has closed down.

Malaya produces small quantities of the ferro-alloy metallic minerals. The only known deposits of manganese occur in Kelantan and Trengganu (Fig. 62). Manganese mining began at Machang

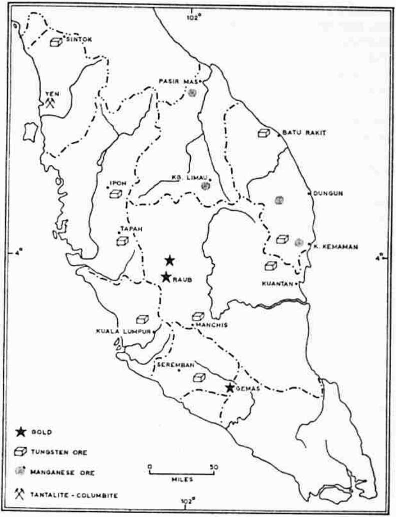


FIG. 62. Distribution of other minerals

Stahun in 1925 and at Gual Priok in Kelantan in 1932. The total production from these two mines during the period 1925–45 was 440,500 tons. Another large deposit of high grade ore is believed to occur at the headwaters of the Sungei Aring in Kelantan. Total manganese ore production in 1961 was only 6,400 tons. The tungsten ores of commercial significance in Malaya are wolframite and scheelite. Both are usually found associated with tin- and gold-ores. Scheelite occurs in many localities, but no large deposit has been discovered since the rich deposit at Kramat Pulai, near Ipoh, was worked out in 1939. Wolframite, too, occurs fairly widely. Production is on a small scale, and is mainly from the Bukit Kachi mine at Sintok, Kedah, and from the Chendrong Concession in Trengganu. Ore reserves, particularly those at Bukit Kachi, are believed to be considerable.

Ilmenite, columbite and monazite are minerals produced in commercial quantities as by-products of tin-mining. Ilmenite is an oxide of iron and titanium, and occurs as the main constituent of *amang*—the local term for the heavy minerals left over as a reject after the tin-ore has been separated as a marketable product in the treatment shed. The rise in demand for ilmenite as a source of titanium paint pigments has led to the production for export of this mineral from *amang*. Exports of ilmenite in 1961 were 107,000 tons. One of the constituents of *amang* is monazite, a valuable phosphate of rare earth metals with thorium. A new technique of separation enables high grade monazite concentrates to be produced from *amang*. Production in 1961 was 696 tons. Columbite is found in association with tin in the alluvium at Semiling and Karangan in Kedah, and at Bakri in Johore (Fig. 62). At Semiling columbite is a by-product of tin mining, but at Bakri, it is often the main mineral and tin-ore a by-product. Tin slags from the smelting companies at Butterworth and Penang contain appreciable quantities of columbium and tantalum, and nearly 20,000 tons of slags were exported in 1953 in response to high prices for columbite. Production of columbite reached a high of 236 tons in 1955 as a result of inducement premiums paid on the price by the United States, but has decreased since the withdrawal of the premium in 1955. Total production in 1961 was only 95 tons.

FUTURE PROSPECTS

While Malaya is capable of increasing its output of minerals other than tin, particularly of iron and, to a lesser extent, of bauxite, there is little likelihood of any of these minerals assuming the importance of tin in the mining economy. Most of the deposits of the other minerals are small, and apart from iron and bauxite, cannot form the bases for the development of a major mineral industry. However.

a substantial part of the country has still not been thoroughly prospected, and the search for minerals which is being intensified now that the Emergency has ended may yet reveal new deposits of tin or other ores in sufficient quantities to sustain the mining industries for an extended period.

CHAPTER 12

INDUSTRY

Malaya, a country engaged primarily in producing raw materials for export, has no heavy industries such as iron and steel or heavy engineering works. Industrial development is based on secondary industries, of which there is a very wide range. Many of these are connected with or are adjuncts to the primary economic activities of agriculture, mining and trading. Most of them are very small-scale enterprises employing less than ten workers. More than a third of the industrial labour force is composed of own-account workers and unpaid family helpers. Another feature of the industrial scene is that, with a few important exceptions, the capital, skill and management are Asian, mainly Chinese, and to a lesser extent Indian and Malay. The coherence and traditions of the Chinese family or clan play a major part in the acquisition of industrial skills and the assembly of capital for starting an enterprise.

The enterprises vary greatly in the levels of technical equipment and working efficiency. Lacking the capital to buy the necessary equipment, many still manage, by combination of ingenuity and improvization, to carry on with a fair degree of success. However, the proportion of failures is normally quite high. Such failures may be due to a drop in demand for the products manufactured, bad management, a tendency to look for speculative profits rather than steady returns, or the need to pay high interest rates. In spite of the risks of failure, many new industrial enterprises are started each year, their establishment being a relatively simple matter because no heavy capitalization or large-scale operations are involved.

As in many other tropical countries producing raw materials for export, industrial development in Malaya was initially concerned with processing these raw materials to a form suitable for export. Thus plants and installations were set up to smelt tin, mill rubber, cure copra, can pineapples and extract oil from the fruit of the oil-palm. These processing factories could only function efficiently where there were establishments concerned with repairing and servicing and/or producing the equipment used in them. A second category of secondary industries therefore developed—light engineering works repairing, servicing, and making equipment and machinery, including small ships and boats, tanks, drums, and pipes.

In addition to these ancillary industries, which sprang up with and were dependent upon the primary industries of agriculture and mining, were the cottage industries run by Malay peasant families in their spare time. But cottage industries, concerned largely with the production of small quantities of hand-made consumption goods in everyday use, have never been important in the industrial economy of the country. They were a part of the Malay self-subsistence economy, the products of these industries going towards satisfying the meagre needs of the local kampong population. Run on a small scale and without assistance from power driven machinery, the cottage industries declined in importance when cheap factory-manufactured goods began to flood the market.

The scarcity of goods during the First World War stimulated the development of light manufacturing industries to cater for some of the needs of the local population. During the Great Depression of the 1930s when the primary industries collapsed and international trade was at a standstill the pace of industrialization quickened considerably as resources were diverted from the export industries to local manufacturing. A further stimulus to industrialization was the Japanese occupation, when a large number of small workshops and factories were established to produce many types of goods once imported. The trend towards local manufacturing continued after the Second World War when many new undertakings were founded, and the range of products widened to include such items as cement, industrial gases, aluminium utensils, paints, plastics, glass, soap and fertilizers. Much of the development was made possible because of the developing internal market created by the increasing population with rising standards of living. Most of the capital investment has come from the Chinese and, in the case of some large concerns, the Europeans, and the labour recruited mainly from the Chinese and Indians. The Malays have not been active in this sector of the Malayan economy, although part of the governmental policy is to encourage the Malays to greater participation in industries.

In 1959 the Federal Department of Statistics carried out a census of manufacturing industries in the Federation. Manufacturing is defined by the United Nations' Statistical Office as 'the mechanical or chemical transformation of inorganic or organic substances into new products, whether the work is performed by power-driven machines or by hand, whether it is done in a factory or in the worker's home, and whether the products are sold at wholesale or retail'. This definition was adopted for the Federation census, and expanded to cover processing and repair work. The results of the census are summarized in Table 53.

TABLE 53. *Manufacturing Industries, 1959*

TYPE OF INDUSTRY	Number of Establishments	Number of Full-time Factory Workers
Processing of Agricultural Products[1]:		
(a) within estates	1,139	14,700
(b) in factories off estates	1,430	20,500
Light Engineering[2]	788	7,000
Light Manufacturing[3]	2,786	34,800
TOTAL	6,143	77,000

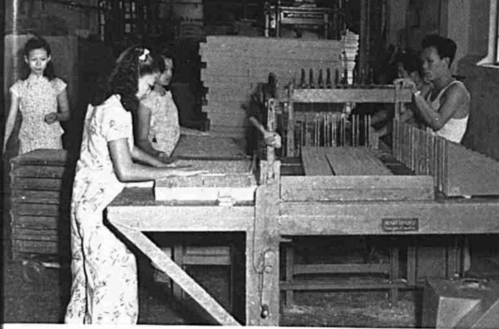
[1] The term covers those establishments which process or mill gutta-percha, jelutong, latex in bulk, rubber, copra, coconut oil, palm oil, sago, tapioca, rice and other grains, coffee, tea, and timber.

[2] The term covers those establishments which retread and vulcanize tyres, manufacture structural steel shapes, machine parts, industrial and transport equipment (including boats and small ships), industrial and transport machinery, and other establishments which specialize in blacksmithing, welding, galvanizing, plating and the repairing of general engineering and transport equipment and machinery.

[3] The term covers those establishments which manufacture foodstuffs, beverages, tobacco, wood, rubber, leather, textile, paper, electrical, chemical, metallic and non-metallic mineral and plastic products as well as a large number of miscellaneous goods such as jewellery, dry-cell batteries, brooms, brushes, mats, etc. The printing, publishing and allied industries are included under this heading.

The wide range of manufacturing is indicated by the fact that more than 120 different industries are included under the main headings of Processing, Light Engineering and Light Manufacturing. The labour force of 77,000 full-time factory workers amounted to 8 per cent of the total working population of Malaya, a percentage greater than in most other South-East Asian countries.

Processing of Agricultural Products. The processing of agricultural raw materials is still the most important form of industrial activity in terms of the annual gross value of sales and the annual net value



41. A soap factory in Singapore. Only washing soap is manufactured in this factory. The large slabs of soap are being sliced into bars and cakes.

42. A Malay child operating a spinning wheel in a small brocade factory in Kota Bharu, Kelantan. The factory also makes mats from the dried leaves of the screw-pine (*Pandanus fascicularis*).

43. Singapore Harbour and City, looking north-east. The photograph shows Keppel Harbour with a large passenger liner and several cargo ships lying alongside the wharves. The islands in the foreground are, from left, Pulau Hantu, Pulau Selugu, part of Pulau Belakang Mati, and Pulau Brani. The Empire Dock lies immediately opposite P. Brani. A large number of small ships lie at anchor on the Inner and Outer Roads. The Roads are separated by a detached mole (right, background).

44. Singapore City, looking north. The ships are lying at anchor in the Inner Roads. The quays of the Singapore River (centre) are lined with lighters. Immediately behind the tall buildings along the waterfront is Chinatown.

of output. But it is no longer as dominant as it once was in terms of number of factories and workers engaged, for the light manufacturing sector has a greater number of factories although employing a few hundred workers less (Table 53).

Most of the larger estates process their own crops in factories set within the estate limits. The census showed that altogether 1,139 (44 per cent) of the total of 2,569 processing factories were run by the estates themselves. More than half of the rubber estates send their rubber elsewhere for processing. On the other hand, all the coconut estates have their own copra kilns. But they do not carry processing beyond the copra stage, for all the coconut oil mills are located outside the estates, usually in or near towns. However, the pattern of estate processing activities is not a fixed one, but may change from year to year.

Partly as a result of superior technical facilities, partly as an outgrowth of the entrepôt trade, and partly also because of locational advantages, Malaya, and especially Singapore, have also been able to attract raw materials for processing from neighbouring territories (Plate 17). The remilling of rubber in particular is an important industry in Singapore and Penang, but the industry suffered a decline when the Indonesian government placed restrictions on the export of slab rubber in 1955, and a total embargo on all exports during its 'confrontation' of Malaysia (1963–66).

Light Engineering. The industries in this category range from small-scale enterprises to major engineering establishments. Most of them are small repair and part-replacement workshops, but there are several major firms both in Singapore and Malaya producing machinery, iron and steel castings, small ships and boats, and a variety of engineering and metal goods. There are many small Chinese-owned foundries and machine-shops in Kuala Lumpur and Ipoh serving the needs of the small tin mines of the Kinta and Klang Valleys, as well as one major concern catering for the requirements of the dredging companies. There are also large engineering works belonging to the Singapore Port Authority and the Penang Port Commission, the armed services and the Malaysian Railway. Ship and boat building is an important industry in both territories, the output of small steel ships, lighters and wooden craft going far towards meeting local demand as well as demand from neighbouring territories (Plate 40). There are many Chinese boat-builders along the west coast, and Malay boatbuilders in Kelantan and Trengganu who construct small fishing boats from local materials. The increasing importance of motorized transport has in turn led to the growth of a considerable motor industry concerned with the sale and maintenance of motor vehicles. The headquarters of the major firms are located in Singapore, with branches in all the large towns of Malaya. All of them are well-equipped for servicing, repairing, painting, welding and overhauling. The bodies of buses and commercial vehicles are made locally.

Light Manufacturing. As indicated earlier, the number of factories engaged in manufacturing light consumer goods is now larger than the number of processing factories. The range of goods produced has also widened considerably in the post-war years, and the census lists over 100 different types of industries under this major category of manufacturing. Transport and storage costs normally constitute a major part of the total costs of production of this form of industrial activity, and most of the factories are located close to their markets, that is, near or in the main towns of the Tin and Rubber Belt. Another factor which tends to attract such industries to these centres of population concentration is the relative ease of availability of labour and services.

The most important group in terms of the number of factories engaged is that producing foodstuffs, beverages and tobacco, most of which are sold in the local markets. Together they constitute 45 per cent of the total number of factories in the light manufacturing category. A great number of factories specialize in the manufacture of foods which are consumed in large quantities by a section of the multi-racial population of the country, as, for example, *meehoon*, *mee* and other vermicelli-like products made from rice flour for the Chinese population, and prepared spices, and curry powder for the Indian and Malay population. But years of contact have caused each racial group to acquire a taste for the other's food, or at least some kinds of food. All have rice as a staple, but the Chinese have come to like curries, while the Indians and Malays have adopted *mee* and *meehoon* as bases for some of their prepared dishes. Other introduced food such as bread, confectionery, chocolate, ice-cream too, have become popular with all the peoples of Malaya, and many factories are engaged in producing them. The manufacture of beer, carbonated drinks and fruit drinks has become an important industrial activity, the lower costs of production of these beverages by the local factories enabling them to compete very successfully with other wellknown but more expensive products from overseas. Tobacco manufactures, too, have expanded markedly in recent years because of the imposition of higher duties on the imported brands.

Only a small fraction of the major raw materials which Malaya exports are retained within the country for the manufacture of finished products. There are fifty-one rubber goods factories in Malaya which make rubber footwear, belting, hose, cycle tyres and tubes as well as other rubber goods. Recent additions to the range are foam rubber mattresses, pillows and cushions. The chemical compounds used in the manufacturing processes are imported. Much of the capital and most of the labour are Chinese. Tin is used in small quantities for making cans and solder. Locally produced coconut and palm oil are used in soap-making. There is an annual output of about 17,000 tons of soap. There are small Chinese-owned soap factories in every State (Plate 41). Little machinery is used in such establishments, but there is a very large and well-equipped factory in Kuala Lumpur which makes high-grade soap and margarine. Local as well as imported timber, notably teak from Burma and Thailand, is the base for the manufacture of furniture, wooden boxes, cases and crates, while local clay, limestone and sand form the bases employed by a large number of factories (172) in the manufacture of a variety of structural clay, glass, cement and concrete products. There is one large cement factory at Rawang with an annual output of over 100,000 tons.

Other goods made in Malaya include aluminium ware, metal boxes, tanks, drums and pipes, wire and wire-netting, industrial gases, plastic goods, matches and paints. All of these are protected by the high transport costs of the imported articles. Tariff protection is not of much significance in the mainland as import duties are imposed for revenue rather than for their protective effects. The flooding of the local markets with cheap factory-made goods has led to the decline and disappearance of many of the Malay cottage industries. Traditional Malay handicrafts range from the purely utilitarian (pottery, mat, basket and atap-making, and cloth-weaving) to the semi-luxury and luxury (lace and embroidery and silver and gold working). The utility market has been largely captured by factory-made articles, and only some of the local luxury industries remain—the weaving of *batek* sarongs, and the skilled working of gold and silver objects for which the Kelantan and Trengganu craftsmen are renowned (Plate 42).

Size of Factories. Using the number of full-time paid employees as a criterion of size, most of the 5,004 factories are small (no data are available for the other 1,139 factories located in estates). One-fifth of these establishments have no full-time paid employees, that is, they are run by working proprietors, unpaid family workers and part-time paid employees. The small family business run by the head of a household with the unpaid assistance of his family and sometimes some other close relatives who may or may not be paid, is a typically Chinese institution and is a common feature of the industrial scene

TABLE 54. *Distribution of Factories by State, 1959*

STATE	Number of Factories	Percentage of Total
Perak	1,113	22
Selangor	1,077	21·5
Penang and P.W.	724	14·5
Johore	610	12
Kedah	517	10
Pahang	259	5
Negri Sembilan	237	5
Kelantan	194	4
Malacca	178	4
Trengganu	51	1
Perlis	44	1
TOTAL	5,004	100

in the Malay Pensinsula as well as other parts of South-East Asia where the Chinese have settled.

Fully two-thirds of the total number of factories have less than twenty full-time paid employees, 12 per cent have between twenty and ninety-nine such employees, and less than 2 per cent have more than 100 employees. The larger establishments, that is, the 14 per cent which employ more than twenty full-time paid workers, are far more important to the industrial economy of Malaya than their actual numbers would indicate, as together they account for 77 per cent of the total value of sales, 68 per cent of all full-time paid employment, and 70 per cent of all salaries and wages paid.

Distribution of Factories by State. Table 54 summarizes the distribution of those establishments that are devoted exclusively to manufacturing activities. No information is available on a State basis on the 1,139 processing factories that form part of the agricultural-cum-manufacturing set-up in many estates. The most striking feature is the concentration of manufacturing in the five States of Perak, Selangor, Penang, Johore and Kedah. Together they account for four-fifths of the total number of factories and for 86 per cent of both the total value of sales and total full-time paid employment in the Federation as a whole. The four States of Kedah, Penang, Perak and Selangor are located in the economic heartland of Malaya, and are served by two major ports—Penang and Port Swettenham. Johore has its main port in Singapore. These five States have nearly three-quarters of the total population of Malaya with a higher per capita purchasing power than the rest. The majority of factories are therefore located here because of proximity to local markets and to major ports serving as outlets for those goods which are exported as well as inlets for raw materials. Other factors which affect the location of industry here are availability of labour and services and of locally produced raw materials which form the bases of some local industries.

Perak has the largest number of factories, but these are generally smaller in size than those of Selangor or Johore. One-third of all its full-time paid employees are engaged in the three largest industries of rubber remilling, sawmilling and plywood milling, and tobacco products manufacturing. Selangor has, on the average, the largest factories of any of the States. Here, again, three major industries—rubber footwear manufacturing, sawmilling and plywood milling, and job printing and bookbinding—dominate the manufacturing economy, together employing more than a quarter of the total full-time paid workers. Penang has an industrial pattern made up of small establishments, with three leading industries—job printing and bookbinding, rubber remilling and tobacco manufacturing—employing more than a quarter of the total number of full-time paid workers. Johore has a pattern based largely on the processing of raw materials and agricultural products, rubber latex processing, rubber remilling, sawmilling, coconut oil milling and pineapple canning being the most important industries. Kedah is one of the major padi producing States, and its one dominant secondary industry is the processing of padi. More than two-thirds of the total number of factories in the State are rice mills.

The leading factories in each of the other States of Kelantan, Pahang, Trengganu and Perlis are sawmills, plywood mills and rice mills. Pahang and Kelantan have a variety of other industries. Negri Sembilan's largest concerns are sawmills and plywood mills, rubber mills and motor repair firms, while Malacca has a wide range of industries, the main ones being the bottling of carbonated beverages, job printing and bookbinding, and sawmilling and plywood milling.

Future Prospects of Industrialization. The prospects of establishing such heavy industries as iron and steel and heavy engineering works in Malaya are not bright. A major handicap is the lack of power. Malayan coal is of the non-coking type, and unsuitable for use in blast furnaces. But a project is in hand for starting an iron and steel mill using imported coking coal and local iron ore.

To a certain extent, increased demand for power for industrial needs can be met by developing the hydro-electric potential and, in fact, there is a scheme under active development at Cameron Highlands for diverting the headwaters of the Telom and Bertam Rivers into the valley of the Batang Padang River. The waters are impounded behind a dam, and are used to drive electric generators in a underground station. Stage I of the scheme is scheduled to be completed by 1964, and will contribute about 300 million kWh in an average year to the Central Electricity Board system in Selangor. The power will go to meet increased requirements from domestic, industrial and commercial consumers, as well as from the tin-mining industry.

Other major problems of establishing heavy industries are: (1) competition from established producers in overseas markets and the limited domestic market for heavy manufactured goods; (2) the difficulty of raising the necessary capital to finance such ventures; and (3) a shortage of skilled labour, and technical and managerial staff with the necessary knowledge of modern productive techniques and methods of organization.

The more promising field for industrial development appears to lie in the extension of secondary industries, though here, too, many problems would have to be faced. Malayan secondary industries have, in the past, been concentrated in fields which offer them a localized natural advantage, such as, for example, the processing of locally produced raw materials, especially those which are less bulky and/or weigh less after processing. Transport costs in this case would make it uneconomical to send the raw materials overseas for processing. The expansion of secondary industries into new fields which are not sheltered by transport costs would mean that such industries would have to face direct competition from overseas industries, which may be able to produce the same goods at a lower cost or of better quality. The case for the Government instituting protective measures for home products has been considered and rejected by the International Bank Mission on the grounds that protective measures '. . . which merely excluded cheaper foreign products and forced Malayan purchasers to buy more costly home manufactures would result in an absorption of capital and resources which might better be employed in other lines'.[1]

For this reason the Mission considers that the best prospects for the future lie in following the pattern of past development, of making fairly small advances along a very wide industrial front, mainly for the home and neighbouring export markets, rather than venturing into new and more risky fields. Certain factors favour such an expansion. Capital, especially overseas capital, is more likely to be attracted to a politically stable area, and in this connection, Allen and Donnithorne, writing in 1957, are of the opinion that '. . . in the immediate future the Federation rather than Singapore will offer the more attractive field for Western manufacturing enterprises, since the new Malayan Government, though nationalist, is likely to be of a less radical temper in economic and social affairs—at any rate, for the time being'.[2] Malaya also offers other requisite conditions to investment in industries, namely, a stable tax system and good public utility services and communications. In addition, the Government has also recently offered tax reliefs for up to five years for pioneer industries, including textiles, chemicals, dairy products, plastics, communications equipment, household utensils, cardboard, and asbestos-cement products.

Another condition favouring the expansion of secondary industries is the expanding domestic market due partly to the increasing population and partly to the continued prosperity of the rubber and tin industries, which have added greatly to personal incomes and the purchasing power of the population.

The shortage of skilled labour, which is often a major impediment to industrialization in underdeveloped areas, is not an acute problem in Malaya, as there is already a sufficient (and increasing) nucleus of

[1] INTERNATIONAL BANK MISSION, *The Economic Development of Malaya* (Baltimore, 1955), 124.

[2] G. C. ALLEN and A. G. DONNITHORNE, *Western Enterprise in Indonesia and Malaya* (London, 1957), 263.

workers who have acquired a knowledge of the processes of factory production. A more serious question is whether the levels of wages and salaries are too high in relation to productivity, since high wage levels and low productivity result in high production costs. Local products which are manufactured at high costs cannot compete successfully with cheaper imported goods unless protected by tariff walls, but such tariff walls if extended to cover a wide range of articles tend to raise the cost of living and depress standards of living.

A factor which might limit or restrict the pace of industrialization is the difficulty of inducing local capital, which tends to be very conservative, to invest in new lines of enterprise which carry with them a certain element of risk. It is, if anything, still more difficult to attract overseas capital into the country for industrial investment unless the investors are reasonably certain of good profits and unless suitable guarantees exist for the protection of such capital. There is one institutional source of industrial finance within Malaya—the Malaysian Industrial Development Finance Limited (MIDFL). It provides only limited amounts of capital for industrial enterprises. Most of the financing of Chinese-owned industries is on a small 'family' basis. However, there appear to be large reserves of capital in the country which have not yet been tapped, and which, if given sufficient inducements, might be mobilized for industrial purposes.

A further limitation to industrialization is the restricted range of raw materials and natural resources which lend themselves to industrial development. Only minute fractions of the rubber and tin produced in Malaya are used locally in the manufacturing industries—rubber in the manufacture of rubber goods for the domestic market, and tin as a very minor component in the metal-box industry. There is some room for expanding the rubber goods industry, especially if a part of the neighbouring markets can be captured, and also scope for a modern tyre factory to cater for local needs. The demand for tin for local industries is not likely to increase. The only other mineral produced in substantial quantities is iron-ore, but the lack of coking-coal, amongst other factors, is a major handicap in the establishment of an iron and steel industry. The other metallic minerals are not produced in sufficient quantities to support large processing industries, and are not used locally in manufacturing industries.

Apart from rubber, the agricultural products that could be used or whose use could be expanded for local industries are coconuts (e.g. the manufacture of desiccated coconut), pineapples, and other fruits and vegetables (for canning), and fibre (for ropes). A greater use could be made of local forestry products in the making of furniture, hardboards and fibreboards. The canning of fish and meat products is still in its infancy and appears capable of expansion, as does the pottery industry using local materials.

In the final analysis, industrial development in Malaya and, to a lesser extent, in Singapore, depends on the continued prosperity of the primary industries of mining and agriculture, and on trade. But the international market for primary raw materials such as rubber and tin is notoriously unstable. The future prospects of industrial development, therefore, are to that extent also uncertain and subject to external market forces.

CHAPTER 13

TRADE

The economy of Malaya has been heavily dependent on trade since the earliest days of history. To a large extent this was due to the position of the Malay Peninsula in relation to the Straits of Malacca, a position which made it the natural doorway to the East Indies. Archaeological and historical evidence points towards the existence of Indian traders in the Malay world as early as Neolithic times. Mediaeval Malacca had a considerable entrepôt trade, attracting merchants with produce from Cairo, Arabia and other Arab countries, India and Burma, as well as merchants from countries east of the Malay Peninsula—China, Thailand, Cambodia and the Malay Archipelago.

The coming of the European powers greatly extended the commercial connections of the Malay world. Penang, founded by the British in 1786, and Singapore, founded in 1819, together captured a large part of the trade of Malacca. All three ports came under British rule in 1824, and were constituted as the Straits Settlements in 1829. The British policy of free trade as well as its unique geographical position and the great natural advantages of its harbour rapidly turned Singapore into the major entrepôt of South-East Asia, eclipsing Malacca, once the great trade centre of the Straits, and Penang. Penang's commerce was limited to trade with Burma, southern Thailand and northern Sumatra, while Malacca's trade connections rapidly dwindled until only those with Sumatra and the adjacent states of the Malay Peninsula remained. A contributing cause of Malacca's decline was the silting of its harbour. In 1825, only six years after its foundation, Singapore had captured over three-fifths of the total trade of the Straits Settlements, while Penang had slightly more than one-quarter of it.

The next twenty-five years saw the continued ascendancy of Singapore over the two other ports of the Straits Settlements. But sections of its great entrepôt trade were diverted with the establishment of Hong Kong in 1842 (which took away much of the China trade), the development of Saigon under the French, and the extension of direct steamship channels of communication between

Indonesia and Europe. Nevertheless, the development of major mining and agricultural enterprises in the adjacent territories, notably of tin and rubber in Malaya, enabled it to add a large import and export trade to its entrepôt activities, and this has more than compensated for the contraction of the area served by the port.

The rapid increase in trade up to the Second World War is an indication of the rate of economic development of Malaya. The volume of trade almost doubled in the five years between 1895 (when the Federated Malay States were constituted) and 1900, and increased by two-thirds in the next five years. The rate of increase then

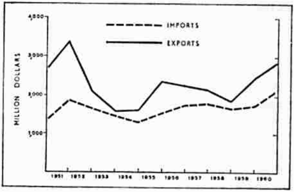


FIG. 63. Balance of trade, Malaya, 1951–60

slowed down until the 1920s, when it became more pronounced, reaching a climax in 1926 when the total trade of the country reached the record figure of nearly $619·5 million. The trade balance was always in Malaya's favour up to the beginning of the Second World War, due largely to the development of the tin, and later the rubber industries. Tin was the dominant export until 1915, when rubber came to the fore, and by 1925 the exports of rubber were nearly four times as important (by value) as tin. Together these two primary products accounted for the larger part of the total export trade of Malaya, a position they continue to hold to the present day. The trade balance continues to be a favourable one in the post-war period (Fig. 63).

The trade of Malaya is mainly of three kinds. First there is the internal trade largely concerned with the sale of locally grown foodstuffs and locally manufactured articles and handicrafts. Secondly there is the important external trade, consisting of imports and exports, and finally there is the important entrepôt trade of Singapore (now politically separate from Malaya) and Penang. The main trading centres are the entrepôt ports of Singapore in the south and Penang in the north-west, and Kuala Lumpur linked with Port Swettenham near by, and lying approximately halfway between these two ports. Ipoh and Malacca are the other important trade centres serving the Tin and Rubber Belt of western Malaya. Eastern Malaya, separated from the west by mountainous country and still relatively undeveloped, trades through the small coastal ports of Kota Bharu, Kuala Trengganu and Kuantan, these having Singapore and Kuala Lumpur as their main outlets and sources.

INTERNAL TRADE

The internal trade is mainly concerned with the sale of locally grown foodstuffs such as rice, vegetables, fruit, etc., and of locally manufactured goods and handicrafts. Although no detailed statistical data are available on this aspect of the national economy, the dimensions of the internal trade are indicated by the fact that the value of locally grown rice alone came up to nearly $200 million in 1958. If to this is added the value of other products grown or manufactured locally and sold in the internal markets, it becomes clear that the internal trade of Malaya is of considerable importance.

Most of the foodstuffs produced figure prominently in the internal trade of the country. Practically all of the surplus rice from the padi lands of the north-west and the other large rice-growing areas of Perak and Selangor are sold and consumed locally. The vegetables, food-crops, fruits and spices cultivated in market gardens, kampong, New Villages and suburban areas are all sold and consumed within Malaya and Singapore, except for small amounts of tea, arecanuts and pepper which are regularly exported. A considerable number of the coconuts harvested enter into home trade, while about one-third of the annual production of coconut-oil is sold in the domestic markets. Of the two other major export crops—rubber and palm-oil —only a very small proportion eventually finds its way into the local markets, rubber in the form of manufactured rubber articles and palm-oil in soaps and margarine.

There is also a fairly important internal trade in livestock—buffalo and oxen for meat and for draught purposes, sheep, goats, pigs and chickens for meat. A large number of livestock is also imported regularly since the country is not self-sufficient in meat. Most of the fish landed from the sea, as well as from freshwater sources, are also sold and consumed locally. About two-fifths of the annual output of sawn timber is exported, the remainder, including other forest products such as poles, charcoal and firewood, entering into local markets. A wide range of goods is manufactured on a small scale, in factory and home, and sold locally.

The directions of such trade depend mainly on the nature of the goods that are sold. Products which are in general demand by all sections of the population such as fish, rice and coconut oil are sold in all parts of the country, although they are only produced in some regions. Generally speaking, there is a constant flow of the products of land, sea and forest into the urban markets, and a flow of locally manufactured articles into the rural markets, such flows consisting of the surpluses from the producing areas.

EXTERNAL TRADE

The import–export trade forms a very important part of the country's economy. Being a primary producing country, nearly all of the agricultural and mineral raw materials produced have to be exported to foreign markets. At the same time large quantities of goods, mainly food and manufactured articles, are imported for internal consumption. Although Malaya traditionally has a favourable balance of trade (Fig. 63), the balance fluctuates widely from year to year depending on the price and volume of the two principal exports —rubber and tin. The largest post-war export surpluses were reached in 1950 ($1,297 million) and 1951 ($1,510 million), during the Korean War boom. In 1961 total exports were valued at $2,626·2 million and total imports at $2,227·5 million, leaving an export surplus of $398·7 million. In the same year, about one-third of all Malaya's external trade passed through Singapore compared with two-thirds in 1950.

Up to 1957, when Malaya obtained its independence, the trade policies of the Government were dictated not by the needs of the country but by its status as a colonial territory. With independence and the assumption of control over external trade relations, the present Government's policy is 'to promote and maintain friendly as well as stable trading relations with as many countries and with as few obstacles as possible, on the basis of reciprocity and mutual benefit'.[1] Some of the steps taken to implement this policy were the removal of licensing requirements in respect of imports from the Dollar Area, the Organization for European Economic Co-operation countries and Czechoslovakia, and the renouncing of the right to impose import restrictions for the purpose of balancing payments under the General Agreement on Tariffs and Trade (GATT). (Malaya became a signatory of GATT soon after independence.) The removal of restrictions on imports has resulted in an extension

TABLE 55. *Exports by Commodity, Malaya, 1961*

COMMODITY	Value in $ Million	Percentage of Total Value
Rubber	1,443	55
Tin (concentrates, ingots, etc.)	553	21
Iron ore	164	6
Food, beverages and tobacco	109	4
Copra and coconut oil	46	2
Palm oil and kernels	61	2
Timber	42	2
Other commodities	208	8
TOTAL	2,626	100

of the trading circle, and Malaya now imports from as many as seventy countries.

Exports. The main items of Malaya's exports are shown in Table 55. Most of them consist of primary produce and raw materials. The overwhelming importance of rubber and tin is apparent: these two commodities together made up three-quarters of the total exports by value in 1961. Not all of the items regularly exported are produced within the country; in any one year as much as one-third by value of the total exports may be made up of re-exports of produce from neighbouring countries and re-exports of manufactured goods from the United Kingdom, Western Europe, the United States,

[1] Minister of Commerce and Industry in *The Straits Times*, 31 August 1960.

Japan, India and other industrial countries. For example, the only food product of Malaya which is normally exported in appreciable quantities is canned pineapples; the other food items are re-exports from other South-East Asia countries.

Table 56 shows the final destinations of Malayan exports as far as could be determined at the time of export. Where information

TABLE 56. *Destinations of Malayan Exports, 1961*

DESTINATION	Value of Exports in $ Million	Percentage of Total Value
Single countries		
Singapore	520	20
Japan	383	14
U.S.A.	334	13
United Kingdom	315	12
U.S.S.R.	159	6
India	72	3
Canada	47·5	2
Australia	29	1
Larger regions		
Europe (excluding the U.K. and U.S.S.R.)	573	22
Asia (excluding Japan and India)	87	3
Rest of the world	106·5	4
TOTAL	2,626	100

regarding the final destinations of exports via Singapore is not available, such exports are lumped under the figures of exports to Singapore, that is, included under the same category of goods exported to and consumed in Singapore. It is apparent, therefore, that though exports to Singapore amounted to 20 per cent of the total Malayan exports, a high proportion of these were eventually re-exported from Singapore to other countries. In fact, the exports of merchandise to or via Singapore actually amounted to $724,000,000 in 1961 (or 28 per cent of total exports), the high figure reflecting clearly the continuing importance of the port as an outlet for Malaya in spite of the political separation of the two territories.

The long-established customers of Malaya's goods are the United Kingdom, the United States, and the countries of Continental Europe. Together these countries consumed nearly half of the total exports. The main exports to the United Kingdom were rubber and tin, foodstuffs and vegetable oils, while those to the United States were rubber and tin, the other exports being of minor importance. The United States' share of the total exports of Malaya has fallen considerably since the war. In the years 1920–40, for example, the U.S. imported between 30 and 50 per cent of the total Malayan exports each year, and was Malaya's chief customer, whereas in 1961 she bought only 13 per cent of Malaya's exports. Japan has become a market of increasing importance over the years, taking nearly the entire output of iron-ore and bauxite from Malayan mines, as well as substantial amounts of rubber and tin. Japan has now become Malaya's biggest single customer. The U.S.S.R. is also an important market for Malayan goods (mainly rubber), purchasing 6 per cent by value of the total Malayan exports.

Imports. The main items imported into Malaya (Table 57) are foodstuffs and manufactured goods for local consumption, with a proportion for re-export to other South-East Asian countries, and raw materials such as rubber, copra, pepper, tin, palm-oil and other agricultural products from neighbouring countries which are re-exported, usually after some processing, to the industrial countries of Western Europe and other parts of the world. The single most important item of food imported into Malaya is rice, the staple food of the overwhelming majority of the population. The traditional suppliers are the countries of continental South-East Asia—Thailand, Burma, Vietnam and Cambodia—with Thailand as the main source. The other foodstuffs imported are meat and meat products, dairy products, fresh, dried and salted fish, cereals other than rice, fruit and vegetables, sugar, coffee, tea, cocoa, spices and miscellaneous food preparations. Malaya's dependence on outside sources for much of its food is well illustrated by the fact that the value of food imports in 1961 was one-quarter of the total value of all imports.

The countries of Western Europe and the United Kingdom are the major sources of the beer, wine, and spirits consumed in Malaya. The only local alcoholic beverage produced locally is beer. Imports of unmanufactured tobacco are derived from a variety of sources, with the Rhodesias as the leading suppliers. Cigarettes are largely of British manufacture, with the United States as a secondary source.

The heavy duties on imported cigarettes have stimulated local cigarette manufacture and sales. In spite of the expansion of local production of beer and cigarettes, imports of beverages and tobacco amounted to $88 million, or 4 per cent of the total value of all imports.

Rubber, tin-ore and copra are regularly imported from neighbour-

TABLE 57. *Imports by Commodity, Malaya, 1961*

COMMODITY	Value in $ Million	Percentage of Total Value
Rice	130	6
Other foodstuffs	432	20
Beverages and tobacco	88	4
Raw materials:		
Copra $13 million		
Rubber $96 ,,		
Tin-ore $122 ,,		
	231	10
Mineral fuels	143	6
Chemicals	159	7
Manufactured goods	540	24
Machinery and transport equipment	389	18
Miscellaneous imports	116	5
TOTAL	2,228	100

ing countries for processing in Malayan and Singapore factories before eventual re-export. The greater proportion of the crude rubber imports are from Sumatra, and most of the remainder from Thailand and Burma. Over half of the tin-ore imported in 1961 was from Thailand; the ore is smelted in Malaya before being re-exported. Sumatra and Celebes were the sources of nearly all of the copra imports. The copra is processed in local oil mills and enters the export markets as coconut oil; some copra, imported as well as local, is also exported for oil extraction overseas. In addition to rubber, tin-ore and copra a variety of other raw materials are also imported from other South-East Asian countries and re-shipped to overseas markets after being processed, graded and packed.

Malaya is a fuel-deficient country, and large quantities of mineral fuels are imported every year for local use. Indigenous sources of fuel are coal and wood. The Batu Arang colliery has stopped production as the price of its coal is no longer competitive with imported fuel oil. Wood is usually used as a domestic fuel and not for industrial purposes. Oil has become the primary fuel for most plants, machinery and motor vehicles, whether private or public, and imports of motor spirit, liquid fuel, gas and diesel oil and other petroleum products have expanded considerably since the war. The major sources of mineral fuels are the oil fields of Sumatra and Borneo.

There are two hydroelectric generating plants, a large one at Chenderoh with an annual output of 200 million kWh and a small one at the Langat with an annual output of 10 million kWh. Another important plant at Cameron Highlands is in the course of development.

The more important chemicals and chemical products imported for home consumption include acids as coagulating agents for latex, sodium arsenite used in rubber estates as weed-killers, monosodium glutamate (food flavouring compound), paints and varnishes, pharmaceutical products and medicine, toilet articles including soaps and detergents, chemical fertilizers, plastic materials and insecticides.

Of the manufactured goods imported into Malaya, textiles have always been one of the most important. The demand for textiles for local sale as well as for re-export has always been steady, with the United Kingdom as principal suppliers before the last war (except for a brief period in the early 1930's when Japan became the leading supplier until it was driven out of the market by the import-quota system imposed in 1934). In the post-war period the textile trade has been shared amongst four major producers—Japan, India, the United Kingdom and Hong Kong.

The other major classes of manufactures imported into Malaya include leather goods, rubber manufactures (mainly tyres and tubes for motor vehicles), wood, paper and cork manufactures; cement, lime and other building materials; glassware and pottery; precious metals, gems and jewellery; and products of the base metals such as iron and steel ingots, aluminium sheets, wire. hardware, metal containers, copper plates, etc.

Imports of machinery and transport equipment include internal combustion engines, including outboard engines for use in the inshore and inland waters of the Peninsula; other machinery such as tractors for agricultural and civil engineering use, refrigerating and air-conditioning units, sewing machines, typewriters, accounting

TABLE 58. *Country of Origin of Malayan Imports, 1961*

COUNTRY OF ORIGIN[1]	Value of Imports in $ Million	Percentage of Total Value
Single countries		
United Kingdom	503	23
Indonesia	250	11
Thailand	248	11
Singapore	205	9
Japan	182	8
U.S.A.	112	5
Australia	95	4
Hong Kong	85	4
China	79	4
India	72	3
Larger regions		
Western Europe (excluding the U.K.)	256	12
Rest of the world	140	6
TOTAL	2,227	100

[1] The country of origin is defined as that in which the goods were given the form in which they are finally imported into Malaya. If the country of origin of goods via Singapore is not available, such imports are included in the figures of goods manufactured in Singapore.

machines and printing presses. Dredges and dredging equipment are imported for use in the tin-mining industry. Electrical machinery including heavy generators for power stations as well as small motors for industrial use, and other electrical goods and appliances form another major class of imports. Motor vehicles are the main items of transport equipment imported.

Table 58 shows the countries of origin of Malayan imports. The main supplier of Malaya's imported goods is the United Kingdom.

The proportion of the United Kingdom's share (by value) in the import trade has increased steadily over the years—from 14·6 per cent in 1939 to 20·8 per cent in 1949 to 23 per cent of the total value of all imports into Malaya in 1961. Manufactured goods, machinery and transport equipment form the bulk of its exports to Malaya.

Indonesia is the source of much of the raw materials imported for processing and eventual re-export. The import trade with Indonesia has fallen off considerably in recent years because of the country's unstable political and economic conditions and also because it has established direct trading relations with many industrial countries. An increasing proportion of its raw materials, especially rubber, is also being processed internally. Thus the value of imports from Indonesia dropped from $771 million (26·7 per cent of the total value of all imports) in 1950 to only $250 million (11 per cent) in 1961.

Imports from Thailand are made up of rice and salt-fish most of which are consumed within Malaya and the remainder re-exported, and also rubber and tin which are processed for the market and re-exported. With the exception of some locally manufactured articles such as electric dry-cell batteries, plastic goods, steel tanks, drums and metal boxes, rubber goods, paints, and some foodstuffs and beverages, notably live pigs from Chinese farms and locally-brewed beer, most of the imports from Singapore originated from abroad. European imports into Malaya are made up mainly of manufactured goods, machinery and transport equipment.

Japan is the source of dried vegetables, printing paper, cotton and synthetic fabrics, fishing nets, chinaware and porcelain, iron and steel bars, galvanized sheets, and luxury articles such as transistor radios and cameras. China's exports to Malaya consist of fruits and vegetables, tea, soya bean and bean flour, herbs, joss paper and cotton fabrics; there is a steady demand for these from the large Chinese population in the country. Malaya is also an important market for Australian products—mainly meat and meat products, milk, wheat flour, fruit, animal fat and motor cars.

The other supplying countries are Hong Kong, Burma, India and the United States. Hong Kong sends sugar, monosodium glutamate, paints, medicinal products, cotton textiles and leather footwear. The import trade with Burma is made up largely of rice for internal consumption, tin-ore and tin concentrates for smelting and re-export, and rubber for processing and re-export. India supplies onions, sugar, cotton fabrics and sarongs, and some manufactured goods. The United States, one of Malaya's principal customers, had never had an important share in the import trade except during the post-war years up to 1949 when American machinery, heavy equipment and other essential goods were imported in large quantities to assist in the rehabilitation programme. Since then American imports have diminished steadily—the value of such imports fell from a total of $112 million in 1949 to $41 million in 1958. But imports increased after 1958, and by 1961 the United States had once again become an important supplier of goods to Malaya. The principal items supplied are cigarettes, paper, detergents, synthetic fabrics and manufactured goods such as electrical equipment, machinery, motor cars, type-writers, drugs and medicines. Owing to the proximity of the Sumatra and Borneo oil-fields the import of mineral oils from America is negligible except for lubricating oils.

THE ENTREPÔT TRADE OF SINGAPORE AND PENANG

The entrepôt trade of the Malay Peninsula has not been affected to any great extent by the political separation of Singapore and Malaya. This trade makes up between 40 and 50 per cent of the total trade of the two territories. Most of the entrepôt trade (about 90 per cent) is handled by Singapore, and almost all of the remainder by Penang. Both act as intermediary centres and temporary depots for goods passing from a foreign source to a foreign destination. Some of the goods, particularly raw materials such as crude rubber and tin concentrates, may undergo some form of processing before being sent to their final destinations. Because Singapore is now politically separate from Malaya, its entrepôt trade includes the movement of goods to and from the mainland. Most of the trade is seaborne trade amounting to 6,567,000 freight tons of general cargo and 8,323,000 tons of mineral oil handled by the port in 1961. The importance of Singapore as a seaport entrepôt is further illustrated by the fact that a total of 37,467 merchant ships with a net tonnage of 66,561,000 entered and cleared the port in that same year.

A number of factors have contributed to the growth of Singapore as a major regional and international trading centre:

(1) Its extremely favourable geographical position. Singapore is the focal point of the major trade routes from Europe to the Far

East. Its commanding position astride the entrance to the rich primary producing countries of South-East Asia makes it the natural and obvious collecting and distributing centre for the region's raw materials destined for the Western industrial nations, on the one hand, and for Western manufactured goods en route to the markets of Malaya, Thailand, Indo-China, Indonesia, Borneo and Sarawak on the other. Except for land-locked Laos, all the countries of South-East Asia have access to the sea and also long coastlines. Easy access to the sea and the general tendency for areas of production in South-East Asia to be concentrated in peripheral and coastal locations make it inevitable that most of the region's trade should be seaborne. Because of its focal location and its excellent harbour and dock facilities, Singapore is able to act as a transhipment centre linking the region's many small ports and landing places with world shipping routes.

(2) Its free port status. The policy of free trade established by Raffles and still largely in force today has contributed much to the success of Singapore as a major entrepôt. Not only is there freedom from customs duties and vexatious harbour regulations, but the free port status includes optional freedom from harbour dues as such dues are only chargeable to ships that use the Port Authority wharves. In spite of the political changes that have taken place in Singapore—the island merging with Penang and Malacca to form the Straits Settlements in 1829, then being separated from the Federation of Malaya in 1948 whilst still remaining a British Colony, emerging as a self-governing state in 1959, merging with Malaya, Sabah and Sarawak in 1963 to form the Federation of Malaya, and finally splitting away from it to form the new Republic of Singapore—the successive governments have retained the policy of unfettered trade. The aim of the present Government is to broaden the base of the island's economy by a programme of industrialization, and it is therefore likely that there will be a gradual erosion of the free trade policy as the pace of industrialization quickens, and tariffs are imposed on goods which are manufactured locally. However, to safeguard the entrepôt trade, the Government is planning to establish a free trade zone in which goods could be brought into, stored, processed, manufactured or re-exported without the payment of customs duty, except when these goods are removed from the zone for local consumption.

(3) Its fine natural harbour and its excellent port facilities. The harbour of the port of Singapore provides a safe anchorage for ships of all sizes, from the small coastal steamers to the large ocean liners.

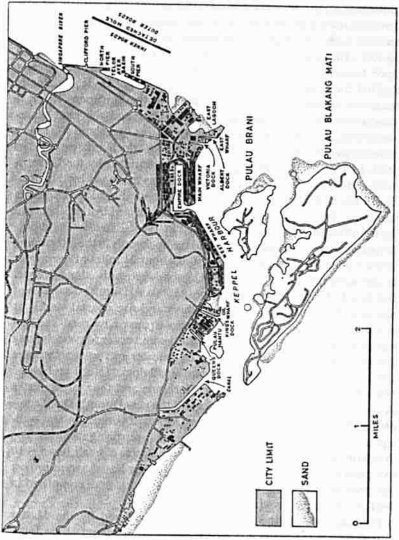


FIG. 64. Singapore Harbour

The harbour lies to the south of Singapore Island and is protected from the open sea by a number of small islands (Fig. 64 and Plate 43). There are no entrance restrictions and the main channel, 40 feet deep, more than fulfils the minimum depth requirements (30 feet at low water) of most modern large ships. The greatest depth of the wharves and the minimum depth of the anchorage are both between 30 and 35 feet. The continual improvement of harbour and port facilities since the early years of the foundation of Singapore has greatly assisted the development of its extensive entrepôt trade. Originally trade was conducted around the mouth of the Singapore River, a sluggish stream of varying depth and width, and the boat quays along both its banks still serve many *godowns* (warehouses). Later, wharves were built by two private companies which amalgamated in 1899. In 1905 their undertakings were expropriated by the Government of the Straits Settlements. The port was managed by the Dock Board until 1913 when the Singapore Harbour Board took over its functions. These functions are now being performed by the Singapore Port Authority, which was established in 1964. Extensive modifications and improvements were made to the dockyards in the intervening years. The present properties consist of about 2½ miles of deepwater berths stretching from the East Lagoon westwards along Keppel Harbour to the main dockyard opposite Pulau Hantu and capable of accommodating twenty-two ocean ships and five coastal vessels at any one time (Fig. 64). The wharf area is served by road and rail transport, and there are bunkering facilities and water for vessels lying alongside, as well as a large number of *godowns* and open-air storage spaces. The Dockyard consists of two small docks (No. 1 and No. 2 Docks) at the east end of Keppel Harbour, and four larger docks (Victoria, Albert and King's Docks and the new Queen's Dock completed in 1956) at the west end. The Dockyard is modern and well-equipped and provides dry-docking and ship-repairing facilities. The Port Authority also manages Telok Ayer Basin, a small basin with two piers used mainly by lighters (Fig. 64). The East Lagoon project will provide nine additional berths, two of which were completed in 1961, with another two in 1962.

Forming part of the Harbour but administered by the Master Attendant are the Singapore Roads which are made up of the Inner Roads providing a 15-foot deep anchorage for small coasters and lighters, and the Outer Roads with an open natural anchorage suitable for deep-sea vessels. The two Roads are separated by an artificial mole (Fig. 64 and Plates 43 and 44). Ships using the Roads and the Singapore River do not have to pay any dues and, because of this, the tonnage of ships entering and leaving the Roads is much greater than that of the wharves. However, the cargo handled at the Roads is usually less than that at the wharves; in 1960, for example, the proportion was 41 per cent to 59 per cent respectively. As a rule the small coastal vessels that ply the local and regional trade tend to use the Roads, discharging their cargo into lighters (Plate 45) or local small craft, but occasionally a large ship may anchor there temporarily while waiting for a berth. In general, however, the larger ocean-going ships tend to use the wharf facilities of the Port Authority.

The major oil companies of Shell, Standard Vacuum and Caltex maintain their own bunkering installations in Singapore Island, while Shell also have a major trading and bunkering installation at Pulau Bukom. Standard Vacuum maintains a similar but much smaller bunkering station at Pulau Sebarok. These stations lie within the Harbour limits. The other port facilities of Singapore include a new port (with a deepwater wharf), a shipbuilding and a shipbreaking yard, and bulk-handling facilities, all sited at the Jurong Industrial Estate. The Jurong Port commenced operations in November 1965.

An ancillary part of the facilities available at Singapore is the commercial organization and services that have been evolved to further the entrepôt trade. These include the grading, processing and packing of such regional produce as rubber, copra and tin, the provision of organized markets and credit and banking facilities, the breaking up of bulk consignments of goods for local distribution, and the maintenance of a large variety of goods in stock. Singapore has been compared with London in the enterprise and accumulated experience of its merchants. These merchants, both Asian and European, have played an important role in the evolution and development of the entrepôt trade of the island.

Singapore's entrepôt trade is conducted along well-defined lines, and consists largely of the import and subsequent export of three major and easily recognizable classes of goods, 'Straits produce', manufactured articles and petroleum.

Straits Produce. Straits produce is a trade term which is used to include all agricultural or mineral raw materials grown or produced in South-East Asia and brought to Singapore (or Malayan ports) for the purpose of grading, bulking or processing prior to shipment to Western or neighbouring markets. Rubber is the single most important Straits product in Singapore's trade. In 1960 imports of rubber from neighbouring countries totalled 643,000 tons valued at $1,357·5 million; of these, Indonesia supplied 286,000 tons, Malaya 280,000 tons, and Sarawak, North Borneo and other South-East Asian countries the remaining 77,000 tons. In the same year rubber exports totalled 598,000 tons valued at $1,426·5 million. The principal markets were the United States (83,000 tons), the United Kingdom (68,500 tons), Japan (42,500 tons), with China, the U.S.S.R., France, Argentina and Western Germany as the other main importers. Tin used to be one of the important components of Straits produce. In recent years, however, export restrictions imposed as a result of the International Tin Agreement and the closing down of the tin-smelting works at Pulau Brani have resulted in a fall in the volume of tin exports from Singapore, which in 1960 totalled only 1,400 tons as compared with 20,800 tons in 1957. It is unlikely that tin will ever regain its former importance in Singapore trade.

There is also a large trade in copra, coconut oil and copra cake. Imports of copra totalled 94,000 tons valued at $52 million in 1960, the main suppliers being Celebes, Sumatra and the Moluccas. Most of the copra that enters the Singapore market is shipped overseas after grading and packing, the principal buyers being India, Japan, Malaya, China and the Netherlands. The remainder is bought by local oil millers for conversion into coconut oil which is then exported together with oil imported from Indonesia. Total exports of coconut oil in 1960 amounted to 21,000 tons. Copra cake from the oil mills is used as feeding stuffs by Chinese pig farmers both in Singapore and Malaya. Imports totalled 57,000 tons in 1960, of which Java supplied 53,000 tons. Malaya absorbed most of the 22,500 tons exported from Singapore. The other vegetable oil that figures prominently in Singapore trade is palm oil. In 1960 Singapore imported a total of 34,000 tons of palm oil, all from Malaya. Exports amounted to 33,800 tons valued at $23·8 million, of which Iraq bought 13,000 tons, India 10,000 tons and the United Kingdom 7,000 tons.

Foodstuffs and spices occupy an important place in Singapore's trade. Large quantities of rice are imported from Thailand, Burma and Indo-China for internal consumption and re-export. Imports totalled 300,000 tons valued at $103·5 million. More than half of these were retained for the home market, and of the 155,000 tons re-exported, more than half entered the Malayan market. The pattern of trade in sugar is similar to that of rice, more than half of the 1960 total imports of 113,000 tons valued at $37 million being consumed internally, and the rest re-exported. Singapore regularly imports dried and salted fish from Malaya, Thailand and China and re-exports them to Java, Sarawak and Malaya after re-drying, cleaning and sorting. Imports in 1960 amounted to 12,000 tons valued at $8·6 million, and exports were 10,000 tons. Singapore imports large quantities of fresh

TABLE 59. *Singapore's Trade in Manufactured Goods and Transport Equipment, 1960*

COMMODITIES	GROSS VALUE IN $ MILLION		
	Imports	Exports	Total Trade
Textile fabric and manufactures	222·7	14·3	237·0
Iron and steel	68·9	40·1	109·0
Industrial machinery	57·0	43·0	100·0
Electrical equipment	53·1	32·9	86·0
Road motor vehicles	91·7	80·9	172·6
Other machinery and transport equipment	85·8	77·8	163·6
Other manufactured articles	390·0	359·5	749·5
	969·2	648·5	1,617·7
Other trade items (Straits produce, petroleum products, etc.)	3,108·5	2,828·5	5,937·0
TOTAL FOREIGN TRADE	4,077·7	3,477·0	7,554·7

pineapples from South Malaya for its pineapple canneries. Exports of canned pineapple came to 36,000 tons, of which 31,000 tons were re-exports from Malaya.

The spice trade has shrunk considerably over the last century and only pepper and cloves continue to figure significantly in the trade of Singapore. Pepper is obtained from Indonesia (Sumatra, Banka and Billiton) and Sarawak, and re-exported to the United States, the United Kingdom, Western Germany, the Netherlands and Australia. Imports in 1960 were 16,000 tons valued at $49·6 million, and exports 21,600 tons.

Manufactured Goods. There has been a considerable post-war increase in the volume of trade in manufactured goods and transport equipment from industrial, mainly Western, countries. The gains resulting from this increase have more than made up for the losses resulting from the lower volume of trade in Straits produce (rubber excepted) in the post-war years. The importance of this trade is shown in Table 59. Manufactured goods and transport equipment made up 24 per cent by value of the total imports, 19 per cent by value of the total exports and 21 per cent of the total foreign trade of Singapore (including trade with the Federation of Malaya). The most important single item of trade was textiles. In recent years Japan has become the principal source of all ranges of textiles, supplying cotton and man-made fibres worth $109·4 million in 1960. Other major suppliers were China ($29·7 million), India ($18·4 million), the United Kingdom ($15·9 million) and the United States ($11·5 million). The pattern of the textile import trade has changed greatly since the days when the United Kingdom held a virtual monopoly in textiles, and today two new competitors—China and the United States—have further reduced the United Kingdom's share of this important trade. The pattern of the textile export trade has, however, remained much the same, with the Federation of Malaya, Indonesia and British Borneo as principal markets, and Ceylon, Pakistan and Thailand as minor markets.

The industrial countries of the Western world continue to be the sources of most of the other manufactured goods and transport equipment which figure in Singapore's entrepôt trade, with Japan and Australia attaining increasing significance as competitors in this field. These goods are redistributed to Malaya and the neighbouring countries of South-East Asia, with a proportion being retained for internal use in Singapore. Malaya continues to be Singapore's most important market, absorbing about one-third by value of all exports of manufactured goods and transport equipment.

Petroleum. The entrepôt movement of petroleum products has been steadily gaining momentum during the post-war years and in 1960 trade in such products accounted for about 13 per cent of Singapore's total trade, thereby making petroleum second in importance only to rubber. The growth of this trade has been made possible by the extensive modern storage facilities available on Singapore's off-shore islands. Singapore has become the main storage, blending and distributing centre for petroleum products from refineries in Sumatra, Sarawak and Borneo as well as places as distant as Venezuela, Australia and the Middle East. It also serves as a bunkering depot of fuel oil for ocean ships. Bunkering facilities are available at Pulau Bukom, the Singapore Harbour and at the new terminal at Tanjong Penuru off West Coast Road. Over 5 million tons of oil valued at $578 million were imported in 1960, the main sources being Sumatra, Sarawak, Iran, Borneo and Bahrein. Secondary sources are Iraq, Australia, Venezuela and other South American countries. Exports in the same year totalled 2·9 million tons valued at $383 million, the main markets being Malaya, Sumatra, Australia, Thailand, the Philippines and Vietnam. Although the petroleum products trade is handled by the oil companies themselves, the shipping, storage and other activities connected with it form an important source of income to Singapore.

Penang. Most of the entrepôt trade of Malaya is conducted in Penang. Initially the trade of the port was of an entrepôt character, and although cargoes today are tending to be less entrepôt in nature and more in the form of regular imports and exports of Malaya, the port still retains its free port facilities. The establishment of Singapore as a rival port in 1819 resulted in a steady shrinkage in the volume of the entrepôt trade of Penang, and today only about one-tenth of the total entrepôt trade of the Malay Peninsula is conducted through Penang.

The harbour of Penang is classified as a natural (coastal) harbour of medium size and affording fair shelter to ships. There are no entrance restrictions but the main channel is shallower than that of Singapore, being only 20 to 25 feet deep. The main anchorage, however, is over 40 feet deep and suitable for ocean going vessels. The port facilities consist of a two-berth wharf at Swettenham Pier, two lighter basins and lighter landing stages along Weld Quay and in Sungei Pinang. The Port's installations also include piers and jetties at Butterworth and Prai, both on the mainland. Unlike Singapore, there is no causeway between Penang and the mainland. Instead the connection is maintained by ferries owned and operated by both the Malaysian Railway and the Penang Port Commission.

A total of 6,269 ships with a net tonnage of 18,199,000 entered and cleared the port in 1960. In addition a large number of small coastal vessels of under 75 tons net register and native craft of all types with a total net tonnage of about 350,000 enter and clear the port every year. The seaborne trade handled by the port in 1960 amounted to 2,126,600 freight tons of general cargo and 74,500 freight tons of petroleum oils. The entrepôt trade of Penang is conducted within a limited trading circle covering the neighbouring countries of Thailand, Sumatra and Burma. Unlike Singapore, its entrepôt trade makes up only 15 to 20 per cent of its total trade. Penang is therefore more important as an import and export port for Malaya than as an entrepôt port. Penang receives rubber from Sumatra and Burma for re-export and tin-ore and concentrates from peninsula Thailand and Burma for smelting and eventual re-export. Apart from rubber, Sumatra is also the source of copra, part of which is processed into oil in the mills in Penang and part re-exported, petroleum from the oil-fields of Palembang, coffee, sugar and areca-nuts. In return Penang supplies it with manufactured goods (notably textiles) imported from the industrial countries. The import trade with Thailand is made up of tin-ore and concentrates, and rice as the main items, and charcoal, teak and animal feeding stuffs as secondary items. Penang has long been the supply centre for southern Thailand, the major exports being petroleum products, iron and steel manufactures and machinery for the mining industry of peninsular Thailand. Burma sends rice, rubber and tin-ore and concentrates in return for coconut oil, fresh coconuts and arecanuts.

CHAPTER 14

TRANSPORT

THE EVOLUTION OF THE MALAYAN TRANSPORT SYSTEM

The history of transport development in Malaya can be divided into two phases—the earlier phase when movement was largely by water and the modern phase when rail, road and air transport superseded rivers as the main means of internal movement. Up to 1885 when the first railway line was constructed, movement in the Malay Peninsula was almost entirely by water with the seas and the rivers forming natural highways. The heavy and uniform rainfall gives rise to a multiplicity of rivers, and these in turn set the original pattern of Malay settlement and transport on the lowlands and coastal areas. The easiest lines of movement in that repellent landscape of lowland swamps and rain forest were along the rivers. Wet-padi cultivation, the basis of Malay agriculture, also tended to draw the Malay settlers towards flat land located near a convenient source of irrigation water. In addition the rivers provided potable water, and the rivers and sea were the natural sources of fish. In this amphibious environment the boat was the main means of communication and distances were usually calculated in terms of sailing or rowing hours or days.

Being a long narrow pensinsula with an extensive coastline and good sheltered harbours along its western side, Malaya has since the earliest days been dependent on the sea as a means of communication. There is evidence that the first people to migrate and settle in the Peninsula were largely water-borne, as were also the later settlers who came from Sumatra and Java. The major cultural influences—Indian, Chinese, Arab and Western—that have helped shape the history of Malaya also came by sea. The sea was not only a link between Malaya and other countries but acted, in the early days before the establishment of land transport, as a means of contact between neighbouring riverine Malay states within the Peninsula. The Malays of the Archipelago had a reputation for being fine and intrepid sailors, though not all of them used their navigational skill and knowledge of local waters for peaceful purposes. The Straits of Malacca and the neighbouring Indonesian seas were once the haunts of roving bands of pirates, and even today there are still occasional cases of piracy in these waters.

Interest in those early days centred around the peripheries of the Peninsula where a number of small petty kingdoms were set up near the mouths of rivers commanding lines of movement both coastwise and along the rivers. Most of the sultanates were backed by vast stretches of freshwater swamps lying between coast and interior. In a number of cases (e.g. Perak and Pahang) the territorial chief of a river mouth settlement exerted control over subsidiary settlements at inland *kuala* sites. The rivers therefore served as the main means of internal transport, linking river mouth settlements with upstream villages, and providing the only practicable means of penetrating the swamp belt into the interior. However, the Malays found little incentive to venture into the interior apart from an occasional excursion to collect jungle produce and mine tin and gold. On the contrary, settlements tended to be concentrated near the lower reaches of the rivers for agricultural as well as economic reasons, since the further upstream the settlement, the more toll-stations the villagers had to pass through, and hence the more taxes they had to pay for their goods.

The rivers on either side of the main watershed of the Peninsula are not long and their catchment areas are small. The western side is broken up by an elaborate network of rivers and hence more accessible by water, whereas the eastern portion is less well served by rivers. Over the last few centuries many of the rivers of Malaya have altered their courses and some their sizes as a result of river capture. The Pahang River used to flow further south than it does today. The Perak River once ran into the sea at Sungei Dinding. It has also increased its basin through capturing some of the major tributaries of the Sungei Bernam. Most of the larger rivers were sufficiently deep for the shallow-draught sailing craft and rowing boats employed by the Malays. River transport, however, had its share of hazards. All the rivers are perennial, though a local drought might reduce the depth of water below that needed for the larger craft. But floods rather than drought were the major hazards. The rivers exhibit a characteristic flattened profile, being swift and narrow at their headwaters in the mountains and slow, sinuous and broad in the lower reaches. A sudden intensive fall of rain in the upper reaches might send a torrent of water downstream at a rate which

45. A lighter being loaded with rubber at the North Boat Quay on the Singapore River. The rubber will finally be loaded into a ship at anchor in the Roads.

4 . The Pahang River at Temerloh. The ferry (right) was in use until late 1960 when the bridge w s completed and opened to traffic. But within a few months the heavy rains of the north-east m nsoon caused the river to flood, and the logs and uprooted trees carried down by the flood w ters rammed against the bridge and brought about a collapse of the central spans. A temporary b dge now spans the gap.

47. The ferry at Dungun, Trengganu. Such ferries are common along the main east coast road, but are gradually being replaced by permanent bridges.

48. A bullock-cart in Malacca. This slow and cumbersome form of transport has lost the importance it had in the early days of the century. Young rubber in the background.

the rivers at the lower courses could not adequately cope with. Floods were therefore common. Such floods could occur suddenly with serious damage to river traffic. Because of its heavy rainfall from the north-east monsoon, the eastern part of Malaya was more liable to flooding. Sunken timber, rapids and shifting sand bars and sand banks added to the risks of river transport.

Land transport was little developed for a number of reasons. The constantly wet swampy environment inhibited movement on land. The dense jungle was difficult to penetrate. The rugged nature of the mountainous interior was another obstacle to movement. Jungle paths had to be kept clear of fallen tree trunks, and if not in regular use rapidly became overgrown. Further, the elephants and human porters used on these paths and tracks could not carry as large a load as even a small *sampan* could. Elephants were employed chiefly by the aristocracy, but they were an inefficient form of transportation, carrying only small loads, frequently falling ill, and occasionally becoming dangerous to handle. As a result, movement on land was limited to movement along footpaths (usually sited on the higher ground of levees) leading from one kampong to another, minor excursions into the fringes of settlement to collect jungle produce, and occasional ventures into the interior by river and thence by land to the tin and gold diggings. The footpaths and jungle tracks were subsidiary to the rivers, serving to extend the basic transport network formed by the rivers rather than existing as a separate network. Jungle paths also served as connecting links between two river systems. During the fifteenth and sixteenth centuries the *penarekan* or porterage route between the sultanates of Malacca and Pahang followed the Muar river to its headwaters where a short porterage across the watershed enabled travellers to continue their journey to Pahang by way of the Serting and Pahang Rivers. Similarly it was possible to travel by river from Pahang to Kelantan by two alternative routes—one following the Pahang–Tembeling Rivers across the watershed of the Lebir and into Kelantan via the Lebir and Kelantan Rivers, and the other following the Pahang–Jelai Rivers across the watershed into Kelantan via the Nenggiri–Galas–Kelantan Rivers. Both of these passed through gold country.

The transformation of this early pattern of transport began with the establishment of British rule. Until 1874 the British controlled only the Straits Settlements of Singapore, Penang–Province Wellesley, and Malacca. The founding of the Straits Settlements ushered in an era of active road construction. These roads were, in fact, cart tracks, sinuous and badly surfaced, but a distinct improvement over the traditional footpaths and jungle tracks. By the last quarter of the nineteenth century a network of cart tracks covering most of Malacca, the eastern half of Singapore island, the eastern side of Penang island and most of Province Wellesley was established, supplementing the existing river network.

The other parts of the Peninsula were still very much dependent upon rivers for internal transport. With the discovery of the rich tin-fields of Larut, Kinta and the Klang Valleys in the latter half of the nineteenth century, the rivers leading to these regions were called upon to bear the strain of greatly increased traffic. The rivers were the only practicable means of access to the tin deposits, enabling the miners to move their mining equipment and stores inland as well as serving as a means of transporting the ore produced to the coast for eventual export. Mining operations were initially limited to the immediate vicinity of the main rivers and their tributaries, but as these operations gathered momentum the miners began to push further afield in their search for new tin lands. Gradually a new transport pattern evolved. This new pattern still hinged on the waterways, but rivers were supplemented by tracks and footpaths leading from the river banks to mines in the interior.

The extension of British control over the Malay States which began in 1874 paved the way for the large-scale development of the tin resources of the interior. The intensification of mining operations resulted in large quantities of tailings being discharged into the rivers of the main tin-producing states of Perak, Selangor and Negri Sembilan. The control of tin tailings was, in those early days, perfunctory and ineffective. Within a few years the rivers were silted up with tin tailings, and their channels became progressively shallower so that river travel became increasing hazardous and difficult. The deterioration of the rivers set in just at that stage when the country was being opened up and improved transport and communications were necessary if the pace of development were not to be drastically slowed down.

It was evident that the rivers were no longer capable of coping with the increasing volume of traffic, and that a more reliable and efficient means of transport had to be found. The answer was found in rail transport, and the period of railway construction which began when the first line was completed in 1885 ushered in the modern phase of transport development in Malaya. Built originally to serve the mining industry, the railway system paved the way and set the pattern for the later development of the country. The existence of an excellent skeleton network of rail transport was one of the major factors responsible for the early and phenomenally successful establishment of the rubber industry. The rubber industry, in turn, provided the additional revenue needed to extend the rail system so as to cover most of the Peninsula.

The first phase of rail construction occupied the ten years from 1885–95 when four short lines were laid along western Malaya, each line connecting a coastal port with an inland tin-field and taking over completely from the rivers as the carriers of supplies and tin-ore. The first line linking Port Weld with Taiping was built to serve the then principal mining region of Larut. Then came the Klang–Kuala Lumpur line serving the tin-rich Klang Valley. Similarly a line was built from Port Dickson to the Seremban fields. The fourth line to be completed joined Telok Anson to Ipoh and Batu Gajah, providing through communications to the Kinta Valley, which had displaced Larut as the leading mining region (Fig. 65A).

The next phase of rail development occupied the period up to 1910, and involved the construction of a north–south trunk line joining the inland mining towns, following the grain of the country and running along the foothill zone where the main tin deposits were to be found. At the same time extensions northwards and southwards were made to the trunk line, and by 1903 through communications were established between Prai, directly opposite Penang, and Seremban. The next few years saw further extensions being made southwards, first to Tampin where a branch line connected it to Malacca, then to Gemas, and finally to Johore Bahru. The pattern in 1910 is shown in Fig. 65B. At this period the rubber-planting fever was reaching its height, and large areas of land were cleared on both sides of the railway line for the new crop.

The next twenty-one years saw the completion of the rail system, and apart from the temporary closure of the East Coast line and some branch lines as a result of the Japanese occupation, the pattern has remained basically the same up to the present day. The Kedah line, completed in 1918, extended the main trunk line further northwards to the Thai border. This line branched off from the main trunk line at Bukit Mertajam, and passed through Province Wellesley, Kedah and Perlis to Padang Besar at the border where it was connected with the Thai rail system. Thus by 1918 there was through

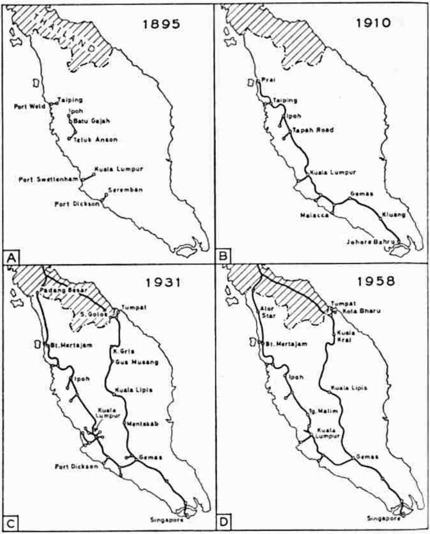


FIG. 65. The evolution of the rail network

communication from Johore Bahru in the south right up to Bangkok. The final southward extension to the railway was made when the causeway across the Johore Strait was built in 1923, connecting Singapore to the Malay Peninsula.

The other major achievement of this period was the construction of the East Coast line, connected to the main trunk line at Gemas. Although work began from Gemas as early as 1907 and from Tumpat in Kelantan in 1912, the line was not completed until 1931. A branch line from Pasir Mas to Sungei Golok was built in 1920. Sungei Golok was the connecting point between the Royal State Railways of Thailand and the Kelantan railway, and later, the East Coast line. Figure 65C shows the rail pattern in 1931.

During the Japanese occupation 276 miles of line consisting of 200 miles of the East Coast line from Mentakab to Krai, and the branch lines of Telok Anson, Tronoh and Malacca, were removed and used in the construction of the Burma–Siam railway. The Telok Anson line was relaid in 1946, but rehabilitation of the East Coast line was not completed until 1953 because of the outbreak of the Emergency in 1948. The Tronoh and the Malacca feeder lines were not replaced. Figure 65D shows the post-war pattern.

The development of rail transport in place of rivers was soon followed by complementary development of road transport. In the early days of mining, movement on land was by way of tracks and footpaths connecting mining centres with the nearest navigable river. Later these tracks gave place to bridle paths, and still further improvements came with the construction of cart-tracks designed for slow-moving bullock carts. None of these were metalled, and rivers and streams were crossed by very simple and cheap bridges. The fragmentary road network in the western Malay States was designed to serve the main highways—the rivers. Later, when river transport was replaced by rail, new feeder bridle paths and cart-tracks were constructed between mines, mining towns, administrative centres and the nearest railhead. As in the case of the railways, the additional revenue derived from rubber was used by the State governments to extend the road system. Each State was left to work out its own road system.

Roads did not attain any major significance until the beginning of the twentieth century because the main transport media—bullock-carts—were slow and of limited capacity, and could not in any way compete with the mechanical efficiency and carrying capacity of a locomotive and its rolling stock. But after the introduction of the motor-car in 1902, roads began to attain increasing importance as an alternative means of land transport, and not merely as subsidiary arms of the railway. Roads were systematically overhauled and improved for motor traffic. The standards aimed at were a metalled surface 16 feet wide laid over a 22-foot foundation between drains, with no gradients outside mountain areas to exceed one in forty. Many of the roads followed the old cart-tracks and were consequently sinuous and indirect. Road making was considerably facilitated by the abundance of granite and limestone, the two rocks commonly used.

Road construction was so rapid that one decade after the introduction of motor vehicles there was through connection by trunk roads between Prai and Malacca, while another road crossed the mountainous backbone and linked Kuantan on the east coast with the western road system (Fig. 66A). The very nature of road transport is such that it is more flexible than rail transport and more quickly responsive to changes in local conditions. High traffic density is less imperative to justify the construction of a road (which need not necessarily be of first-class standards until the volume of traffic has grown). They are therefore the most suitable media for linking up scattered points and creating a variety of routes in all directions. For these reasons, and as motorized vehicles came into general use, roads began to compete with the railway and gradually a system of trunk roads was built which followed much the same directions in western Malaya as the railway. By 1928 the road network had extended northwards to cover the north-western States of Kedah and Perlis, and southwards to link Johore with the rest of western Malaya. Development in eastern Malaya was confined to a local network serving the Kelantan delta west of the river (Fig. 66B).

The next decade saw the further expansion of the road network in all the States. The network in western Malaya became denser, with subsidiary roads being built as the region was opened up for agricultural and mining development, but it was in the east coast States and Johore that the more important advances were made. In Johore a new road was constructed between Senggarang and Pontian Kechil, thereby completing the network covering the west coast of the State. A road between Kota Tinggi and Mersing similarly provided a direct link between Johore Bahru and the eastern portion of the State. Another road joining Yong Peng and Segamat opened up the rolling country of north central Johore for rubber and oil-palm cultivation, and also provided an alternative through route north, by-passing Malacca. In Pahang a road from Kuantan was constructed southwards to Pekan, the old capital of the State, pro-

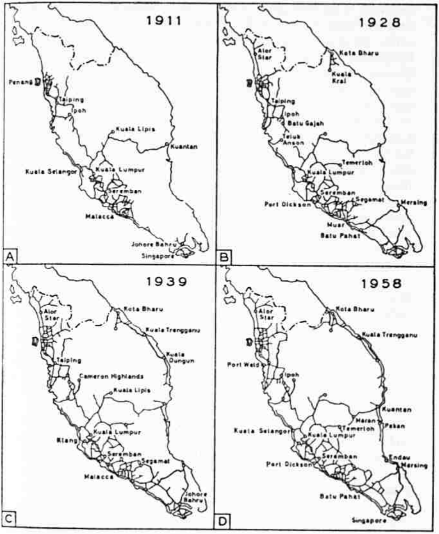


FIG. 66. The evolution of the road network

viding direct access to the undeveloped Pahang deltaic area. Perhaps the most significant advances were made in Trengganu, which up to 1928 was isolated from the rest of Malaya and only accessible by sea. During the next decade a coast road was built running nearly the length of the State, and linking it with Kelantan though not with Pahang. Figure 66C shows the pattern at this stage.

Two major extensions were made in the Malayan road system in the post-war period. The first was a main road linking Kuantan to Chukai, thus providing through communication with the north-eastern States of Trengganu and Kelantan. The other was a 29-mile stretch of new road between Temerloh on the Pahang River and Maran on the main east–west trunk road between Kuala Lumpur and Kuantan. The Temerloh–Maran road completed in 1955 by-passes the towns of Bentong, Raub and Kuala Lipis and cuts short, by 72 miles, the journey from Kuala Lumpur to Kuantan. This east–west road is still the only road link between western Malaya and the three eastern States of Pahang, Trengganu and Kelantan. There is as yet no through road between Johore Bahru and Kota Bharu, as the gap in the road system between Endau and Nenasi has not been bridged. Figure 66D shows the post-war pattern.

A new phase in the history of Malayan transport was inaugurated when an internal air service between Singapore and Penang began in 1937. The post-war period has seen a progressive expansion of air transport to cover most of the main towns of Malaya.

THE PRESENT PATTERN

Two important and interconnected factors have exerted considerable influence in the development of the Malayan transport pattern. First is the physical structure of Malaya—a long, narrow peninsula with extensive coastlines and flat, narrow coastal plains on the west and east separated by a mountainous backbone. The main transport routes by land, sea and air are aligned north–south following the grain of the country, and the pattern is one of parallel coastal shipping, rail, road and air routes with few east–west land connections across the mountain barrier. The rivers of the Peninsula flowing east and west into the South China Sea and the Straits of Malacca are no longer of any consequence as highways, and the old *penarekan* route based on the Muar and Pahang Rivers had long been abandoned. Secondly, a combination of circumstances has worked to establish the greatest concentrations of people and industries in western Malaya. This pattern of economic development is reflected in the transport network which shows its greatest and most elaborate development west of the Main Range. Although eastern Malaya (except

Trengganu which is not served by the railway) is connected to the rest of the country by the main arteries of the transport systems, these arteries carry little traffic and have very few branches in the way of feeder roads and feeder railway lines. Nearly all of Malaya's international traffic is carried by sea or by air. The major ports of Singapore, Penang and Port Swettenham are the links between Malaya's internal transport system and overseas transport, while Singapore and, to a lesser extent, Kuala Lumpur are the connecting points for international air traffic. Malaya shares a common land frontier with Thailand. Although the frontier is crossed by two railway lines and two roads, most of the traffic between these two countries that goes by land is carried by rail since the road system in southern Thailand is poorly developed.

River and Sea Transport. Rivers, once the main highways of Malaya, are no longer of significance as a means of communication, and inland water transport is of some importance only in the eastern States of Kelantan, Trengganu and Pahang where much of the interior is roadless and accessible only by river. Such traffic as moves along the rivers of the Peninsula is highly localized, and is usually made up of small launches and *sampan* moving between points up- or down-stream, or between one kampong and another. River transport is greatly hampered by silting of the channels due to mining and by the attendant problem of floods. The continual development of roads, especially in the interior and eastern Malaya, will result in a further decline in the importance of river transport.

Most of the traffic that moves by water is seaborne, being either coastal and local or oceanic and international. Malaya is well served by a large number of major shipping lines connecting Singapore and, to a lesser extent, Penang and Port Swettenham with the United Kingdom, Western Europe, America, Africa, the Far East and Australia, and by local lines which trade with Indonesia, Borneo, Indo-China, Burma, Thailand, the Philippines and Hong Kong. Nearly all of the entrepôt and import–export trade of Malaya and Singapore is carried on by ships. The importance of sea transport is indicated by Table 60, which shows the number of ships of over 75 net registered tons calling at Singapore and the major Malayan ports. The ports of Singapore and Penang have been described earlier in connection with the trade of Malaya. The other major port of Malaya is Port Swettenham which, unlike the two major island ports, has no natural harbour but is located on a mangrove swamp near the mouth of the Klang River. The original intention of the Federated Malay States Government was to build a railway port serving west central Malaya, thereby making the F.M.S. Railway independent of Singapore and Penang both of which were at that time under the Straits Settlements administration. The port was built on a site south of the point where the Klang River breaks up into an island-studded estuary, a site which, however, was a poor one from the navigational

TABLE 60. *Arrivals and Departures between Malayan and Foreign Ports, 1960*

PORT	ARRIVALS		DEPARTURES	
	Number of ships	Total tonnage	Number of ships	Total tonnage
Singapore	10,112	33,612,000	9,551	32,005,000
Penang	3,167	9,109,000	3,162	9,078,000
Port Swettenham	1,672	6,137,000	1,668	6,127,000
Other ports	593	1,672,000	588	1,646,000
TOTAL	15,544	50,530,000	14,969	48,856,000

point of view since berthing and turning operations were difficult. The facilities of the port included two ocean berths, one coastal wharf, one lighter wharf, some small pontoon jetties and six river anchorages. The original planned capacity of the port was 400,000 tons a year, but even before the Second World War the traffic had outgrown the port's capacity, and in post-war years traffic had increased to more than twice the planned capacity. In 1960 825,000 tons of general cargo and 401,000 tons of oil in bulk were discharged, and 650,000 tons of general cargo were loaded in the port. A 350-foot extension of the coastal wharf was completed in mid-1960, but the main steps being taken to increase the port capacity are the construction of three or possibly four new deep-water berths in the North Klang Straits, the project being scheduled for completion in 1963–64.

The other ports that are used to some extent by international shipping are Malacca and Dungun. Malacca, once the greatest port of Malaya, has declined steadily in importance because of extensive silting of the harbour, the increased size of shipping, and as a result of competition from Singapore and Penang. It has now become, and in fact has been for the last century, only a lighterage port for occasional ships and small coastal steamers. The original entrepôt trade of Malacca has completely disappeared with the inclusion of the port in the customs area of the Federation. It now serves to export the rubber produced in its immediate hinterland, and to import some of the general cargo such as rice and sugar consumed in the region.

The port of Kuala Dungun in Trengganu handles only a very small amount of commercial cargo, but is of considerable importance as a lighter port for the iron-ore shipped from Bukit Besi to Japan. Although iron is mined all the year round at Bukit Besi, shipment is possible only during the months of March to October because the lack of shelter at the port prevents it from being used during the north-east monsoon. The ore is loaded into lighters at Kampong Sura, south of the mouth of the Dungun River and transported to the ore-ships which lie at anchor a mile or so out to sea.

The major ports of Singapore and the Federation are connected to a large number of minor ports on both sides of the Peninsula by ships that ply the coastal trade (Fig. 67). Coastal shipping attained its greatest importance as a means of internal transport during the period after the First World War and before the mid-1920's when lorry transport established itself as a serious competitor for much of the traffic carried by rail and by coasters. In general, the development of road transport has had an adverse effect on coastal shipping in that it drove the railways out of short hauls, and into direct competition with shipping for the longer coastal trades. The position of coastal shipping has declined still further after the Second World War because of the great increase in the capital and running costs of small ships.

This competition between land and local sea transport has been most marked in western Malaya where the development of extensive networks of roads and railways has resulted in the relative decline of coastal shipping, but in eastern Malaya where land transport is still rudimentary and skeletal in pattern, movement by sea still retains much of its original significance. However, a number of

FIG. 67. Ports, airports and landing fields

physical handicaps stand in the way of any further development of sea transport in eastern Malaya. The north-east monsoon restricts movement by small coastal vessels during the months of November to March. The coast itself consists of a series of monotonous flat beaches shelving very gently seawards and interrupted at intervals by river mouths. Every minor port of the east coast is located at or near a river mouth. The entrance to every port is obstructed by a shifting sand bar. The shallow approaches and the sand bar limit the use of such ports to small vessels with a shallow draft.

The coastal trade is dominated by ships of the Straits Steamship Company. Some of it is handled by the lighters and tugs belonging to the Malayan Stevedoring and Transportation Company. The large iron mines on the east coast maintain their own craft. The two major oil companies also operate their own coastal tankers and petrol carriers which call at the minor ports. In addition a great number and variety of local craft—tongkangs, koleks, junks and fishing boats (powered and non-powered)—operate in coastal waters on both sides of the Peninsula.

The arrivals and departures of vessels engaged in the coastal trade and calling at the ports of Penang, Port Swettenham, Malacca, Port Dickson, Telok Anson, Lumut and Pangkor, Muar, Batu Pahat, Mersing, Tumpat, Dungun, Kuala Trengganu and Kuantan are shown in Table 61.

There is very little passenger traffic because of competition from road, rail and air transport except for a very small, two-way passenger movement in ocean liners calling at Penang and Singapore. The commodities usually carried by coastal shipping include rubber for transhipment into ocean-going vessels at Penang and Singapore, tin for smelting at Butterworth and Penang, palm oil from the Selangor and Bernam Rivers to Singapore for bulking, some rice and sugar for distribution to centres near the coast, and miscellaneous cargo such as timber, firewood, charcoal and fish which are mainly carried by local craft. In addition there is a regular movement of petroleum products by coastal tankers to depots in Kuala Trengganu, Kuantan, Kota Tinggi, Batu Pahat, Port Dickson, and Telok Anson. The cargoes that are handled by the minor ports do not usually exceed 4,000 tons a month except in Telok Anson, which has considerable fuel traffic. In general, the coastal traffic that moves through the minor ports is small for a Peninsula with over a thousand miles of coast. This is in part a result of adverse physical conditions which make movement by sea difficult along the east coast during the north-east monsoon, and which prevent any but the smallest ships calling at the east coast ports even in calm weather, and in part a reflection of the degree of development of other forms of transport.

Rail Transport. The basic pattern of the rail network covering the

Peninsula was established as early as 1931 with the completion of the East Coast line. With the exceptions of the gaps caused by the removal of the Malacca and Tronoh branch lines during the Japanese occupation, the present rail network is essentially the same as in 1931, shaped in the form of the letter Y, the left arm being the western and main line, the right arm the East Coast line, and the trunk of the Y running down the centre of Johore and joining both arms to Johore Bahru and Singapore. All three lines meet at Gemas. The main line

TABLE 61. *Arrivals and Departures of Vessels engaged in the Coastal Trade, 1961*

Vessel Size	Arrivals		Departures	
	Number of Vessels	Total Tonnage	Number of Vessels	Total Tonnage
Vessels of over 75 net registered tons	1,215	640,417	1,183	632,576
Vessels of 75 net registered tons and under and local craft of all sizes	Not recorded	387,574	Not recorded	382,847
Total		1,027,991		1,015,423

runs from Singapore to Kuala Lumpur and Prai, a total distance of 488 miles. Prai is connected to Penang by ferry. The western line continues from Prai to Padang Besar (98 miles) where it joins the State Railway of Thailand. Despite its name, the East Coast line does not run parallel and adjacent to the coast, but through the interior of Pahang and Kelantan between the Main Range and the Trengganu Highlands, by-passing Trengganu altogether. The major port of the Railway is Port Swettenham which serves west-central Malaya, mainly Kuala Lumpur and its hinterland. The railway also operates wharves at Port Dickson, Telok Anson and Port Weld, all connected to the main line by branch lines (Fig. 65D).

Physical conditions in Malaya are not very favourable to railway construction and maintenance. The orographic barrier of the Main Range has prevented the construction of an east–west line, and Kelantan can be reached by rail from west-central Malaya only by either going north to Haadyai Junction in Thailand and then south-east to Kota Bharu, or by going south to Gemas and joining the East Coast line. The ruling gradient is 1:100 except in the Taiping Pass section where it is 1:80. While it has been relatively easy to lay lines without exceeding the ruling gradient along the low-lying and gently undulating country in western Malaya and central Johore, the construction of the East Coast line across the rugged terrain of northern Pahang and southern Kelantan was difficult and expensive, and in places involved tunnelling through granite masses.

Heavy rainfall and occasional floods add to the difficulties and cost of railway maintenance. Persistent and excessive falls, especially during the north-east monsoon, may cause landslips and landslides in cuttings and embankments in unstable soil. Floods may inundate portions of the track in both eastern and western Malaya, and railway bridges are sometimes washed away in serious floods such as those of 1926 and 1947. The magnitude of this problem varies from year to year. In 1957, for example, there were nine major and eighty-one minor cutting and bank slips and washouts, but in 1958 only eleven minor occurrences.

The establishment of a north–south rail network following the grain of the country entailed the spanning of numerous east–west-flowing rivers by bridges, thereby adding considerably to the cost. Other conditions in Malaya are, however, otherwise more favourable to railway construction than in many other parts of the tropics. Material suitable for ballast is obtained from the Railway-owned granite and limestone quarries at Kodiang, Ipoh, Kuala Lipis and Segamat. Local coal, though poor in quality, was available in sufficient quantity from the Batu Arang coalfields to supply the needs of the entire system until the recent changeover to oil as a source of fuel. Local hardwood sleepers, pressure creosoted in the railway plant at Gemas, are sufficiently durable to resist the ravages of climate and white ants for periods up to twelve years. Timber from Malayan hardwood forests is also used for coach building.

The Malaysian Railway Administration lies in the portfolio of the Federal Minister of Transport. At the end of 1960, 1,028 miles were open to traffic. Most of the route mileage consists of a single track of metre gauge. Much of the rolling stock is old. For example, the average age of the steam locomotives is about thirty years, and it has been estimated that if these were replaced by diesel-powered locomotives, the Railway could expect to obtain net savings of from 2 to 3 million dollars a year and at the same time compete on more even terms with other forms of modern transport. The main feature of the modernization programme of recent years has been the replacement of all main line steam locomotives with 26 diesel-electric locomotives, each of 1,500 h.p. These powerful diesels have obviated the need for banking engines over the pass section between Padang Rengas and Taiping, increased the maximum speeds of passenger trains from 40 to 45 miles per hour, and have brought about a reduction in the journey times for both through passenger and freight trains. Net savings of between \$1¼ and \$1½ million per annum have accrued as a direct result of dieselization. Six diesel railcars have also been introduced to take the place of minor locomotive-hauled passenger trains.

The Railway provides passenger and freight services between Singapore and most of the larger towns of Malaya. The traffic pattern reflects closely the pattern of economic activities, with the western (and main) line carrying the greatest traffic and the East Coast line insufficient traffic to cover running costs. The greatest passenger loads are carried on the main line linking Singapore, Kuala Lumpur, Ipoh and Prai.

The pattern of freight movement is more complex. In general, the east–west branch lines between the main line and the seaports as well as short sections of the main line carry the largest freight loads. The heaviest goods traffic density occurs along the Kuala Lumpur area, in particular between the capital and Port Swettenham. Rubber, tin and other primary produce for export generally move from the producing areas to the nearest port, while imported goods are carried in a reverse direction to the main urban distributing centres. Table 62 shows the principal commodities carried by the Railway in 1960. Minerals, especially iron-ore, form the single most important commodity carried by the railways. They are carried in train loads at low cost, and, together with other bulk products such as rubber, latex and palm oil, are the most remunerative of the goods moved by rail. In point of fact, the great increase in iron-ore traffic in 1960 as a result of Japan's heavy buying of Malayan ore has been responsible for the Railway making its first profits since 1956. In contrast, the revenue earned from the carriage of consumer goods and other general merchandise is low, and in some cases, barely covers haulage costs, an indication of the keen competition from other forms of transport for this class of goods.

Road Transport. Malaya has the best road system in South-East Asia. Roads provide access to all the developed parts of the country.

TABLE 62. *Principal Commodities Carried by the Malayan Railway, 1960*

COMMODITIES	Tonnage
Primary Export Products	
Rubber	347,000
Palm oil and other oils	73,000
Timber and logs	130,000
Iron-ore	1,471,000
Tin and tin-ore	64,000
Other minerals	114,000
Foodstuffs and Livestock	
Rice, bran and padi	192,000
Other foodstuffs	169,000
Livestock	7,000
Fuel and Petroleum Products	
Petroleum products	243,000
Coal, coke and firewood	21,000
General Merchandise	
Consumer goods	728,000
TOTAL	3,559,000

The trunk roads in western Malaya follow closely the line taken by the main railway as evidenced by the fact that the roads and the railway lines meet or come within half a mile of each other at not less than 121 places, and are never more than 15 miles apart throughout the length of the Peninsula. The main roads along the much less developed eastern sector, however, do not run side by side with the East Coast railway (which passes through the interior) but hug the coastline (in the case of the Kota Bharu to Pekan trunk road). Another trunk road runs in an east–west direction joining Kuantan to Kuala Lumpur, while in Johore a similar east–west road joins Batu Pahat, Kluang and Mersing. A road from Mersing to Johore Bahru through Kota Tinggi serves eastern Johore (Fig. 66D). The areas served by the road and the rail systems do not overlap in eastern Malaya so that the keen competition between the two forms of transport in western Malaya does not exist in this part of the country. The coastal alignment of the road network in eastern Malaya emphasizes the interest in coastal sites, recalling conditions in the Peninsula during the nineteenth century and earlier when most of the people were concentrated in riverine and deltaic locations.

The main trunk roads are connected to and augmented by an elaborate network of other main and feeder roads, more especially along western Malaya. The result is a pattern composed of a dense network of roads running the length of the Peninsula along its western side from Perlis to south Johore, and on the eastern side, a skeleton system of roads running from Kota Bharu and the Kelantan delta southwards through the Trengganu coast to Kuantan, Pekan on the Pahang River, and to Nenasi. The road pattern reflects the peripheral development of Malaya, the continuing interest in coastal sites for development and settlement, and the very large central, mountainous and swampy areas between the two coastal networks of roads that still remain unopened and inaccessible except by river and tracks.

There are 6,200 miles of developed roads in the Federation, two-thirds of which are metalled, and the remainder either with a hard surface or an earth surface. About 2,500 miles of the trunk roads and several other main roads are maintained by the Federal Government. All the other roads are State roads, and come under the control of the State Governments. The municipalities of Kuala Lumpur, Georgetown and Malacca are responsible for the roads within the municipal limits. The developed roads, both Federal and State owned, provide access to the major towns and villages of Malaya. There is no system of improved secondary or local roads, and the rural areas adjoining the main roads are served by estate roads, usually of laterite, cart-tracks and footpaths. All these minor roads usually join on to the nearest main road, railway line, or occasionally, navigable river.

The standard width of the main roads in western Malaya, where traffic is heaviest, was 18 feet prior to and immediately after the recent war, but a width of 20 feet is now being adopted. Most of the roads have a bituminous surface which provides a good riding surface. Vehicles last much longer on these roads than on say, the unpaved, corrugated roads of many parts of Africa, where it has been estimated that a car using such roads has a life of only about 20,000 miles. Many of the tortuous bends which were a characteristic feature of the early roads have been straightened out and banked. Road gradients are fairly gentle except in mountainous country. A load restriction of 8 tons on two axles and 12 tons on three axles is imposed on vehicles on all the roads of Malaya.

Owing to the wet conditions which prevail all the year round, a waterproof surface is necessary if a road is to carry even light traffic. The method of road construction generally adopted is to lay about 7 inches of block-stone pitching and a 3-inch layer of bitumen grouted 2-inch stone. The surface of all main roads is remetalled with a similar 3-inch layer of grouted stone every twelve years. A related problem of road construction in an equatorial setting is the need to drain away the water that runs off the road surface. In urban areas the roadside drains also function as anti-malarial drains, while in rural areas they may be combined with land drainage and padi irrigation canals. A further problem is that of bridging the numerous rivers, especially in the coastal plains where the rivers are wide and shallow. The construction of culverts and bridges add considerably to the costs of road making in Malaya (Plate 46). Many of the rivers, particularly in eastern Malaya, are not bridged but are crossed by ferries. The ferries on the Muar and Batu Pahat Rivers in Johore and the larger rivers of eastern Malaya are pontoons, side-towed by a powered boat (Plate 47). The ferries on the smaller rivers of eastern Malaya are propelled by cables stretched between the banks.

Road construction is facilitated by the abundance of good roadstone, generally within a 25 to 40 mile haul of the job. Most of the stone quarries are owned by the Public Works Department. Road maintenance costs are nevertheless high, due to the need for keeping down vegetation on the side margins, and the need to keep the drains as well as the road surface in good order. Construction and maintenance costs vary over the different classes of roads, and here lies one of the main advantages of road over rail in an underdeveloped tropical country, namely, the possibility of beginning modestly and improving the standards as traffic grows, whereas in the case of railways the full cost of a prohibitively high standard must be borne at the outset.

Road traffic in Malaya comprises all types of wheeled vehicles from the bullock-cart, bicycle and trishaws to large motor lorries. Table 63 shows the number and types of motor vehicles registered in 1961.

There is in addition a very large number of bicycles both in urban and rural areas. In the rural areas the bicycle is the universal carrier, carrying heavy and bulky loads along roads as well as cart-tracks and footpaths not normally accessible to motor vehicles. Bullock-carts are still in use in some localities, Malacca for example (Plate 48). In the urban centres motor-cycles, cars, buses, taxis and bicycles

TABLE 63. *Motor Vehicles Registered in Malaya, 1961*

	Number
Motor-cycles	60,000
Motor-cars	98,600
Buses	2,800
Taxis	4,400
Lorries and Vans	30,000
Road Rollers, Trailers, etc.	8,900
TOTAL	204,700

are the common means of transport. The number of motor vehicles has increased greatly in the larger towns such as Kuala Lumpur, Ipoh and Penang, creating problems of traffic congestion which are difficult to solve because of the narrow streets of these unplanned towns. Trishaws are also employed for passenger transport in urban areas.

Buses operate on all the major and most of the minor roads of Malaya. The importance of this form of transport is illustrated by the fact that on an average the buses travel over 100 million miles and carry over 250 million passengers a year. Lorries are usually employed for freight hauling, and in the transportation of less bulky goods have a distinct advantage over the railway in that goods are carried from door to door without the need for any transference. An increasingly large number of private cars are being used for personal transportation in town and country, and a traffic count on the main north–south trunk road established that two-thirds of all the motor vehicles counted were private cars, and less than one-third buses and lorries. Traffic densities were evenly distributed at 32–79 vehicles per hour in one direction, and 60–115 vehicles per hour in both directions. Densities of up to 2,000 vehicles per day were estimated to occur along the main Federal roads in 1953, and with the ending of the Emergency, as well as the increase in the numbers of motor vehicles, such densities are likely to be much higher today.

Air Transport. Air transport has become an accepted and important means of movement in the post-war world. The declaration of a State of Emergency in Malaya in 1948 had the effect of greatly increasing the number of people travelling by air between the main towns as neither road nor rail travel was very safe. Many small landing grounds were constructed throughout the Peninsula for use by military light aircraft and, with the ending of the Emergency, they have become useful to civil aviation.

There are three international airports in the Peninsula—Singapore, Kuala Lumpur the International Airport at Subang, and Penang. Singapore is the focal point of international air services operated by sixteen international airlines with connections to all the continents. Kuala Lumpur and Penang airports are used by a smaller number of international airlines maintaining scheduled flights to over 30 cities throughout the world. Internal air services are provided by the Malayan Airways (now Malaysian-Singapore Airways) which maintain regular passenger, mail and cargo services by Douglas DC3 and, recently, F27 aeroplanes between Singapore and Kuala Lumpur and all the other seven major airports in Malaya (Fig. 68). In addition the government-owned but Malayan Railway-managed Federation Air Service until 1961 provided links between Kuala Lumpur as well as the other air-ports and the smaller towns and important tin and rubber production areas. Passengers, mail, newspapers and parcels were carried by a fleet of five de Havilland Beaver aeroplanes which in 1957 flew 168,000 miles on scheduled services and an additional 60,000 miles on chartered flights. The range of operations of these light aircraft was considerable as they could land on all of the fifty-four landing places scattered throughout Malaya as well as the main airports. Although only nineteen landing grounds were in regular use, the others could be used on charter flights. The Federation Air Service thus provided a means of quick transport to many of the outlying and remote parts of the country.

Paya Lebar Airport in Singapore is fully equipped to handle its heavy international air traffic. It has a 9,000-foot runway, sufficiently long for the largest jet aircraft. The old Kuala Lumpur Airport has a runway of only 6,200 feet, and this, together with its obstructed approaches, made it unsuitable for the larger jet aircraft used for long-distance international flights. The new airport at Subang will

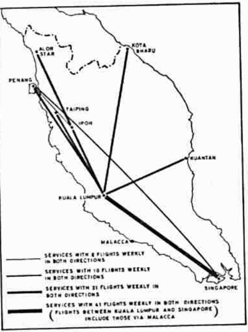


FIG. 68. Internal air services, Malaya and Singapore, 1958

meet the needs of all types of aircraft. Penang Airport has a runway of only 4,500 feet. All the eight airports in Malaya—Kuala Lumpur, Penang, Alor Star, Ipoh, Taiping and Malacca in western Malaya and Kuantan and Kota Bharu in the east—are fully equipped and maintained by the Department of Civil Aviation. Fig. 67 shows the distribution of the airports and main landing grounds. Taiping Airport ceased operations at the end of 1959.

The importance of Paya Lebar Airport in Singapore is attested by the large number of passengers and the weight of general cargo and mail handled (Table 64). Kuala Lumpur and Penang are the two busiest airports in Malaya. The number of aircraft landings and take-offs at these two airports has remained fairly constant over the past

TABLE 64. *Air Traffic at Singapore and Malayan Aerodromes, 1960*

AERODROME	Aircraft Landings and Take-offs	Number of Passengers	Cargo Handled (tons)	Mail Handled (tons)
Paya Lebar	6,233[1]	298,602	5,000	1,590
Kuala Lumpur	9,174	82,515	1,200	270
Penang	4,254	47,066	470	130
Ipoh	3,686	15,371	550	70
Malacca	2,120	5,155	10	10
Kuantan	780	2,206	30	10
Kota Bharu	854	12,093	250	40
Alor Star	418	2,034	10	nil
Other aerodromes	878	445	nil	nil

[1] Landings only.

decade, amounting to about 9,000 and 4,000 per annum, respectively. The relative importance of the other airports as terminals for internal air transport, however, has varied over the decade, the individual position of each airport being a reflection of its isolation in terms of other means of transportation as well as the security conditions of the country. Thus the numbers of air passengers at Kota Bharu and Kuantan, both on the east coast and separated from the rest of Malaya by hundreds of miles of terrorist-rife jungle, were 19,600 and 7,100 respectively at the height of the Emergency in 1952, but has since steadily decreased with the improvement in security conditions to 12,000 and 2,200 in 1960 (Table 64).

CHAPTER 15

PROBLEMS AND PROSPECTS

In less than two centuries Malaya has emerged from obscurity to occupy an outstanding place among the new nations of South-East Asia. For most of this period it was a colony, a small part of the British Empire. The revolutionary changes that have occurred in this country were by-products of colonialism: the development of an economy based on agriculture, mining and trade, and the transformation of a homogeneous society into a multi-racial one were the fruits of a policy which delegated to Malaya, as indeed to the other British colonies, a role as a source of raw materials and a market for British manufactured goods. In fulfilling this role, Malaya started with two natural advantages. Its western coastline adjoins the narrow Straits of Malacca, one of the great trade routes of the world along which pass the ships plying between Western Europe and the Far East. From the earliest times Malaya has been in a position to take advantage of the opportunities for trade afforded by this international highway crowded with traffic. Malacca, of historic fame, and, more recently, Penang, Singapore and Port Swettenham served as convenient refuelling stations and as points of entry and exit for goods and people.

The other natural advantage was in possessing some of the richest tin resources of the world in an easily accessible and easily mined form. The revenue derived from the development of these resources paved the way for the early establishment of modern land transport which in turn was one of the main factors contributing to the remarkable rise of the rubber industry. Tin was the magnet which drew in thousands of Chinese miners, just as much as rubber was later to draw in further thousands of Indian labourers. The material results of the development of the tin and rubber industries are striking. Physically, it led to the opening up of large expanses of once unproductive land. A country which less than a century ago had only about half a million acres under crops now has more than five and a half million cultivated acres, and a further half-million acres alienated for mining. In addition one-quarter of the total land area of the Peninsula is under productive and protective forest reserves. The attendant benefits of prosperity have permeated into all phases of life, in the forms of modern health and medical facilities, roads, railways, schools and universities, and social services. Equally striking was the parallel expansion of population following upon the influx of great numbers of immigrants from China, India and Indonesia.

In the early days of the colonial era the major problem was the comparatively straightforward one of locating the natural resources of the country, assessing their potentialities and developing them. Development was along *laissez faire* lines. The colonial government regulated many, and established some, of the economic and social institutions necessary for such development to take place. Likewise it brought stability to a land once racked by internal strife, and ensured that the returns of production were not seized upon by the exercise of arbitrary right. In an atmosphere which saw everyone preoccupied with making a living, and some with accumulating a fortune, it was not surprising that politics were relegated to the background. There was little friction among the different peoples not only because there was plenty of land and room for expansion, but also because they did not compete for the same jobs. This divergence of economic interests among the races also meant that their settlements were physically separate. The Malays and the immigrant Indonesians continued growing padi along river and coast. The other immigrants, on the other hand, were drawn to the towns, villages, tin-mines and estates along what later came to be known as the Tin and Rubber Belt of western Malaya, between the coast and the Main Range.

The present level of economic development was not attained without many mistakes and failures caused through lack of understanding of and adaptation to the environmental conditions of the Peninsula. Many thousands of acres of land were destroyed by the 'land-mining' techniques adopted by the early planters in their search for quick profits. The top-soil from further thousands of acres of rubber land was stripped off by erosion because the planters kept the estates clean-weeded in the manner of orchards in Europe. During the earlier and extremely destructive phase of tin-mining, whole countrysides were exposed to severe erosion because of the removal of the protective forest cover, while the natural regime of many of the rivers of west central Malaya was permanently disrupted through the uncontrolled discharge of mining effluent into the river beds.

The European as well as Asian pioneers were also confronted from the onset with the problem of health maintenance in a country rife with many deadly endemic and epidemic diseases. The hot, wet climate of Malaya is highly favourable to the development of a large number of diseases as well as of the vectors which transmit them. Vector-borne diseases are especially dangerous because the physical conditions are ideal for the year-round propagation of many of the vectors, notably insects. Perhaps the most deadly and certainly the most notorious of the disease-carrying insects is the anopheline mosquito which transmits malaria. Climatic conditions are continuously favourable to mosquito life, and malaria took a heavy toll of life before effective measures were discovered to control the disease. The extensive clearing of forested land for tin-mining, rubber cultivation, fuel, for the construction of roads and railways and other forms of land-use inevitably disturbed the ecological balance of nature, and where such clearing took place on hilly and undulating land drained by swift-flowing streams, led to the rapid multiplication of *Anopheles maculatus*. Since the most suitable locations for rubber are the free-draining foothills of western Malaya, the rubber estates suffered heavily from malaria transmitted by *A. maculatus*, with mortality rates reaching 63 per thousand in 1911. But over the years malaria and the other major tropical diseases such as cholera were brought under control, and today the developed parts of Malaya are among the healthiest areas in the tropical world. But constant vigilance by the health authorities is needed to keep this record, for the breakdown of health and medical services during the latter days of the Japanese occupation has shown how easily and quickly malaria, cholera, smallpox, yaws and other endemic and epidemic diseases can sweep across the country once health measures are relaxed.

When the new Malayan Government achieved independence for the country in 1957, it inherited a land rich by the standards normally applied to tropical areas. The real income per capita in Malaya is one of the highest in all of Asia. But there is extreme inequality in the distribution of incomes, and a large proportion of the population have real incomes and standards of living which are low compared with the national average. In common with other countries of the tropical world Malaya's peasantry, engaged in the rural pursuits of small-scale agriculture, fishing and some stock-rearing, occupy the lowest rungs in the income ladder. There are altogether some 800,000 such peasants, and together with their dependents, they constitute about three-fifths of the total population. Roughly three-quarters of them are Malays, and most of the rest Chinese.

Many factors are responsible for the poverty of these peasants. One of the most important is the difficult physical environment of the Peninsula. The climate with its constantly high temperature and humidity, and especially its monotony, is a handicap to the efficient working of farmers and fishermen engaged mainly in outdoor manual work. They are also regularly exposed to disease-carrying mosquitoes, mites, flies and other insects, and the nature of the occupations is such that they are often in contact with infected soil. Living as they do, on an inadequate and badly balanced diet, in insanitary surroundings and without proper medical facilities, it is not surprising that they find it difficult if not impossible to maintain a high level of health and efficiency. Their output consequently is low. The great number and variety of insects and other pests which flourish in the hot and humid climate also contribute directly to the low output by attacking the farmers' crops. Moreover, as noted earlier, the soils of the Peninsula are, with few exceptions, infertile and easily eroded, and require regular fertilization to support good crops. Few of the farmers use fertilizers, mainly because they are too poor to be able to afford them, but also because many of them are not convinced of their value. This vicious circle of low output and low incomes is difficult to break.

But the low living standards of the peasants are also caused by other non-physical factors. Widespread rural indebtedness, poor marketing and transport facilities in the rural districts, excessive price fluctuations, agricultural holdings which are too small for their labour capacity and made smaller year by year through increasing pressure of population on the land, through land laws and customs which lead to the repeated subdivision and fragmentation of land, and insecurity of land tenure, among others, are also directly or indirectly responsible. About half of the total peasant population, most of them Malays, grow padi as the main crop. Except in abnormally bad times such as experienced during the Japanese occupation, padi grown in the small holdings brings in a very low income. The high cloudiness, the lack of variations in the length of day, the high temperature and humidity of the Peninsula are all unfavourable to optimum yields from a plant which grows best under sub-tropical and warm temperate conditions. But due to tradition, conservatism and lack of official encouragement to change their crops, the farmers continue to put their land under padi.

Coupled with these are the less tangible, but no less important, questions of the prevailing social and religious attitudes towards economic matters. Peasants who do not regard their economic status in life with much concern, and who place custom and religion above better food, or housing or health, would understandingly find it difficult to change their outlook overnight, even assuming that they do want to change it. This is markedly true of the indigenous Malays who seem to lack the stimulus for greater profits and a larger income which drives the Europeans and the immigrant Chinese and Indians to subjugate leisure to work. The rigidity of the inherited social system of the Malays has also narrowly limited the opportunities for individual advancement. Most economists writing on the problems of developing the underdeveloped countries conceive of the internal impetus to economic development as coming through an increase in the consumptive wants of the people, which will in turn generate the incentive to earn more money in order to be able to satisfy these wants. Such a move implies the acceptance of the Western principle of insatiability, with economic and material considerations instead of social and cultural factors occupying the foremost place in the scale of values. To bring about an adoption of such values, assuming again that it is desirable to do so, is more an educational and sociological problem than an economic one, although it has undoubted economic implications.[1]

Progress in the battle against poverty in the rural areas of Malaya will depend to a great extent on the effectiveness of the Federal Land Development Authority (FLDA) and of the Rural and Industrial Development Authority (RIDA) which was started in 1950 with the primary objective of promoting economic betterment in the rural districts. Both the FLDA and RIDA represent a concrete attempt by the Federal Government to play a more decisive role in a hitherto neglected sector of the national economy. It is a step forward from the haphazard *laissez-faire* attitude, characteristic of a colonial economy, towards the direction whereby future growth in the rural areas is shaped and guided to some degree by conscious planning.[2]

There is a real danger that the rate of growth in the rural as well

[1] These and other problems of economic development are discussed in greater detail in the author's monograph on 'Rural development in tropical areas, with special reference to Malaya', *J. Trop. Geogr.*, **12**, 1959.

[2] The functions of RIDA have now been taken over by a new body—the Majlis Amanah Ra'ayat (MARA).

as the other sectors of the national economy may be too slow in relation to the rate of population increase to make for a net increase in the overall standards of living. The rate of natural increase of the population in Malaya is between 3·3 and 3·5 per cent per annum. If unchecked, such a rate of growth would result in the doubling of the population in 25 years. Such a rate of growth would also mean that between 8 and 10 per cent of the national income would have to be saved and invested each year to prevent a decline in the income per person, that is, simply to maintain the existing level of living. On the surface the solution to this problem appears to be a fairly straightforward one: measures must be taken to control the rate of population increase and to foster the expansion of the country's economy.

It is safe to assume that large-scale immigration will no longer be a factor of importance in the future growth of the population, and that such growth will depend on the excess of births over deaths. Death rates are likely to fall still further with the spread of modern medical science to cover all sections of the population, but little has been done to reduce the high birth rates among each of the main racial groups. The question of birth control, a complex one in any society, is even more complex in Malaya where the peoples differ so widely in their history, culture, language, religion and education. In general most of the population are by nature conservative in outlook, and traditional family practices, especially among the Chinese, tend towards large families. There is as yet no organized family planning in Malaya. It is likely that such a move would meet with resistance from a large section of the population.

It is necessary to find ways and means of encouraging the development of the Malayan economy to keep pace with the rate of population increase. At the same time it is vital to ensure that economic expansion be channelled along lines that will reduce the country's extreme vulnerability to world market fluctuations. Although Malaya was the most successful colony in South-East Asia from the economic point of view, its success has been achieved at the expense of a lack of balance in the economy. Like most other colonial countries, Malaya had a set function—to produce only those goods which gave the best returns, namely, rubber and tin. Most of its needs have had to be imported. The result was an inflexible economic structure, ill-equipped to withstand the strains caused by changes of up to

30 per cent in the national income in a single year.[1] In the past the risks of social and political unrest during periods of economic depression were minimized because the labour force was flexible and the unemployed could be repatriated to India or China as the case may be. This safety valve no longer exists, and the only way to counter the potential threat to the stability of the country arising from its over-dependence on rubber and tin is to diversify the economy.

Diversification in the Malayan context can be along two parallel lines: the first is to expand the established industries so as to reduce the relative, though not necessarily the absolute, contributions of rubber and tin to the national income. At the same time diversification can take the form of the introduction of new industries, primary or secondary or both, into the present pattern of industries. In this connection the post-war development of secondary industries is a step in the right direction. Whether the Government should create a still more favourable climate for the further development of secondary industries by deliberately manipulating the conditions of growth (as for example, by the imposition of protective tariff walls against certain commodities) is a matter for debate. But there is no doubt about the desirability of expanding this sector of the economy.

The dominance of tin in the mining economy has diminished slightly because of the growing importance of iron-ore mining and, to a lesser extent, of bauxite mining. But these gains have been somewhat nullified by the recent closure of the only coal and gold mines in Malaya. There is little anyone can do to diversify this sector of the national economy because the pattern of development of the mining industries depends entirely on the nature and types of minerals in the country. Available evidence indicates that tin will continue to be the major mineral ore produced in Malaya in the foreseeable future.

The best prospects for diversification lies in agriculture. The present unbalanced structure of agriculture can gradually be altered by a policy aimed at encouraging the development of crops other than rubber. Of these, coconut and oil-palm offer good possibilities. Not only are they established crops familiar to planters in Malaya, but the world market for vegetable oils is a promising one. The introduction of new crops into the agricultural scene presents many problems. In the first instance the crops must be suitable for cultivation in an equatorial environment, that is, they must be capable of giving sustained yields over a period of time without straining the

[1] See F. C. BENHAM, *The National Income of Malaya, 1947–49* (Singapore, 1951).

fertility of the soil. In the Malay Peninsula where the climax vegetation is composed of trees, perennials such as trees and shrubs will be ecologically more suitable for cultivation than annuals. Unlike the shallow-rooted annuals which require continuous cropping and rapidly deplete the soil fertility, perennials remain on the land for several years so that the soil is little disturbed. Their foliage, augmented by cover crops, shades and protects the soil from the direct effects of solar radiation and from being eroded by the heavy rains. Moreover most perennials yield regular and frequent crops, an important feature if they are to be taken up on a wide scale for peasant cultivation as this means that the farmers will have income at regular intervals and are less liable to be forced into debt to meet their daily needs.

However, planters taking up the cultivation of any new crops will have to face competition from other tropical areas growing the same crops. Such areas might have advantages derived from an early start and established markets, from some peculiarly favourable physical factor of soil or climate, or from proximity to markets. Most of the known tropical crops are already grown on an extensive scale in one tropical country or another, and any attempt to compete with an established rival territory implies a capacity to produce the same crop cheaper or better, provided that the market for the crop is not already saturated.

About three-quarters of the land area of Malaya is still under forest. It would therefore appear that there is more than sufficient land for agricultural development and to provide for the needs of the agricultural population. But it must be remembered that over half of Malaya is mountainous and unsuitable for agriculture because of the risks of erosion. A further 10 per cent of the land area is covered by freshwater swamps which are difficult and expensive to clear. Peaty swamp soils are capable of supporting only a limited range of crops—padi where the peat is not too deep, otherwise only pineapple and shallow-rooted vegetables. Even assuming that all of the remaining 10 per cent of the land area (or about 5,000 square miles) is suitable for agriculture, this is by no means a large reserve. Silcock estimates that about 350 square miles of new land must be opened up each year to meet the demand for land by the growing agricultural population and to keep up living standards.[1] The land reserve will only last some fifteen years or so if new land is developed at this rate.

[1] T. H. SILCOCK, 'Economic potential of Malaya', in *Readings in Malayan Economics*, ed. by T. H. Silcock (Singapore, 1961), 97–98.

At the moment there is land shortage in some parts of Malaya, as seen in rising land values, in the underemployment of the agricultural population, and in the excessively small size of many of the farms. In the past new land was not released for agriculture at anywhere near the rate necessary to keep pace with the growth of the agricultural population because of the administrative inadequacies in the Land Offices and also because of the unduly conservative approach to land matters shown by some of the State Governments. This bottleneck still remains, for when the Federation attained its independence, land matters and land policy remained in the hands of the State Governments. The Federal Land Development Authority, however, is providing some measure of relief to the land shortage by initiating a number of land development projects for peasant farmers in various parts of the country. Land is the key not only to economic development and the raising of living standards, but also to social and political stability in a country where such a large section of the population is dependent directly on the land for its livelihood.

The complex social and political problems arising from the multiracial character of the population are as much a legacy of the colonial past as is the lop-sided nature of the economy. Communalism is a disrupting force in any society. It was communalism which sparked off the Hindu–Muslim conflict and led to the separation of Pakistan from India, and which now threatens to split Ceylon. Malaya faces a similar danger because of the diversity of its peoples, the weakness of nationalism as a unifying force and, above all, because of the strength of ancient loyalties among the Malays, the Chinese and the Indians. Under these circumstances great care must be taken to see that no one sectional or group interest is allowed to override national interest, as can easily happen.

The racial question has become still more complicated because the merger of Malaya, Sabah and Sarawak to form the Federation of Malaysia has added a fourth important group of people—the Borneo tribesmen such as the Dayaks, Muruts, Kelabits, Dusuns and others—to the Malay–Chinese–Indian pattern of society. The integration of these polyglot peoples into a multi-racial nation is a task of great immensity, and calls for the highest level of economic, social and political planning.

SELECT BIBLIOGRAPHY

Bibliographical Note. The following list of 400 titles includes most of the references consulted by me. It is by no means an exhaustive compilation, and the specialist will find many gaps and omissions. For those who wish to delve deeper into the subject of Malaya there are two bibliographies, one by K. J. Pelzer (*Selected Bibliography on the Geography of Southeast Asia. Part III. Malaya*. Southeast Asia Studies, Yale University, by arrangement with Human Relations Area Files, Inc., New Haven, 1956), and the other, a more recent compilation by H. R. Cheeseman (*Bibliography of Malaya*, published for the British Association of Malaya by Longmans, Green and Co., London, 1959).

CHAPTER 1

GEOLOGICAL EVOLUTION, RELIEF AND DRAINAGE

AGOCS, W.B. and PATON, J.R., *Airborne Magnetometer and Scintillation Counter Survey over Parts of Kedah and Perlis* (Ipoh, 1958).

ALEXANDER, F.E.S., 'Observations on tropical weathering: a study of the movement of iron, aluminium and silicon in weathering rocks at Singapore', *Quart. J. geol. Soc. Lond.* (Dec. 1959), 123–144.

ALEXANDER, J.B., 'Pre-Tertiary stratigraphic succession in Malaya', *Nature* (*Lond.*) (1959), 230–231.

DOBBY, E.H.G., *Southeast Asia* (London, 1950).

FITCH, F.H., 'Evidence for recent emergence of the land in East Pahang', *J. roy. Asiat. Soc., Malay. Br.* (Mar., 1949), 115–122.

FITCH, F.H., *The Geology and Mineral Resources of the Neighbourhood of Kuantan, Pahang* (Kuala Lumpur, 1952).

HO, R., 'Malayan limestone scenery', *Bull. sci. Soc. Malay.* (Sept., 1956), 40–41.

HUTCHINSON, C.S., 'The basement rocks of Malaya and their paleogeographic significance in Southeast Asia', *Amer. J. Sci.* (Mar., 1961), 181–185.

INGHAM, F.T., *The Geology of the Neighbourhood of Tapah and Telok Anson, Perak, Federated Malay States, with an Account of the Mineral Deposits* (Singapore, 1938).

INGHAM, F.T. and BRADFORD, E.F., *Geology and Mineral Resources of the Kinta Valley, Perak* (Kuala Lumpur, 1960).

NOSSIN, J.J., 'Relief and coastal development in north-eastern Johore (Malaya)', *J. trop. Geogr.* **15** (1961), 27–38.

PATON, J.R., 'Jurassic/Cretaceous sediments in Malaya', *Nature (Lond.)* (1959), 231.

RICHARDSON, J.A., *The Geology and Mineral Resources of the Neighbourhood of Raub, Pahang, Federated Malay States, with an Account of the Geology of the Raub Australian Gold Mine* (Singapore, 1938).

RICHARDSON, J.A., 'An outline of the geomorphological evolution of British Malaya', *Geol. Mag.* (May–June, 1947), 129–144.

RICHARDSON, J.A., *The Geology and Mineral Resources of the Neighbourhood of Chegar, Perah and Merapoh, Pahang* (Kuala Lumpur, 1950).

ROBINSON, A.G., 'The training of alluvial rivers', *Malay. Forester*, **10** (1941), 42–48.

ROE, F.W., *The Geology and Mineral Resources of the Fraser's Hill area, Selangor, Perak and Pahang, Federation of Malaya, with an Account of the Mineral Resources* (Kuala Lumpur, 1951).

ROE, F.W., *The Geology and Mineral Resources of the Neighbourhood of Kuala Selangor, and Rasa, Selangor, Federation of Malaya, with an Account of the Geology of Batu Arang Coal-Field* (Kuala Lumpur, 1953).

SAVAGE, H.E.F., *The Geology of the Neighbourhood of Sungei Siput, Perak, Federated Malay States, with an Account of the Mineral Deposits* (Singapore, 1937).

SCRIVENOR, J.B., 'The physical geography of the southern part of the Malay Peninsula', *Geogr. Rev.* **11** (1921), 351–371.

SCRIVENOR, J.B., 'The structural geology of British Malaya', *J. Geol.* **31** (1923), 556–570.

SCRIVENOR, J.B., *The Geology of Malaya* (London, 1931).

SCRIVENOR, J.B., 'Geological and geographical evidence for changes in sea-level during ancient Malay history and late pre-history', *J. roy. Asiat. Soc. Malay. Br.* (Mar., 1949), 107–115.

SCRIVENOR, J.B. and JONES, W.R., *The Geology of South Perak, North Selangor and the Dindings* (Kuala Lumpur, 1919).

VAN BEMMELEN, R.W., *The Geology of Indonesia. Vol. Ia. General Geology of Indonesia and Adjacent Archipelagoes* (The Hague, 1949).

VAN BEMMELEN, R.W., *Mountain Building* (The Hague, 1954).

WALKER, D., 'Studies in the Quaternary of the Malay Peninsula. I. Alluvial deposits of Perak and the relative levels of land and sea', *Fed. Mus. J.* **I** and **II** (1954–55), 19–34.

WILLBOURN, E.S., *An Account of the Geology and Mining Industries of South Selangor and Negri Sembilan* (Calcutta, 1922).

WILLBOURN, E.S., 'The Geology and Mining Industries of Kedah and Perlis', *J. roy. Asiat. Soc., Malay. Br.* (Dec., 1926), 289–332.

CHAPTER 2

CLIMATE

DALE, W.L., 'Wind and drift currents in the South China Sea', *Malay. J. trop. Geogr.* **8** (1956), 1–31.

DALE, W.L., 'The rainfall of Malaya, Part I', *J. trop. Geogr.* **13** (1959), 23–37.

DALE, W.L., 'The rainfall of Malaya, Part II', *J. trop. Geogr.* **14** (1960), 11–28.

FROST, R., 'Cumulus and cumulonimbus clouds over Malaya', *Met. Rep.* **15** (H.M.S.O., 1954).

JOHN, I.G., 'The properties of the upper air over Singapore', *Mem. Malay. Met. Ser.* **4** (Singapore, 1950).

MALAYAN METEOROLOGICAL SERVICE, *Climatological Summaries, Part I. Wind* (Singapore, n.d., mimeo).

MALAYAN METEOROLOGICAL SERVICE, *Climatological Summaries, Part II. Rainfall* (Singapore, n.d. mimeo).

MALAYAN METEOROLOGICAL SERVICE, *Climatological Summaries, Part III. Temperature, Humidity and Pressure* (Singapore, n.d., mimeo).

WATTS, I.E.M., 'Line-squalls of Malaya', *Malay. J. trop. Geogr.* **3** (1954), 1–14.

WATTS, I.E.M., 'The rainfall of Singapore Island', *Malay. J. trop. Geogr.* **7** (1956).

WATTS, I.E.M., *Equatorial Weather* (London, 1955).

CHAPTER 3

VEGETATION

CARTER, J., 'Mangrove succession and coastal change in south-west Malaya', *Trans. Inst. Brit. Geogr.* (1959), 79–88.

CORNER, E.J.H., *Wayside Trees of Malaya* (Singapore, 1953).

COUSENS, J.E., 'Some notes on the composition of lowland tropical rainforest in Rengam Forest Reserve, Johore', *Malay. Forester*, **14** (1951), 131–139.

COUSENS, J.E., 'A study of 155 acres of tropical rainforest by complete enumeration of all large trees', *Malay. Forester*, **21** (1958), 155–164.

CUBITT, G.E.S., *Forestry in Malaya* (London, 1926).

DURANT, C.L., 'A note on the coastal forests of Kelantan', *Malay. Forester*, **8** (1939), 50–52.

DURGNAT, P.A., 'Swamp forests in Lower Perak', *Malay. Forester*, **15** (1952), 127–131.

FOXWORTHY, F.W., 'Malayan forests, their composition and value', *Proc. Br. Emp. For. Conf.* (1926), 99–116.

FOXWORTHY, F.W., 'Commercial timber trees of the Malay Peninsula', *Malay. For. Rec.* **3** (Singapore, 1927).

FOXWORTHY, F.W., 'Dipterocarpaceae of the Malay Peninsula', *Malay. For. Rec.* **10** (Singapore, 1932).

GARFITT, J.E., 'Malayan forest types', *Malay. Forester*, **10** (1941), 136–140.

HAMILTON, A.W. and HOLTTUM, R.E., 'Malayan plants', *J. roy. Asiat. Soc., Malay. Br.* **8**, pt. 2 (1930), 318–329.

HENDERSON, M.R., 'The flora of the limestone hills of the Malay Peninsula', *J. roy. Asiat. Soc., Malay. Br.* **17**, pt. 1 (1939), 13–87.

HOLTTUM, R.E., *Plant life in Malaya* (London, 1954).

HOLTTUM, R.E., 'Adinandra Belukar: a succession of vegetation from bare ground on Singapore Island', *Malay. J. trop. Geogr.* 3 (1954), 27–32.

LANDON, F.H., 'Malayan tropical rainforest', *Malay. Forester,* **18** (1955), 30–38.

SYMINGTON, C.F., 'The study of secondary growth on rainforest sites in Malaya', *Malay. Forester,* **2** (1933), 107–117.

WALTON, A.B., *et al.*, 'The silviculture of lowland dipterocarp forest in Malaya', *Malay. Forester,* **15** (1952), 181–197.

WATSON, J.G., 'Mangrove forests of the Malay Peninsula', *Malay. For. Rec.,* **6** (Singapore, 1928).

WATSON, J.G., 'The regeneration of tropical rainforest', *Malay. Forester,* **5** (1936), 20–23.

WYATT-SMITH, J., 'Natural plant succession', *Malay. Forester,* **12** (1949), 148–152.

WYATT-SMITH, J., 'Malayan forest types', *Malay. Nat. J.,* **7** (1952), 45–55; 91–98 and **8** (1953), 52–58.

WYATT-SMITH, J., 'Forest types in the Federation of Malaya', *Malay. Forester,* **17** (1954), 83–84.

CHAPTER 4

SOILS

BELGRAVE, W.N.C., 'Considerations on a soil survey on Malaya', *Malay. agric. J.* **17** (1929), 175–178.

CORBET, A.S., *Biological Processes in Tropical Soils, with special reference to Malaysia* (Cambridge, 1935).

COULTER, J.K., 'Organic matter in Malayan soils', *Malay. Forester,* **13** (1950), 189–202.

COULTER, J.K., 'Peat formations in Malaya', *Malay. agric. J.,* **33** (1950), 63–81.

DENNETT, J.H., 'Preliminary results of a soil survey of Selangor', *Malay. agric. J.* **17** (1929), 179–191.

DENNET, J.H., 'The soils of Cameron Highlands', *Malay. agric. J.* **18** (1930), 20–29.

DENNETT, J.H., 'The western coastal alluvial soils', *Malay. agric. J.* **20** (1932), 298–303.

DENNETT, J.H. and BELGRAVE, W.N.C., 'Studies in Malayan soils', *Malay. agric. J.* **21** (1933), 345–361.

DURANT, C.L., 'Erosion', *Malay. Forester*, **5** (1936), 109–111.

EATON, B.J., 'Soils, with reference to the cultivation of perennial crops in Malaya', *Planter*, **7** (1927), 275–277.

HARTLEY, C.W.S., 'Soil erosion in Malaya', *Corona*, **10** (1949), 25–27.

OWEN, G., 'A provisional classification of Malayan soils', *J. Soil Sci.* **2** (1951), 20–42.

OWEN, G., 'Determination of available nutrients in Malayan soils', *J. Rubb. Res. Inst. Malaya*, **14** (1953), 109–120.

PANTON, W.P., *Reconnaissance Soil Survey of Trengganu* (Dept. of Agriculture, Kuala Lumpur, 1958).

SCRIVENOR, J.B., 'Laterite', *Malay. agric. J.* **17** (1929), 454–459.

TEMPANY, H., 'Studies in Malayan soils', *Malay. agric. J.* **21** (1933), 471–491.

WILLIMOTT, S.G. and BUCKLEY, T.A., *The Soils of Malaya: their Classification and Properties* (mimeo. Kuala Lumpur, 1948).

CHAPTERS 5, 6, 7

POPULATION

ADAMS, T., 'The Malays in Malaya', *Asian Rev.* **40** (1944), 98–100.

'Aspects of urbanization in E.C.A.F.E. countries', *Econ. Bull. Asia and F. E.* **4** (1953), 1–15.

BLYTHE, W.L., 'Historical sketch of Chinese labour in Malaya', *J. roy. Asiat. Soc., Malay. Br.* (June, 1947), 64–114.

BOZMAN, G.S., 'Some problems of Indian emigration', *Asian Horizons*, **1** (1948), 13–25.

CHAPMAN, F.S., 'The Chinese in British Malaya', *Geogr. Mag.* **23** (1951), 401–411.

CHEN, L.M., 'The Chinese in British Malaya', *China Quart.* **3** (1938), 245–254.

COOPER, E., 'Urbanization in Malaya', *Population Studies*, **5** (1951), 117–131.

CORRY, W.C.S., *A General Survey of New Villages* (Kuala Lumpur, 1954).

DEL TUFO, M.V., *Malaya, comprising the Federation of Malaya and the Colony of Singapore. A Report on the 1947 Census of Population* (London, 1949).

DOBBY, E.H.G., 'Settlement and land utilization, Malacca', *Geogr. J.* **94** (1939), 466–478.

DOBBY, E.H.G., 'Settlement patterns in Malaya', *Geogr. Rev.* **32** (1942), 211–232.

DOBBY, E.H.G., 'Resettlement transforms Malaya', *Econ. Dev. and Cult. Change*, **1** (1952), 163–189.

DOBBY, E.H.G., 'Recent settlement changes in south Malaya', *Malay. J. trop. Geogr.* **1** (1953), 1–8.

EMERSON, R., 'The Chinese in Malaysia', *Pacific Affairs*, **7** (1934), 260–270.

FIRTH, R., 'The coastal people of Kelantan and Trengganu, Malaya', *Geogr. J.* **101** (1943), 193–205.

GINSBURG, N., 'The great city in Southeast Asia', *Amer. J. Sociol.* (Mar., 1955), 455–462.

GINSBURG, N. and ROBERTS, C.F., *Malaya* (Chicago, 1955).

GULLICK, J.M., 'The Negri Sembilan economy of the 1890s', *J. roy. Asiat. Soc., Malay. Br.* **24**, pt. 1 (1951), 38–55.

JACKSON, R.N., *Immigrant Labour and the Development of Malaya, 1786–1920* (Kuala Lumpur, 1961).

KANWAR, H.I.S., 'Indians in Malaya', *Eastern World*, **6** (1952), 14–16; and **7** (1953), 19.

KING, J.K., 'Malaya's resettlement problem', *Far east. Survey*, **23** (1954), 33–40.

KONDAPI, C., *Indians Overseas, 1838–1949* (New Delhi, 1951).

MA, R. and YOU POH SENG, 'The economic characteristics of the population of the Federation of Malaya, 1957', *Malay. econ. J.* **5** (1960), 10–45.

MACGOWAN, D.J., 'Notes on maritime Malays', *J. Indian Archipelago and east. Asia*, **4** (1850), 687–691.

MARRIOTT, H., 'Population of the Straits Settlements and Malay Peninsula during the last century', *J. roy. Asiat. Soc., Straits Br.* (Dec., 1912), 31–42.

MIDDLEBROOK, S.M., 'Pulai: an early Chinese settlement in Kelantan', *J. roy. Asiat. Soc., Malay. Br.* **11** (1933), 151–156.

MORRISON, I., 'Aspects of the racial problem in Malaya', *Pacific Affairs*, **23** (1949), 239–253.

NATHAN, J.E., *Census of British Malaya, 1921* (London, 1922).

NEWBOLD, T.J., *Political and Statistical Account of the British Settlements in the Straits of Malacca* (London, 1839), 2 vols.

NOONE, R.O.D., 'Notes on the kampong, compounds and houses of the Patani Malay village of Banggul Ara, in the Mukim of Batu Kuran, Northern Perak', *J. roy. Asiat. Soc., Malay. Br.* **21,** pt. 1 (1948), 124–147.

'Notes on the Chinese in Penang', *J. Indian Archipelago and east. Asia*, **8** (1854), 1–27.

OFFICE OF ECONOMIC ADVISOR TO THE GOVERNMENT OF INDIA, *Indians in the Malayan Economy* (New Delhi, 1950).

OOI JIN-BEE, 'The distribution of present-day man in the tropics: historical and ecological perspective', *Proc. 9th Pacific Sci. Congr. 1957*, **20** (Bangkok, 1958), 111–124.

PARMER, J.N., *Colonial Labour Policy and Administration* (New York, 1960).

PELZER, K.J., 'Resettlement in Malaya', *Yale Rev.* **41** (1952), 391–404.

1957 Population Census of the Federation of Malaya, Report Nos. 1–12 (Kuala Lumpur, 1958–1959).

POUNTNEY, A.M., *The Census of the Federated Malay States, 1911* (London, 1911).

PURCELL, V., 'Chinese settlement in Malacca', *J. roy. Asiat. Soc. Malay. Br.* (June, 1947), 115–125.

PURCELL, V., *The Chinese in Malaya* (London, 1948).

PURCELL, V., *The Chinese in Southeast Asia* (London, 1951).

PURCELL, V., 'The position of the Chinese community in Malaya', *J. roy. cent. Asian Soc.* **140** (1953), 70–81.

RAJARATNAM, S., 'Changing Malay people', *Asia*, **42** (1942), 449–453.

RAMSAY, A.B., 'Indonesians in Malaya', *J. roy. Asiat. Soc., Malay. Br.* (May, 1956), 119–124.

Resettlement and the Development of New Villages in Malaya, 1952 (Kuala Lumpur, 1954).

ROBERTS, G., 'East to the Indies', *Geogr. Mag.* **18** (1946), 347–358.

ROBERTS, G., 'South to the Indies', *Geogr. Mag.* **18** (1946), 393–402.

ROBERTS, G., 'From Europe to the Spice Islands', *Geogr. Mag.* **18** (1946), 473–482.

ROBERTS, G., 'Making Malaya a nation', *Geogr. Mag.* **19** (1946), 141–150.

SANDHU, K.S., 'Chinese colonization of Malacca', *J. trop. Geogr.* **15** (1961), 1–26.

SKINNER, G.W., *Report on the Chinese in Southeast Asia* (Cornell University, 1951).

SMITH, T.E., *Population Growth in Malaya* (London, 1952).

SMITH, T.E., *The 1957 Census, a Preliminary Report* (Kuala Lumpur, 1957).

TA CHEN, *Emigrant Communities in South China* (New York, 1940).

TAN, T.H., 'The Chinese in Malaya', *Eastern World*, **7** (1953), 13–16.

UNGER, L., 'The Chinese in Southeast Asia', *Geogr. Rev.* **34** (1944), 175–195.

VLIELAND, C.A., *British Malaya. A Report on the 1931 Census and Certain Problems of Vital Statistics* (London, 1932).

VLIELAND, C.A., 'The population of the Malay Peninsula: a study in human migration', *Geogr. Rev.* **24** (1934), 61–78.

WHEELER, L.R., *The Modern Malay* (London, 1928).

WINSTEDT, Sir RICHARD, 'The elements of Malayan civilization', *Asian Rev.* **57** (1941), 349–353.

WINSTEDT, Sir RICHARD, 'Malayan background', *Geogr. Mag.* **14** (1941–1942), 105–121.

WINSTEDT, Sir RICHARD, *The Malays, a Cultural History* (London, 1950).

CHAPTER 8

THE PRIMITIVE ECONOMIES OF THE ABORIGINAL GROUPS

ARNOT, D.B. and SMITH, J.S., 'Shifting cultivation in Brunei and Trengganu', *Malay. Forester*, **6** (1937), 13–17.

COLE, R., 'Temiar Senoi agriculture, pts. 1 & 2', *Malay. Forester*, **22** (1959), 191–207, and **22** (1959), 260–271.

EVANS, I.H.N., *The Negritoes of Malaya* (Cambridge, 1937).

SKEAT, W.W. and BLAGDEN, C.O., *Pagan Races of the Malay Peninsula* (London, 1906), 2 vols.

STRONG, T.A., 'The Sakai and shifting cultivation', *Malay. Forester*, **1** (1931–32), 243–246.

WILLIAMS-HUNT, P.D.R., *An Introduction to the Malayan Aborigines* (Kuala Lumpur, 1952).

WYATT-SMITH, J., 'Shifting cultivation in Malaya', *Malay. Forester*, **21** (1958), 139–152.

CHAPTER 9

THE AGRICULTURAL ECONOMY

BURKILL, I.H., *A Dictionary of the Economic Products of the Malay Peninsula* (London, 1935), 2 vols.

DOBBY, E.H.G., *Agricultural Questions of Malaya* (Cambridge, 1949).

DOBBY, E.H.G., 'The development of Malaya's uplands', in *The Development of Upland Areas in the Far East*, **2** (New York, 1951), 1–21.

FEDERATION OF MALAYA, *Rep. Dep. Agric., 1958* (Kuala Lumpur, 1959).

FEDERATION OF MALAYA, *Rep. Dep. Agric., 1959* (Kuala Lumpur, 1961).

FIRTH, R., 'The peasantry of Southeast Asia', *International Affairs*, **26** (1950), 503–514.

GRIST, D.H., *An Outline of Malayan Agriculture* (2nd ed. London, 1950).

HAYNES, A.S., *Agricultural Research Work and Problems in Malaya* (Kuala Lumpur, 1927).

JACOBY, E.H., *Agrarian Unrest in Southeast Asia* (2nd ed., London, 1961).

KING, A.W., 'Plantation and agriculture in Malaya, with notes on the trade of Singapore', *Geogr. J.* **93** (1939), 136–148.

LADEJINSKY, W.L., 'Agriculture in British Malaya', *Foreign Agric.* **5** (1941), 103–125.

MACANDREW, W.R., *The Growing of Possible Economic Crops in British Malaya* (Ipoh, 1932).

OOI JIN-BEE, 'Rural Development in Tropical Areas, with Special Reference to Malaya', *J. trop. Geogr.* **12** (1959).

PIM, Sir ALAN, *Colonial Agricultural Production* (Oxford, 1946).

SOPER, J.R.P., 'Government and the small-holder', *Malay. agric. J.* **31** (1948), 214–218.

TEMPANY, H.A. and MANN, G.E., *Principles of Tropical Agriculture* (Kuala Lumpur, 1930).

WEST, H.W., 'Current economic production in the Malay Peninsula', *J. Manchester geogr. Soc.* **55** (1952), 91–107.

WIKKRAMATILEKE, R., 'Trends in settlement and economic development in eastern Malaya' *Pacific Viewpoint*, **3** (1962), 27–50.

WILSON, T.B., *Census of Agriculture, Federation of Malaya, 1960. Preliminary Report No. 1* (Kuala Lumpur, 1960).

WILSON, T.B., *Census of Agriculture, Federation of Malaya, 1960. Preliminary Report No. 2* (Kuala Lumpur, 1960).

WILSON, T.B., *Census of Agriculture, Federation of Malaya, 1960. Preliminary Report No. 3* (Kuala Lumpur, 1961).

RUBBER

'Achieving an optimum stand', *R.R.I. Plant. Bull.*, **34** (1958), 5–10.

AKERS, R.L., 'Drainage of low coastal areas', *R.R.I. Plant. Bull.*, **27** (1956), 101–104.

ALLEN, G.C. and DONNITHORNE, A.G., *Western Enterprise in Indonesia and Malaya* (London, 1957).

BAPTIST, E.D.C., 'Recent progress in Malaya in the breeding and selection of clones of *Hevea Brasiliensis*', *Report of the 13th International Horticultural Congress*, Vol. 2 (Kent, 1953), 1100–1121.

BAUER, P.T., 'The economics of planting density in rubber growing', *Economica*, **14** (1946), 131–135.

BAUER, P.T., 'The working of rubber regulation', *Econ. J.* **56** (1946), 391–414.

BAUER, P.T., 'Malayan rubber policies', *Economica*, **14** (1947), 81–107.

BAUER, P.T., *Report on a visit to the Rubber Growing Smallholdings of Malaya* (London, 1948).

BAUER, P.T. *The Rubber Industry: a Study in Competition and Monopoly* (Cambridge, 1948).

BENHAM, F., 'The rubber industry', *Economica*, **16** (1949), 355–368.

'Buddings and clonal seedlings', *R.R.I. Plant. Bull.*, **36** (1958), 51–59.

COOK, J., 'Further notes on the marketing of smallholding latex', *Malay. agric. J.* **36** (1953), 181–189.

'Cover plants', *R.R.I. Plant. Bull.*, **37** (1958), 90–93.

CRAMER, P.J.S., 'High yield rubber material', *The Planter* (Nov., 1950), 1–4.

DAVIDSON, L.R., 'Rubber smallholders' problems and progress', *World Crops*, **5** (1953), 190–193.

DJIKMAN, M.J., *Hevea* (Florida, 1951).

'Drainage on estates', *R.R.I. Plant. Bull.*, **28** (1957), 20–22.

EDGAR, A.T. (comp.), *Manual of Rubber Planting* (London, 1947).

Final Report of the Rubber Smallholdings Enquiry Committee. (Kuala Lumpur, 1952).

'From synthetic to synthetic natural', *R.R.I. Plant. Bull.*, **43** (1959), 75–76.

GAMBA, C., *Synthetic Rubber and Malaya* (Singapore, 1959).

HAINES, W.B., *The Uses and Control of Natural Undergrowth on Rubber Estates* (Kuala Lumpur, 1940).

HAINES, W.B. and GUEST, E., 'Recent experiments on manuring *Hevea* and their bearing on estate practice', *The Empire J. of exp. Agric.* **4** (1936), 300–324.

HAMILTON, R.A., 'Soil investigations in relation to the cultivation of rubber trees in Malaya', reprinted from *The Planter* (Oct., 1936), 1–7.

HILTON, R.N., *Maladies of Hevea in Malaya* (Kuala Lumpur, 1959).

INTERNATIONAL BANK MISSION. *The Economic Development of Malaya* (Baltimore, 1955).

JENKINS, R.O., 'Rubber—1. Introduction and expansion with special reference to Malaya', *Brit. Malay.* **26** (1951), 296–299.

JENKINS, R.O., 'Rubber—2. The development of plantation systems of upkeep', *Brit. Malay.* **26** (1951), 323–327.

LEWIS, H., *Rubber Regulations and the Malayan Plantation Industry* (Washington, 1935).

MACFADYEN, Sir ANDREW, *The History of Rubber Regulation, 1934–43* (London, 1944).

MCGAVACK, J., 'The future of natural rubber', *Nat. Rubber News* (Mar., 1959), s–1 to s–6.

MANN, C.E.T., and SHARP, C.C.T., The History and Description of Clones of *Hevea Brasiliensis* (Kuala Lumpur, 1937).

MANN, C.E.T. 'Improvement in the quality of rubber planting material', *R.R.I. Trans.*, **15** (1940), 251–270.

MARKS, O., 'The pioneers of para rubber planting in British Malaya', *Brit. Malay.* **2** (1927), 281, 285, 292.

MILLS, L.A., *British Rule in Eastern Asia* (London, 1942).

MILLS, L.A., *Malaya: a Political and Economic Appraisal* (London, 1958).

MUDIE, R.F. *et al.*, *Report of the Mission of Enquiry into the Rubber Industry of Malaya* (Kuala Lumpur, 1954).

OWEN, G., *et al.*, 'Manuring *Hevea*: effects of fertilizers on growth and yield of mature rubber trees', *J. Rubb. Res. Inst. Malaya*, **15** (1957), 29–52.

PARMER, J.N., *Colonial Labour Policy and Administration* (New York, 1960).

Proceedings of the Natural Rubber Research Conference, Kuala Lumpur, 1960 (Kuala Lumpur, 1961).

RAWLINGS, E.H., 'The smallholders in Malaya', *Eastern World*, **6** (1952), 36–37.

RIDLEY, H.N., *Story of the Rubber Industry, with an Appendix by L. Lewton-Brain showing the Growth of the Rubber Industry in Malaya* (London, 1911).

SMITH, H.F., 'A sampling survey of tapping on smallholdings, 1939–40', *J. Rubb. Res. Inst. Malaya*, **12** (1947), 77–125.

'Tapping: an introduction', *R.R.I. Plant. Bull.*, **9** (1953), 113–119.

'Tapping systems', *R.R.I. Plant. Bull.*, **11** (1954), 32–37.

WATSON, G.S., 'Cover plants in rubber cultivation', *J. Rubb. Res. Inst. Malaya*, **15** (1957), 2–18.

WESTROP, A.R., *The Use of Fertilizers on Malayan Rubber Estates* (Kuala Lumpur, 1939).

PADI

ALLAN, F.H. and BERWICK, E.J.H., 'The development of new rice lands in Malaya', *Proc. U.N. sci. Conf. on Conservation and Utilization of Resources*, **6** (New York, 1951), 588–590.

ALLEN, E.F. and HAYNES, D.W.M., 'A review of investigations into the mechanical cultivation and harvesting of wet padi with special reference to the latter', *Malay. agric. J.* **36** (1953), 61–80.

ASTON, A.V., 'Review of the Sungei Manik padi irrigation scheme', *Malay. agric. J.* **28** (1940), 322–329.

BERWICK, E.J.H., 'Mechanical cultivation of rice in Malaya', *World Crops*, **3** (1951), 207–210.

BLAGDEN, C.O., 'An account of the cultivation of rice in Malaya', *J. roy. Asiat. Soc., Straits Br.* **30** (1897), 285–304.

BUCKLEY, T.A., 'Improvement of rice yields in Malaya by the use of fertilizers', *Malay. agric. J.* **34** (1951), 119–126.

COOK, J., 'Fallow season cultivation of padi-land in Malacca' *Malay. agric. J.* **31** (1948), 115–118.

COOKE, E.M., *Rice Cultivation in Malaya* (Singapore, 1961).

COPELAND, E.B., *Rice* (London, 1924).

DE GENS, J.G., *Means of Increasing Rice Production* (Geneva, 1954).

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA, *Investigations into the Mechanical Cultivation of Padi in Malaya, August, 1950* (Kuala Lumpur, 1952).

DOBBY, E.H.G., 'The North Kedah plain, a study in the environment of pioneering for rice cultivation', *Econ. Geogr.* **27** (1951), 287–315.

DOBBY, E.H.G., 'Malaya's rice problem', *Pacific Affairs*, **27** (1954), 58–60.

DOBBY, E.H.G. *et al.*, 'Padi landscapes of Malaya', *Malay. J. trop. Geogr.* **6** (1955).

DOBBY, E.H.G., *et al.*, 'Padi landscapes of Malaya', *Malay. J. trop. Geogr.* **10** (1957).

FEDERATION OF MALAYA, *Report of the Rice Production Committee* (Kuala Lumpur, 1953).

FEDERATION OF MALAYA, *Final Report of the Rice Committee* (Kuala Lumpur, 1956).

FEDERATION OF MALAYA, *Action taken by the Federation Government on the Report of the Rice Production Committee* (Kuala Lumpur, 1954).

FERGUSON, D.S. 'The Sungei Manik Irrigation Scheme', *Malay. J. trop. Geogr.* **2** (1954), 9–16.

GRANTHAM, W. 'Malaya's position with regard to rice production', in *Federation of Malaya, Annual Report of the Drainage and Irrigation Department, 1948* (Kuala Lumpur, 1949), 31–39.

GRIST, D.H., *Rice* (London, 1953).

HARTLEY, C.W.S., 'Establishment of new rice areas in Malaya', *World Crops*, 3 (1951), 171–175.

HILL, A.H., 'Kelantan padi planting', *J. roy. Asiat. Soc., Malay. Br.* **24**, pt. 1 (1951), 56–76.

JACK, H.W. *Rice in Malaya* (Kuala Lumpur, 1923).

JAGOE, R.B. and LARTER, L.N.H. 'Improvement of padi varieties in Malaya', *Malay. agric. J.* **34** (1951), 127–130.

LARTER, L.N.H. *Rice variety trials in Malaya, 1947–1950* (Kuala Lumpur, 1953).

LAYCOCK, H.G. 'Rice production in Malaya', *Malaya* (1954), 278–281.

MOUBRAY, G.A. DE C. DE. 'Sungei Manik Irrigation Scheme', *Malay. agric. J.* **24** (1936), 160–166.

'Padi planting methods in Malaya', *Malay. agric. J.* **27** (1939), 40–59.

RAMIAH, K. *Factors affecting Rice Production* (Rome, 1954).

SHAW, G.E. *Malay Industries, Pt. 3. Rice Planting* (Papers on Malay Subjects, Series 1, No. 5, Kuala Lumpur, 1926).

'The development of rice cultivation in Malaya', *Malay. agric. J.* **28** (1940), 472–478.

WICKIZER, V.D. and BENNETT, M.K. *The Rice Economy of Monsoon Asia* (Stanford, 1941).

WILSON, T.B., *The Economics of Padi Production in North Malaya, Part I* (Kuala Lumpur, 1958).

WILSON, T.B. 'Some economic aspects of padi-land ownership', *Malay. agric. J.* **37** (1954), 125–135.

WILSON, T.B., 'The inheritance and fragmentation of Malay padi-lands in Krian, Perak', *Malay. agric. J.* **38** (1955), 71–77.

COCONUT

COGHLAN, H.L., *The Coconut Industry in Malaya* (London, 1914).

COOKE, F.C., *Investigations on Coconuts and Coconut Products* (Kuala Lumpur, 1932).

'Dwarf coconuts in Malaya', *Malay. agric. J.* **26** (1938), 282–287.

FEDERATION OF MALAYA LABOUR DEPARTMENT, *Report on the Coconut Industry in Malaya* (mimeo. Kuala Lumpur, 1955).

JACK, H.W. and SANDS, W.N., 'Observations on the dwarf coconut palm in Malaya', *Malay. agric. J.* **17** (1929), 140–165.

Report of a Committee appointed to Investigate and Report on the Present Economic Condition of the Coconut and Other Vegetable Oil Producing Industries in Malaya (Kuala Lumpur, 1934).

Report of the Working Committee on Coconut and Coconut Products (mimeo. Kuala Lumpur, 1957).

SHARPLES, A., 'Coconut research in Malaya', *Malay. agric. J.* **18** (1930), 71–77.

SMITH, A.C., 'The coconut industry of Malaya , *Malaya* (Dec. 1952), 26–29.

WILSON, T.B., *The West Johore Coconut Production Survey* (Kuala Lumpur, 1958).

OIL-PALM

BUNTING, B., *et al.*, *The Oil Palm in Malaya* (Kuala Lumpur, 1934).

DEASY, G.F., 'The oil palm in Malaya', *J. Geogr.* **41** (1942), 21–32.

FEDERATION OF MALAYA LABOUR DEPARTMENT, *Report on the Oil Palm Estates in Malaya* (Kuala Lumpur, n.d.).

JAGOE, R.B., 'Notes on the oil palm in Malaya', *Malay. agric. J.* **22** (1934), 541–549.

JAGOE, R.B., 'Deli oil palms and early introductions of *Elaeis guineensis* to Malaya', *Malay. agric. J.* **35** (1952), 3–11.

JAGOE, R.B., 'The "Dumpy" oil palm', *Malay. agric. J.* **35** (1952), 12–21.

MANN, C. 'Oil palms in Malaya', *Malaya* (Jan. 1952), 25–27.

MILSUM, J.N. and GEORGI, C.D.V. 'Small scale extraction of palm oil', *Malay. agric. J.* **26** (1938), 53–58.

PINEAPPLE

BIRKINSHAW, F., 'Pineapples', *Malay. agric. J.* **26** (1938), 321–327.

BROWN, F.B., 'Pineapple varieties and selection in Malaya', *Malay. agric. J.* **36** (1953), 237–246.

COURTENAY, C.E., 'The reconstruction of the Malayan canned pineapple industry', *Malay. agric. J.* **30** (1947), 183–190.

FEDERATION OF MALAYA, *Memorandum on the Resuscitation of the Malayan Canned Pineapple Industry* (Kuala Lumpur, 1949).

FEDERATION OF MALAYA, *Report of the Committee of Enquiry into the Pineapple Industry in Malaya and Statement of Government's Policy for the Industry* (Kuala Lumpur, 1960).

FEDERATION OF MALAYA LABOUR DEPARTMENT, *Report on Canning and Preservation of Fruits* (Kuala Lumpur, n.d.).

GRIST, D.H., 'The Malayan pineapple industry', *Malay. agric. J.* **18** (1930), 188–191.

JOHNSON, W.J.B., 'Recent developments in the Malayan pineapple canning industry', *Malay. agric. J.* **25** (1937), 270–276.

OLDS, G.D.P., 'The Malayan pineapple industry', *Malay. agric. J.* **23** (1935), 471–476.

'The pineapple canning industry in Malaya', *Malay. agric. J.* **19** (1931), 425–445.

SECONDARY AND MINOR CROPS

ALLEN, E.F., 'The cultivation of *Colocasia Esculenta* Schott in Malaya', *Malay. agric. J.* **28** (1940), 392–398.

BARNETT, H.L., 'A brief review of essential foodcrop cultivation in Malaya', *Malay. agric. J.* **30** (1947), 13–18.

BELGRAVE, W.N.C., 'The cultivation of foodcrops on estates', *Malay. agric. J.* **27** (1939), 209–213.

BLAUT, J.M., 'The economic geography of a one-acre farm on Singapore Island', *Malay. J. trop. Geogr.* **1** (1953), 37–48.

BUNTING, B., *The Culture of Vegetables in Malaya* (Kuala Lumpur, 1930).

BUNTING, B., 'Cultivation of coffee in Malaya', *Malay. agric. J.* **18** (1930), 481–496.

BUNTING, B., and MILSUM, J.N., 'Agriculture at Cameron Highlands', *Malay. agric. J.* **18** (1930), 5–19.

FAIRWEATHER, J., 'The sago industry in Malaya', *Malay. agric. J.* **25** (1937), 329–333.

FEDERATION OF MALAYA LABOUR DEPARTMENT, *Report on the Tobacco Industry in Malaya* (mimeo. Kuala Lumpur, n.d.).

FEDERATION OF MALAYA LABOUR DEPARTMENT, *Report on the Tea Planting Industry of Malaya, 1955* (mimeo. Kuala Lumpur, n.d.).

FRYER, D.W., 'Food production in Malaya', *Aust. Geogr.* **6** (1952), 35–38.

GREENSTREET, V.R. and LAMBOURNE, J., *Tapioca in Malaya* (Kuala Lumpur, 1933).

GRIST, D.H., 'The Malayan tea industry', *Malay. agric. J.* **25** (1937), 228–233.

HAMILTON, A.W. and HOLTTUM, R.E., 'A Malay garden', *J. roy. Asiat. Soc., Malay. Br.* **11**, pt. 2 (1933), 139–143.

HOLTTUM, R.E., *Gardening in the Lowlands of Malaya* (Singapore, 1953).

JOLLY, J.W., 'Survey of cultivated fruits in Pahang', *Malay. agric. J.* **22** (1934), 270–275.

LE MARE, D.W., 'Pig-rearing, fish-farming and vegetable-growing', *Malay. agric. J.* **35** (1952), 156–166.

LOWE, B.G.A., 'Vegetable production at Cameron Highlands', *Malay. agric. J.* **30** (1947), 5–12.

'Malayan fruits', *Malay. agric. J.* **23** (1935), 110–133.

MARSH, T.D. and KANAGARATNAM, N., 'The cultivation of tobacco in Malaya', *Malay. agric. J.* **20** (1932), 557–574.

MASON, F.R., 'The clove and nutmeg industry of Penang and Province Wellesley', *Malay. agric. J.* **19** (1931), 4–8.

MILSUM, J.N., 'Liberian coffee in Malaya', *Malay. agric. J.* **19** (1931), 521–525.

MILSUM, J.N., 'The local Mandarin orange', *Malay. agric. J.* **25** (1937), 234–238.

MILSUM, J.N., 'Derris cultivation in Malaya', *Malay. agric. J.* **25** (1937), 239–245.

SIMPSON, H.J. and LAU SING NAM, 'Chinese market-gardening', *Malay. agric. J.* **22** (1934), 119–124.

SMITH, H.V., *Report on Marketing Problems in the Fruit Industry of Malaya, July–September, 1957* (mimeo. Kuala Lumpur, n.d.).

SPENCER, J.E., 'Seasonality in the tropics: the supply of fruit to Singapore', *Geogr. Rev.* **49** (1959), 475–484.

CHAPTER 10

LIVESTOCK REARING, FISHING AND FOREST PRODUCTION

LIVESTOCK REARING

'Breeding for beef in tropical and sub-tropical climates', *Nature (Lond.)* **174** (1954), 915–916.

FAULKNER, O.T., 'The yield of perennial fodder grasses in Malaya and its implications', *Trop. agric.* **19** (1942), 51–53.

GEORGI, C.D.V. *et al.*, 'A manurial experiment with Merker and Napier grasses', *Malay. agric. J.* **29** (1941), 304–321.

GUNN LAY TEIK, *Fodders and Feeding Stuffs in Malaya* (Johore Bahru, 1951).

HENDERSON, R.M.C., 'The cultivation of fodder grasses in Malaya', *Malay. agric. J.* **38** (1955), 71–77, 141–150, 250–255.

KANAGARATNAM, N., 'Indian buffaloes in Kuala Lumpur District and environs', *Malay. agric. J.* **23** (1935), 421–425.

MANN, G.E., 'Poultry husbandry in Malaya', *Malay. agric. J.* **23** (1935), 262–273.

MARSH, T.D., 'Pigs in Malaya', *Malay. agric. J.* **20** (1932), 392–406.

MARSH, T.D. and DAWSON, V., 'Animal husbandry in Malaya', *Malay. agric. J.* **30** (1947), 133–142, 204–211; **31** (1948), 102–114, 157–179.

UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION, *Improving Livestock under Tropical and Sub-tropical Conditions* (Washington, 1950).

VIVIAN, L.A., 'The leguminous fodder "Stylo" or "tropical lucerne" in Kelantan', *Malay. agric. J.* **42** (1959), 183–198.

WELLS, C.W., *Report on Livestock Improvement in Negri Sembilan* (Kuala Lumpur, 1936).

FISHING

BIRTWISTLE, W., 'Rearing of carp in ponds', *Malay. agric. J.* **19** (1931), 372–383.

BRAXTON, W.B., 'The problems of fish storage and refrigeration in Southeast Asia', *Proc. Indo-Pacific Fisheries Council, Mar. 1949* (Singapore, 1950), 96–100.

BURDON, T.W., *The Fishing Industry of Singapore* (Singapore, 1957).

FEDERATION OF MALAYA LABOUR DEPARTMENT, *Report on the Fishing Industry* (mimeo. Kuala Lumpur, 1955).

FIRTH, RAYMOND, 'Economics of a Malayan fishing industry', *Man*, **41** (1941), 69–73.

FIRTH, RAYMOND, *Malay Fishermen: their Peasant Economy* (London, 1946).

Fish and their Environment (Singapore, n.d.).

FRASER-BRUNNER, A., 'Sea fishes of Malaya', *Malay. Shell*, **5** (1958), 10–14.

GOPINATH, K., 'The Malayan purse seine (*Pukat Jerut*) fishery', *J. roy. Asiat. Soc., Malay. Br.* **23** (1950), 75–96.

HEATH, R.G., 'Fish production in the Krian Irrigation Area', *Malay. agric. J.* **22** (1934), 186–188.

JOHNSON, D.S., 'A survey of Malayan freshwater life', *Malay. Nat. J.* **12** (1957), 57–65.

KESTEVEN, G.L., ed., *Malayan Fisheries* (Singapore, 1949).

LE MARE, D.W., 'Application of the principles of fish culture to estuarine conditions in Singapore', *Proc. Indo-Pacific Fisheries Council, Apr. 1950* (Bangkok, 1951), 180–183.

LE MARE, D.W., 'Malaya's fish industry', *Malaya* (July 1954), 390–393.

LE MARE, D.W. and THAM AH KOW, 'On the inshore fish population of the Straits of Singapore', *Proc. Indo-Pacific Fisheries Council, Jan.–Feb., 1954* (Bangkok, 1955) Sec. II & III, 168–176.

Report of the Committee to Investigate the Fishing Industry (Kuala Lumpur, 1956).

SOONG MIN KONG, 'Fishes of the Malayan padi fields', *Malay. Nat. J.* **3** (1948), 87–89; **4** (1949), 29–31; **5** (1950), 88–91.

STEAD, G.D., *General Report upon the Fisheries of British Malaya* (Sydney, 1923).

THAM AH KOW, *The Food of Fishes in the Singapore Straits* (H.M.S.O., London, 1950).

THAM AH KOW, *A Preliminary Study of the Physical, Chemical and Biological Characteristics of Singapore Straits* (H.M.S.O., London, 1953).

TROPICAL FISH CULTURE RESEARCH INSTITUTE, MALACCA, *Report for 1957–1959* (Kuala Lumpur, n.d.).

WILKINSON, R.J. *et al.*, *Report on the Fishing Industry on the West Coast of the Malay Peninsula* (Kuala Lumpur, 1904).

FOREST PRODUCTION

DESCH, H.E., 'The forests of the Malay Peninsula and their exploitation', *Malay. Forester*, **7** (1938), 169–180.

DESCH, H.E. and THOMAS, A.V., 'Timber utilization in Malaya', *Malay. Forest Rec.* **13** (Kuala Lumpur, 1940).

DURGNAT, P.A., 'Some aspects of Malaya's sawmilling industry', *Malay. Forester*, **21** (1958), 215–230.

FEDERATION OF MALAYA, *Report on Forest Administration, 1957* (Kuala Lumpur, 1958).

FEDERATION OF MALAYA, *Report on Forest Administration, 1958* (Kuala Lumpur, 1959).

NOAKES, D.S.P., 'The mangrove charcoal industry in Matang', *Malay. Forester*, **13** (1950), 80–83.

SETTEN, G.G.K., 'What does Malaya get from its forest?' *Malay. Forester*, **17** (1954), 114–128.

WALTON, A.B. *et al.*, 'The silviculture of lowland dipterocarp forest', *Malay. Forester*, **15** (1952), 181–197.

WATSON, J.G., 'Forests and timber production', *Malay. Forester*, **10** (1941), 93–96.

WEBB, B.E., 'Trouble in the sawmilling industry', *Malay. Forester*, **17** (1954), 147–150.

CHAPTER 11

THE MINING ECONOMY

BIRKINSHAW, F., 'Reclaiming old mining land for agriculture', *Malay. agric. J.* **19** (1931), 470–476.

COURTENAY, P.P., 'International tin restriction and its effects on the Malayan tin industry', *Geogr.* **46** (1961), 223–231.

FERMOR, L.L., *Report upon the Mining Industry of Malaya* (Kuala Lumpur, 1940).

GREIG, G.E., *Mining in Malaya* (London, 1931).

HARRIS, H.G.B. and WILLBOURN, E.S., *Mining in Malaya* (London, 1936).

HUTTON, G.H., 'The evolution of the tin-mining industry', *Federated Malay States Chamber of Mines Yearbook, 1931* (Kuala Lumpur, 1931).

'Iron-mining boom in Malaya', *Far East. Econ. Rev.* **17** (1954), 455–456.

KING, A.W., 'Changes in the tin mining industry of Malaya', *Geogr.*, **25** (1940), 130–134.

MALAYAN COLLIERIES LTD., *A Description of the Property, Operations and Social Organization at Batu Arang Colliery* (Kuala Lumpur, 1950).

MITCHELL, B.A., 'Malayan tin tailings—prospects of rehabilitation', *Malay. Forester*, **20** (1957), 181–186.

OOI JIN-BEE, 'Mining Landscapes of Kinta', *Malay. J. trop. Geogr.* **4** (1955).

ROE, F.W., *The Geology and Mineral Resources of the Neighbourhood of Kuala Selangor and Rasa, Selangor, Federation of Malaya, with an Account of the Geology of Batu Arang Coalfield* (Kuala Lumpur, 1953).

SCRIVENOR, J.B., *The Geology of Malayan Ore-Deposits* (London, 1928).

THOMSON, A.G., 'Mineral resources of Malaya', *Brown's Malayan Econ. Rev.* **2** (1952), 12–13.

Tin in Malaya (Kuala Lumpur, 1951).

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST, *Coal and Iron-ore Resources of Asia and the Far East* (Bangkok, 1952).

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST, *Development of Mineral Resources in Asia and the Far East* (Bangkok, 1953).

CHAPTER 12
INDUSTRY

CAINE, Sir SYDNEY, 'Enterprise and capital in industrial development', in Lim Tay Boh (ed.) *Problems of the Malayan Economy* (Singapore, 1957), 66–70.

FEDERATION OF MALAYA DEPARTMENT OF STATISTICS, *Census of Manufacturing Industries in the Federation of Malaya, 1959* (Kuala Lumpur, 1961).

FEDERATION OF MALAYA, *Report of the Industrial Development Working Party* (Kuala Lumpur, 1957).

GIBSON-HILL, C.A. and HILL, A.H., *Malay Arts and Crafts* (Singapore, 1951).

GULLICK, J.M., 'A survey of the Malay weavers and silversmiths in Kelantan in 1951', *J. roy. Asiat. Soc., Malay. Br.* **25**, pt. 1 (1952), 134–148.

HILL, A.H., 'The weaving industry in Trengganu', *J. roy. Asiat. Soc., Malay. Br.* **22**, pt. 3 (1949), 75–84.

MACKENZIE, K.E., *Malaya: Economic and Commercial Conditions in the Federation of Malaya and Singapore* (London, 1952).

'Secondary industries of Malaya and Singapore', *Far East. Econ. Rev.* **17** (1954), 694–695.

SHEPHERD, J., *Industry in Southeast Asia* (New York, 1941).

STATE OF SINGAPORE, *Report of the Ministry of Commerce and Industry, 1958* (Singapore, 1960).

WINSTEDT, R.O., 'Malay industries', in R. J. Wilkinson (ed.) *Papers on Malay Subjects* (Kuala Lumpur, 1909).

CHAPTER 13

TRADE

BENHAM, F., *Report on the Trade of Penang* (Kuala Lumpur, 1948).

FEDERATION OF MALAYA, *Statistics of External Trade, 1961* (Kuala Lumpur, 1962).

GIBSON, W.S., *Trade of the Colony* (Singapore, 1934), 5 vols.

LI DUN-JEN, *British Malaya, an Economic Analysis* (New York, 1955).

MEYER, F.V., *Britain's Colonies in World Trade* (London, 1948).

Report of the Commission appointed . . . to enquire into and Report on the Trade of the Colony, 1933–34 (Singapore, 1934).

Singapore Trade (published monthly in Singapore, beginning January 1960).

STAHL, K., *The Metropolitan Organization of British Colonial Trade* (London, 1951).

STATE OF SINGAPORE, *Statistics of External Trade, 1960* (Singapore, 1961).

CHAPTER 14

TRANSPORT

ALLEN, D.F., *Report on the Major Ports of Malaya* (Kuala Lumpur, 1951).

ALLEN, D.F., *Report on the Minor Ports of Malaya* (Kuala Lumpur, 1953).

BARNES, W.D., 'Singapore's old straits and new harbour', *J. roy. Asiat. Soc., Straits Br.* **60** (1911), 25–36.

Development of the Port of Penang (Kuala Lumpur, 1954).

FEDERATED MALAY STATES RAILWAYS, *Fifty Years of Railways in Malaya, 1885–1935* (Kuala Lumpur, 1935).

FEDERATION OF MALAYA, *Report of the Department of Civil Aviation, 1955 and 1956* (mimeo. Kuala Lumpur, 1957).

FEDERATION OF MALAYA, *Report of the Federal Ports Committee* (Kuala Lumpur, 1952).

FISHER, C.A., 'The railway geography of British Malaya', *Scot. geogr. Mag.* (Dec. 1948), 123–136.

MACTIER, R.S., 'The ports of Malaya', *Malaya* (Oct. 1952), 29–35.

MALAYAN RAILWAY ADMINISTRATION, *Report for the year 1960* (Kuala Lumpur, 1961).

MORGAN, W.S., 'Pioneers of Malaya's transport', *Brit. Malay.* **20** (1945), 172–174.

NOONE, H.D., 'The *penarekan* and Bernam land-routes', *J. roy. Asiat. Soc., Malay. Br.* **17**, pt. 1 (1939), 144–145.

Report of the Commission of Enquiry into the Port of Singapore, Aug.–Sept., 1957 (Singapore, 1957).

Report on Rivers in the Federated Malay States, 1928 (Kuala Lumpur, 1928).

WILLIAMS, F.H.P., *Report on Roads and Road Problems in Southeast Asia and the Caribbean* (London, 1957).

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