PART TWO

Rural and Urban Development

1

THE LAND

NATURAL RESOURCES CONSERVATION

Basic factors

Conservation of natural resources means their wise use and management to provide for all the needs of the community. This demands the setting aside of areas for all these purposes and their subsequent management in a manner which will ensure that their usefulness for the chosen purpose will be maintained. As population increases, some of the less significant needs of the past become more pressing needs in the future.

Natural resources originally available in Victoria depended on the character of the different types of land and their varying capabilities. The character of land is determined by the particular combination of its features such as its geology, topography, soils, hydrology, flora, fauna, and the climate of the area in which it is located. The pattern of distribution of different kinds of land is the result of a long period of interaction between the features to produce different combinations of them from place to place. Particular communities of plants and animals are associated with certain soils in particular climatic, geologic, topographic, and hydrologic situations. Where similar conditions have prevailed, there have been similar interactions to produce similar types of land with similar character and capability.

The seemingly unchanged character of any particular kind of undisturbed land does not mean that it is a static system. In fact there is a continuing interaction between the features to produce a dynamic stability, at which there is the highest possible sustainable production which can be attained from the array of plant and animal species in the locality. Although all types of land are naturally stable, some are inherently more stable than others when changes are imposed on them. For example, in those situations where the climate, topography, and soils provide favourable conditions for a large number of plant and animal species such as on volcanic tuffs in good rainfall areas as at Ballarat or Koroit, there is a high degree of stability. Where the conditions are only suitable for a few highly specialised plant and animal species which have evolved to exist under such conditions, such as the Bogong High Plains (cold environment) or the hot arid north-west, the stability is precarious.

The character of the land determines its potential as a natural resource, its capability of being changed by man to suit his own purposes, and how far its stability and productive capacity are affected when these changes are

made. Much of the land in Victoria is the result of a long evolutionary period on old land surfaces, frequently on parent materials naturally deficient in plant nutrients and with a peculiar array of plant and animal species not found in other parts of the world. When European settlers arrived they found an unusual environment in which the natural biological productivity was not of much value to them. They were faced, therefore, with the task of changing the land by clearing, burning, and cultivating so that more useful species of plants and animals could be introduced.

Their efforts affected the land in different ways because they did not understand the nature of the dynamic systems on which they were imposing significant and drastic changes. On land having an inherently weak stability, such as the light textured soils of the Mallee, the effect of man was to create almost immediate instability and there was soil erosion and loss of productivity. On other land such as the Eppalock catchment, constant hard grazing of vegetation not evolved under such conditions and the introduced close-cropping hard-hooved animals caused gradual degradation and instability many years later. Current forms of soil erosion, such as tunnelling and salting, are the result of this unknowing misuse. Many plants and animals which were introduced provided the basis for productive agriculture; others, such as the blackberry and the rabbit, having been introduced into environments which suited them, at times became almost uncontrollable pests.

On some inherently stable land man has been thwarted in his attempt to convert it to his purpose. The changes he has made merely provided conditions for another set of vigorous native species to dominate and retain the stability of the system, often at a lower level and in an even less useful form of biological productivity. In south Gippsland, some land cleared of forest has now become overrun by bracken or blackberry. Man's knowledge of the land has, however, improved. Not only are fewer mistakes being made in land use and development, but also the effects of past misuses are gradually being corrected. Nevertheless, some resources which were available initially have been lost, but more than sufficient remain to ensure that the various needs of the community can be satisfied if there is wise allocation and use of land for various purposes.

The resources available to the early Europeans did not provide all essentials for survival. They needed food and water, fibre for clothing, and timber for shelter and fuel. Although there was water and timber, the peculiar flora and fauna did not provide the food they desired or to which they were accustomed, nor did it produce fibre. Thus domesticated plants and animals were introduced. To grow and maintain these, arable and grazing land was required and accordingly the pattern of development was determined by the type of land available in areas which had water.

Resources

The environment at the time of settlement is illustrated by the available water resources and the nature of the vegetative cover. The original water resources as shown on the accompanying map can be described in three categories. First, there were areas in which the annual rainfall exceeded the annual use by vegetation and loss by evaporation, to give an excess of water. In these areas there were perennial streams, lakes, or swamps, and water

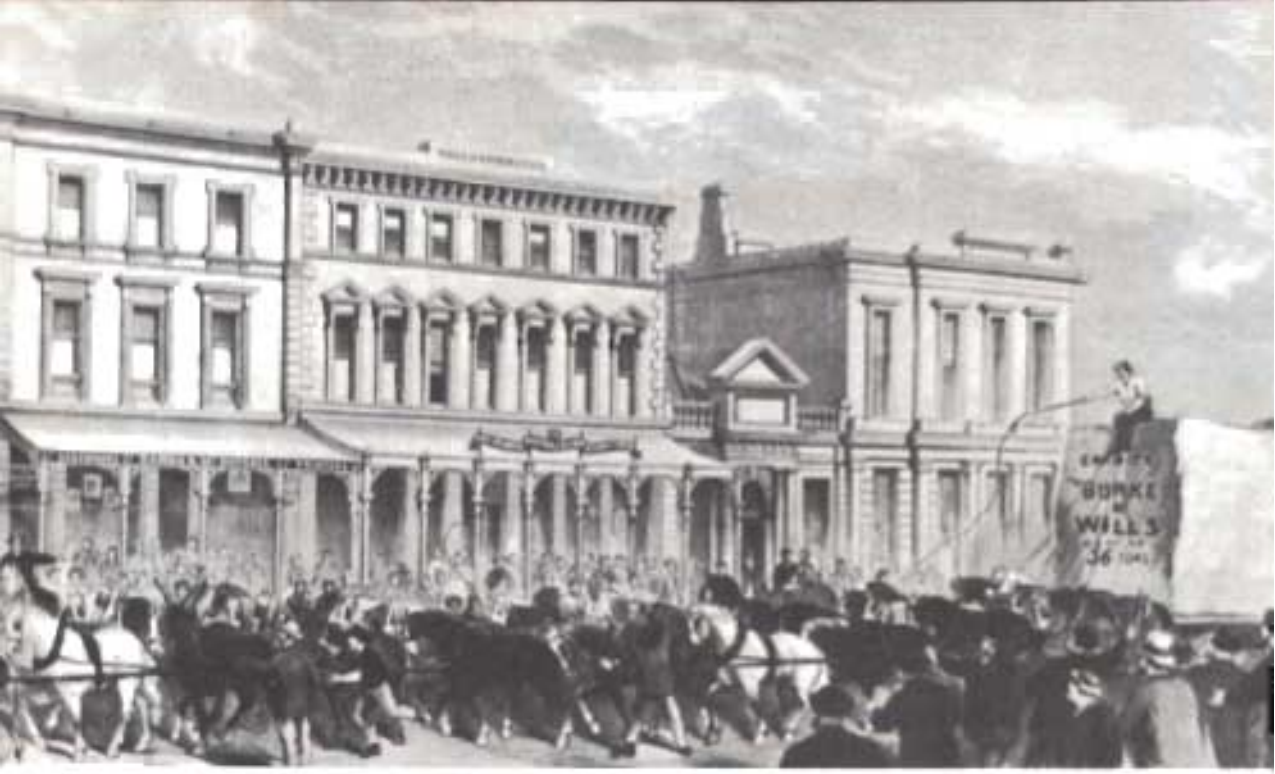
Melbourne from the south side of the Yarra River, 1839.
La Trobe Collection, State Library of Victoria

Mail coach from Geelong arriving at Ballarat, 1854.
La Trobe Collection, State Library of Victoria

The main road in Ballarat East, 1859.
La Trobe Collection, State Library of Victoria

Golden Square, Sandhurst (Bendigo), *c.* 1875.
La Trobe Collection, State Library of Victoria

Pall Mall, Sandhurst (Bendigo), 1864.
La Trobe Collection, State Library of Victoria

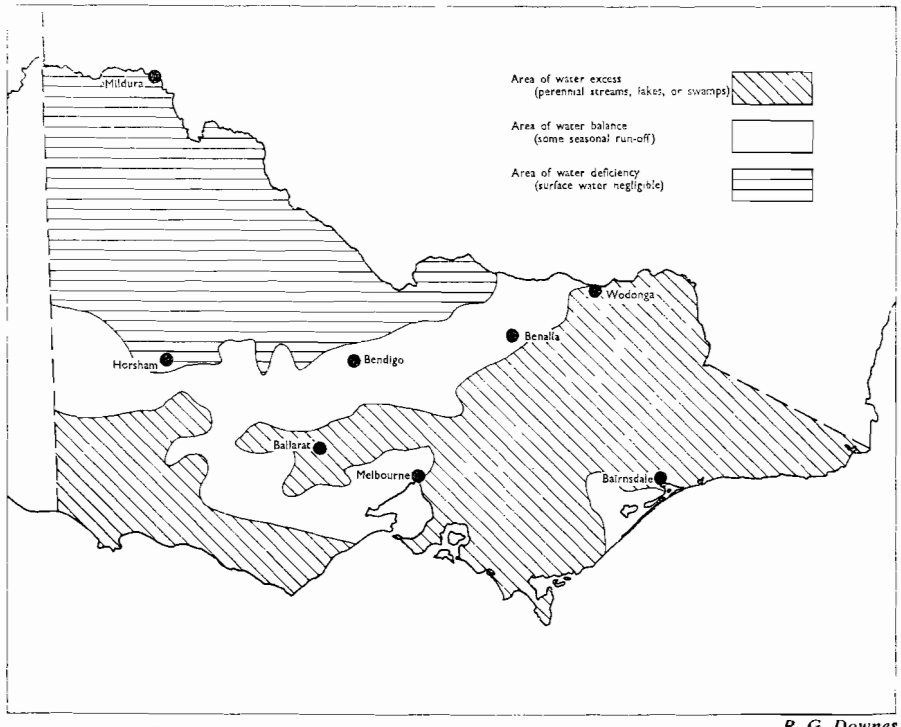


The monolith commemorating the expedition of Burke and Wills being moved along Collins Street, September 1864

La Trobe Collection, State Library of Victoria

Governor La Trobe's cottage at Jolimont in the early 1850s

La Trobe Collection, State Library of Victoria



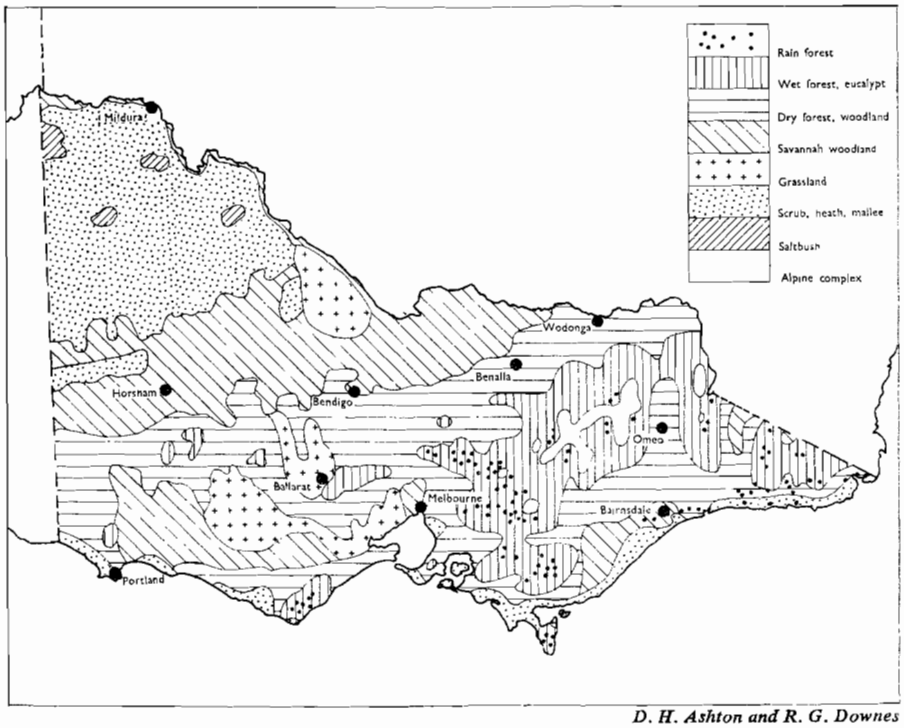
Victoria—Original surface water resources (generalised). *R. G. Downes*

was readily available. Second, there were areas in which the rainfall only just balanced the needs of the vegetation and so run-off was infrequent, local, and seasonal. In these areas, water was available in a few major perennial streams having their origin in areas of water excess, but, away from the streams, the settlers were forced to collect the occasional run-off in surface storages. Third, there were areas in which there was a water deficiency, and, although a few streams from wetter areas flowed into this country, they were mostly dry during the summer.

The nature of the original vegetative cover is shown in the following map, and indicates the degree of ease or difficulty with which the land could be used for cultivation or grazing. The areas most useful to the settlers were those which were already devoid of trees, such as the grasslands of the Western District and some parts of central Victoria, or alternatively, the savannah woodland, in which the trees were sparsely scattered, the native grass beneath them suitable for grazing, or the soil suitable for cultivation after clearing. The next most useful areas were those of dry forest which could be converted to pasture land by the simple but laborious job of ringbarking.

Melbourne was ideally situated for the early settler. It was reasonably close to an area of water excess and to good forests ; nearby were grasslands and savannah woodlands, and these in fact were some of the earliest of the settled areas to be used for productive agriculture and grazing.

Before the passing of the *Land Act* 1869, which stimulated more dense settlement, most of the land was held in large runs for grazing. Around the towns and the goldfields there were areas of local agriculture, and

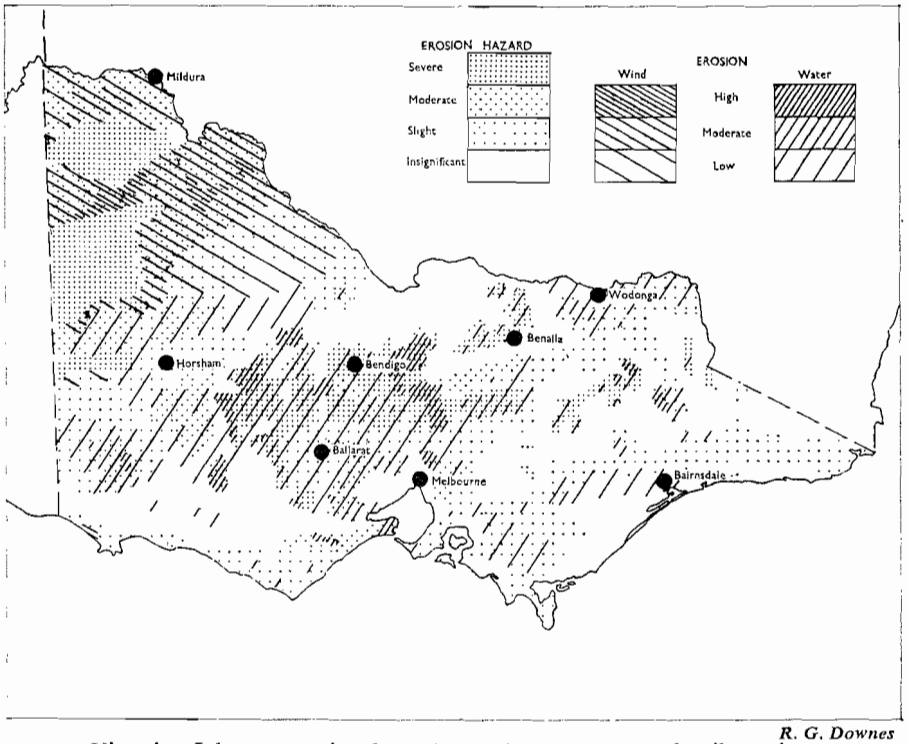


D. H. Ashton and R. G. Downes

Victoria—Predominant original vegetation (generalised).

forests near these settled areas were used extensively to provide timber and firewood. The rest of the country, however, was still in good condition because the grazing was not heavy. The more dense settlement began to create problems of instability. Cultivation up and down the slopes to accomplish " drainage " initiated gullies in areas north of the Great Dividing Range where it is now known that moisture conservation is important for success in arable agriculture. More intensive grazing on much smaller holdings caused a degradation of pasture cover, increased run-off, and the uneven absorption of water. These phenomena are now known to be the cause of the slow initiation of tunnelling or salting, and eventually the rapid degradation of land as has occurred near Stawell, Benalla, and Eppalock. On areas where the soils had higher fertility and better structure near Ballarat and Colac, and in Gippsland, few problems arose because these soils were better able to support the imposed use.

In later years some misuse of the land became apparent. The clearing of high class forest country in some parts of south Gippsland to create farms on steep exposed country did not succeed agriculturally and in fact rapidly destroyed a timber resource which would have been extremely valuable today. In the development of the Mallee country not only did some farms fail economically for some decades, but clearing also caused considerable destruction of productive resources under the original farming system of crop-fallow. The consequent soil erosion created maintenance and management problems for water supply, roads, and railways. A general picture of the effect of past land use is given in the following map, which



R. G. Downes

Victoria—Inherent erosion hazard and the occurrence of soil erosion.

shows the inherent erosion hazard of the different kinds of land, and the degree and extent to which soil erosion has occurred.

On the other hand, from the beginning of settlement some land has been used well; for example, the use of phosphatic fertilisers and later trace elements with various introduced legumes and other pasture species has improved productivity on grazing lands. Wider rotations have therefore been possible, as well as more stable systems of cereal–animal farming in the drier areas such as the Mallee where erosion was a serious menace. Improved productivity has been helped by the breeding of more suitable varieties and strains of plants and animals, and by checking diseases and pests.

Water conservation has also helped to increase productivity. The control of the water resources by the State subsequently implemented by means of a statutory authority was most significant. Water conservation in zones of water excess, and the control of rivers and streams to give more reliable flow throughout the year and water for irrigated agriculture, have enabled some semi-arid areas to be developed for highly productive agriculture. But some irrigation areas were not successful. The original notion that any arid land only needed water poured on it to grow crops successfully was shattered when some kinds of irrigated land in northern Victoria developed salinity and drainage problems. Another important aspect of water conservation was the provision of the domestic and stock supply for the dry north-western part of the State. Without this the Mallee, parts of which are now useful and productive, could not have been developed.

Forest resources were used rather prodigally in the early days ; there seemed to be no end to them. Fire was the main instrument in destroying forests ; graziers often burned areas in an attempt to produce ground forage for their animals, and this led to the deterioration of the forest resource in some areas. For example, a most valuable timber species, mountain ash, has not survived in a considerable part of its original habitat. Since then the trend has been reversed by setting aside areas of dedicated forests and establishing a statutory authority for the protection and management of all State forest resources.

The conservation of flora and fauna received little attention in the early days of settlement as there appeared to be a boundless source of wildlife and plenty of areas of untouched country. Furthermore, the scientific importance of reserving special areas was not understood. A few species appear to have been lost for all time ; others such as the koala and the platypus were reduced to small numbers and would have been exterminated if a conscious effort had not been made to preserve them. Although the loss of species may have been due partly to predation by man, undoubtedly the main cause for the diminution of numbers of certain species has been the continuing loss of habitat which is essential for their survival : river control along streams has altered the environment to such an extent that the native fish now find it difficult to breed and survive ; the introduction of exotic fish species has affected native populations ; the excessive drainage of swamps has reduced the habitat for water-birds ; competition for food by sheep grazing in certain areas has caused a decline in some species, notably the Mallee fowl ; and persistent and frequent fires in forest areas have altered the plant communities to the detriment of particular animal species.

Patterns of settlement

During the early stages of settlement the urgency and need to occupy the country stimulated exploration and subsequent settlement on large holdings on which little improvement was carried out. Except for areas near to the centres of population the main form of land use was open range grazing. The second stage came when the increased population created a pressure for land and a demand for different products. Closer settlement, by breaking up the large holdings for more intensive use, was followed by clearing, fencing, and the development of agriculture. At this time farmers very often mismanaged their land, mainly because they were over-optimistic about its potential and ignorant of its inherent instability. The clearing and cultivating of unsuitable areas such as the western Millewa, and the more intensive stocking of pastures elsewhere, showed their effects both on the land and on the settlers.

In the third stage there was a sorting out of land potential and suitability for different forms of production, mainly on the basis of economic success or failure, rather than on the basis of any reasonable study of the land or its reaction to the uses imposed. The final stage was the technological improvement of the forms of land use found suitable for different types of country. This now includes the study of the land, its hazards, and capabilities as the basis for soil conservation and determining the most appropriate systems of land use for a high level of permanent production.

By comparison with many other countries, significant changes to the environment by man in Victoria have been of recent origin. Although the full implications and effects of these changes are not yet known, there are sufficient areas in various stages of development to show the nature of the problems which can arise and to indicate how quickly the land resource can deteriorate when improper systems of land use and management are imposed.

In retrospect a major misjudgment in land development and use appears to have been the failure to preserve in their natural condition areas of many productive types of land. By this omission, all future generations have been denied the possibility of scientifically studying and knowing the original nature and dynamics of these important types of land.

Just as there were evolutionary stages of development in the use of land, so too there were evolutionary stages in man's attitude towards the land and its resources. In a newly-settled country the first stage is inevitably exploitive. Settlers are always hopeful of making a fortune and returning to their former homes with quickly acquired wealth. This applied not only to the first settlers coming from Europe, but subsequently to those from settled areas who went to pioneer new land in another part of the State. Few such people envisaged living their whole lives in newly settled areas. Those farmers who were unsuccessful in this objective did one of two things : they either abandoned the land and went elsewhere, or they realised that they could make a living but not a fortune, and that this was to be their home and that of succeeding generations. The development of this attitude has been followed by consolidation, conservation, and improved productivity up to a level which can be maintained. Instead of abusing the land to make a fortune, the farmers began to use it within its capabilities to make a permanent living. Most people now have this attitude and are looking towards conservation.

Conservation

In this last stage basic problems of certain difficult kinds of land are better understood. Technological advances have opened the way towards determining more appropriate systems of land use and management, and the changes are gradually being made. Further, there is a better understanding of the overall needs of the community in the use of its land. The early settlers only had to worry about uses which provided for their subsistence. They did not have to concern themselves about the need for open space for recreation and enjoyment, or for the preservation of particular types of land for scientific study, or for the preservation of particular communities of plants and animals. They were not worried by the increasing need for land for transport and communications, nor by the rapid expansion of urban areas, nor the need for carefully selecting areas for industrial uses so that insurmountable pollution problems could be avoided.

The Government has accepted responsibility for conservation of natural resources within a broader context. Apart from having individual departments and statutory authorities whose functions are specifically directed to the conservation and better use of individual resources, a more integrated approach to the assessment, development, and use of the State's natural resources is being made. The Land Conservation Council has the

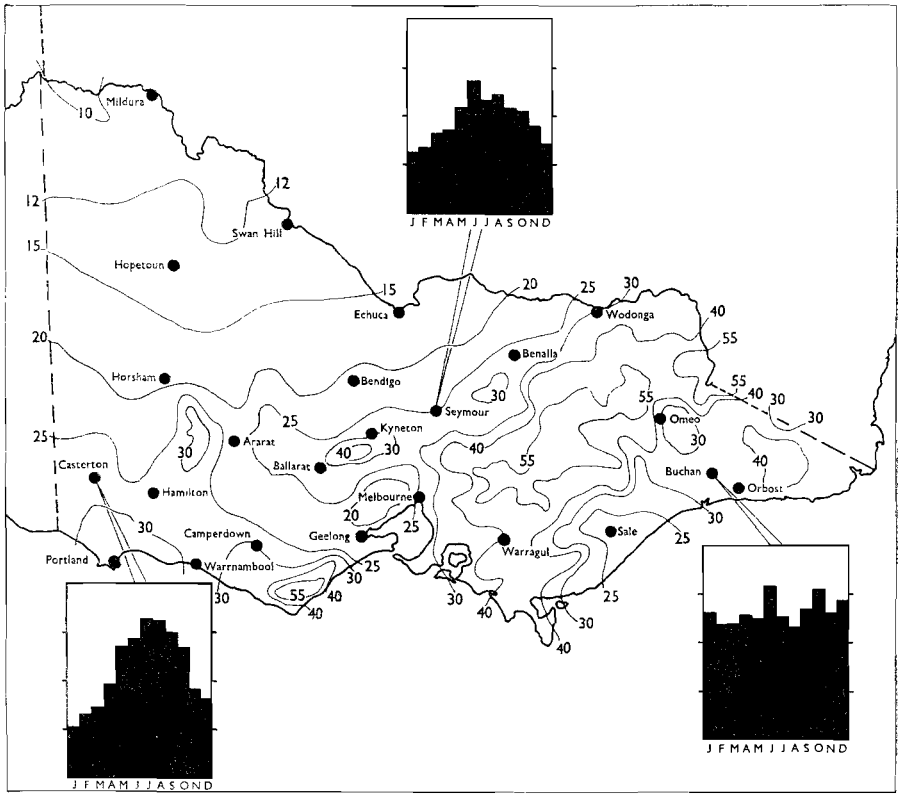
statutory function of advising the Minister about the future use of Victoria's public lands, as well as of assisting the Soil Conservation Authority in the protection of water supply catchments from bad land usage. The State Planning Council has been established to develop planning policies to guide town and country planners in the development of plans for the future use of land, with particular emphasis on the problems of the urban-rural fringe, and the provision of public utilities required for a rapidly increasing population. The Environment Protection Authority, aided by its advisory Council, is responsible for protecting and improving the environment, particularly with regard to the prevention of pollution due to the discharge of waste matter. All these authorities are helping to provide a higher quality environment as a suitable habitat for human beings.

CLIMATE

Climate is described here as one of the main influences which the early settlers encountered—something which had controlled the vegetation of the countryside as they found it, and something which had limited, and still limits, man's success in growing crops.

Victoria covers a wide range of climates, from the almost drought-free western coast to the edge of the continental desert, and from the mountains with their winter snow to the hot inland. The snow country is of only small extent, and the major concern in Victoria, as in most of Australia, is how dry the weather is and for how long. This is so whether one is interested in the native plants or in the introduced economic crops; among the native plants the dominance of the eucalypt is evidence of the long dry periods which marked past centuries and which still limit man's use of the land. The starting point, then, is the map of average annual rainfall. This shows, first, the general decline of rainfall in going inland from the coast (best seen in the western half) and, second, the concentration of rain in the highlands. Besides the effects of elevation and distance from the sea, minor features can be seen, of which the rain shadows in southern Victoria, lying south-east and north-east from the high country, are of most interest.

The whole of Victoria can be thought of, as a first approximation, as having a dry and warm to hot summer and a wet and cool winter. In the far west of the State this " mediterranean " feature of dry summer and wet winter is simply shown by the monthly average rainfalls. The further east one goes, and so the closer to the Tasman Sea, the greater is the contribution of summer rain to the total as shown by the graphs on the average annual rainfall map. Yet even with an approximately equal distribution of rain through the twelve months (as in Melbourne, midway from west to east) the effective rain is far greater in winter and spring than it is in summer, when the soil's reserves of water are rapidly transpired into the air during the dry spells. Thus the popular idea of summer as the dry time and winter as the wet is correct not merely in terms of hours of rainfall (which are much greater in the winter), but in terms of plant utilisation as well. Further, the rain falling during the summer months is unreliable, being derived from erratic inflows of moist sub-tropical or tropical air, while the winter–spring rain, being derived from regular depressions in the westerlies to the south, is reliable.



Based on Commonwealth Bureau of Meteorology map

Victoria—Average annual rainfall, and monthly distribution at selected stations. Isohyets in inches (generalised). The three graphs show the average monthly rainfall distribution in inches at Casterton, Seymour, and Buchan, illustrating the change from predominantly winter rainfall in the west to a more even distribution throughout the year in the east of the State.

The most obvious contrast among climates is in terms of latitude, which also means distance from the coast. But the commonly quoted and more helpful contrast is in terms of the Great Dividing Range. The cool and moist south-westerlies coming off the southern seas often bring cloud or showers to coastal and rising country in the south, but after crossing the Divide the same winds may form little cloud; the weaker southerlies may not even persist into the hot north-east during summer. The north is a good deal hotter than the south in summer. The mean January maximum is below 80°F. in the south, and is over 85°F. in the Mallee, northern Wimmera, and generally over the northern plains. In winter skies are clearer in the north than in the south, but the average temperature is much the same; the more frequent blanket of cloud in the south makes for milder nights, with less range of temperature.

A marked feature of Victorian climates is the regular changes of weather. While changing weather is a feature of the temperate latitudes, the most

southerly parts of the Australian mainland are unusual in that a continent which is warm to hot for most of the year adjoins a cool ocean along a line from west to east ; so, most of Victoria is dominated in turn by warm air from inland and by cool moist air from the ocean. As the weather systems travel from west to east, there is a cycle starting from cool, warming up, then going rapidly back to cool, a cycle which varies greatly in length but is often from five to seven days. The weather during much of the year can be thought of as dominantly mild with occasional invasions of hot air from the inland which raise the temperature 20°F. or even 30°F. above normal.

The hot northerlies are associated with bush fires. At a temperature of 100°F. and the common vapour pressure of 12 millibars, the relative humidity falls to 18 per cent, and on some of the worst days it has fallen to below 10 per cent. In this condition the forest is easily ignited during the hottest four to six hours of the day. Most of the hottest days are dry. On a few days in each summer the vapour pressure exceeds 17 millibars, which could be called a dividing line between humid and non-humid days ; on most of these moister days the temperature is not high. There is not much difference in this respect throughout the State, although the west is drier than the east.

Days much colder than average are rare; the southerlies of winter and spring are seldom derived from sub-antarctic latitudes. But on rare occasions there is a really cold invasion, and dry snow has fallen at sea level in southern Victoria. Snow falls on the higher land every winter, and lies on the mountains from June to September. Ground frosts are common through the State on clear winter nights, but severe frosts (with air temperatures falling at night below 30°F.) are rare away from the mountains.

It is usually convenient to think of Victoria as a unit: the weather is changeable ; the summer is typically dry and the winter showery ; north of the Divide the summer is hotter; and many rain-bearing storms do not reach far inland. All this is a matter of more or less; often a wet season is a wet season and a dry season is a dry season throughout. But eastern Gippsland must be excepted from all these generalities ; if it belongs to any part of Australia climatically it is not to Victoria but to coastal New South Wales. Eastern Gippsland may have drought while western Gippsland is receiving ample rain from the regular westerly storms, or it may be deluged with rain from east coast cyclones which hardly affect the rest of the State. Summer here brings a higher proportion of the year's rain than anywhere else in the State.

Variability of rainfall

Average rainfall is a valuable figure to know, but it is necessary also to know how often the rainfall will be far above or below the average. For any one locality this information may be taken from the records, by noting (e.g., for Swan Hill) that while the average is 13 inches, the total has fallen below 8 inches four times in 50 years. One may compare the variability of two towns by recording the mean deviation as a percentage of the mean. When this is done it is found that the lowest variability (under 15 per cent) is in the Western District and the western part of Gippsland and the highest (over 20 per cent) is in the northern part of the State and the Mallee. While the Mallee is the most variable, it should be noted that most other parts of the world with the same low annual rainfall are even more variable. The western

coast has the least variable rain. Generally the greater the exposure to the south-west the more reliable the rain ; among the wetter areas, eastern Gippsland has the most erratic rainfall. This can be explained partly by the relative importance of its summer rain, and partly by its protection from the westerlies in winter.

The variability of the annual rainfall is itself a composite figure, since over most of the State the summer and early autumn months are erratic while winter and early spring months, with their more frequent showers, are reliable.

Droughts

Both droughts and floods are of concern to most parts of the world since rainfall is everywhere variable, and in this Victoria is no exception. Floods are much less widespread than droughts in their effects in Victoria, and may be expected to become less important as more storages are built in the headwaters, so providing buffers against heavy rains, and as better drains are built in basins such as Koo Wee Rup, which was formerly subject to floods. But man cannot as yet order rain to fall on dry places, and the chief interest in variability lies in droughts, which show their effects both on native vegetation and on introduced crops.

Summer drought is a regular recurring event. Agriculture is adapted to it, mostly by using annual plants such as wheat and subterranean clover which make their growth from autumn to spring and have died before the summer sets in. The various perennial species of the native vegetation have survived according to the severity of the drought ; the time of surplus rain is during the cooler months of the year, and for the rest of the year the store in the soil is being used up. The time of annual stress is progressively longer towards the north-western corner of the State.

In speaking of drought, however, it is not a single summer which is considered, but rather a period in which the rain fails during the normally sufficient time of the year, namely winter and spring. Perennial plants then enter on the next summer without the normal reserves in the soil; reservoirs for cities, for stock, and for irrigation fall too low to do their duty for the next season ; and the annual crops and pastures fail with a dry spring. The fairly reliable spring rain is one great merit of the climate of much of Victoria.

The word " drought " may be used of one year (such as 1967, the worst recorded in much of Victoria), or of a succession of years with less than average rainfall. This second meaning is more common in the dry inland of Australia (where there is no regular wet season) than it is in Victoria. However, a succession of dry years will multiply the bad effects of one dry year. It must leave its mark on the native vegetation and may kill some perennials among the introduced plants ; it may cause great hardship to all those in city or country who depend on reservoirs.

VEGETATION AT THE TIME OF DISCOVERY

Natural vegetation in Victoria is now confined mainly to areas too unproductive or inaccessible for agriculture, grazing, or intensive forestry. It is, therefore, to be found in national parks, wildlife and water catchment reserves, and undeveloped Crown land. Modification and replacement of original vegetation is virtually complete in large areas of the Mallee, the

Wimmera, the western and central parts of the State, and southern Gippsland. The original vegetation of the more fertile soils is conjectural and only fragments exist along road and railway reserves and in country cemeteries. Early descriptions of vegetation were mostly poor and fragmentary, and were nearly always evaluated in terms of potential land use for sheep and dairying. In this section each of the main divisions shown in the map on page 66 is described in turn.

Grasslands and grassy woodlands

The vegetation which first attracted the early explorers and settlers was the grassland and grassy woodland of the central, northern, and western areas. These areas ranged from treeless grassy plains to open park-like woodlands. Relatively treeless plains occurred on the heavy basalt soils west of Melbourne and through the drier Western District (rainfall 17–20 inches). Other areas occurred on parts of the northern plains. Tussocks of kangaroo grass were characteristic of this vegetation but numbers of spear grasses and wallaby grasses also occurred. Perennial herbs, particularly of the Compositae, were characteristic and were prevalent where burning was frequent. Temporarily wet areas contained tussock grass and lignum. River red gum lined the banks of streams.

The relatively open savannah woodlands occurred in the slightly wetter areas ranging to 30 inches rainfall. These were frequently burned. The trees ranged from 40 to 60 ft in height and the grass stratum was very well marked. These woodlands north of Melbourne and in the Western District were composed of river red gum on the drier and manna gum on the wetter areas. Volcanic hills were either treeless or were sparsely timbered with she-oak or manna gum depending on the rainfall of the region. Yellow gum was also an important tree of the western and northern plains. In the rain shadow of the Sale plains extensive tracts of forest red gum occurred. In the Wimmera the heavy soils carried open stands of buloke and grey box. In the northern plains woodlands of grey box, yellow box, buloke, and Murray pine occupied extensive tracts of country. The pine occurred especially on the drier and sandier soils.

River red gum or black box followed the watercourses, the latter where the flow was less reliable, and in the flood plain of the Murray these formed extensive, relatively dense, forests, the nature of which depended on the frequency and duration of flooding. The woodlands of red gum had an understratum dependent on the flooding regime ; in good seasons it consisted of abundant moira grass and cane grass.

Dry open forest and woodland

This area comprises a wide range of forms from grassy forest to heathy forest, with a rainfall from 25 to 40 inches. The eucalypts which dominated these stands were 50 to 100 ft high and showed great regional differences. The grassy forests tended to occur on the better soils and the heathy forests on the poorer. Grassy forests were dominated by grey box and yellow box and red gum on the better soils of the northern and western plains. In the southern areas of the Western District manna gum and swamp gum were common, while in the areas to the east of Melbourne the important trees were narrow-leaf peppermint, yellow box, long-leaf box, candlebark, messmate, and manna gum.

Low heathy forests occurred in the shallower soils of the northern plains as at Bendigo; red ironbark and red stringybark were dominant and pea shrubs and epacrids were common. In the sandstone areas of the Grampians and the poorer soils near Portland forests of messmate and brown stringybark occurred over a rich heathy understorey of bush peas, common heath, and grasstrees. Similar forests occurred in the ironstone-rich tablelands of the Central District, where messmate and red stringybark were common, and on the poorer sandy soils of southern and eastern Gippsland, where various forest types included messmate, yellow stringybark, white stringybark, silvertop, and yertchuk. The understoreys were similar to those further west, but contained numerous species such as geebung, acacia, and saw sedge, which are characteristic of New South Wales. In the far east of the State bloodwood and gum myrtle occurred, indicative of the tropical affinities of this part of the State.

Many areas of dry sclerophyll forest were relatively open, as observed by Howitt; McMillan, however, observed that some areas were very thick at the time of discovery. Many open areas were observed to have regenerated freely following occupation by Europeans, and previously grassed areas became shrubby and dense.

Wet open forest

With rainfall above 40 inches, the vegetation was tall wet sclerophyll forest with tall undergrowth and ferns in altitudes reaching to about 3,500 ft. The forests of mountain ash grew to heights of over 300 ft in areas with a rainfall of 45 to 90 inches in the central highlands, southern Gippsland, and the Otways. This dominant species was associated with a variable tall undergrowth of hazel, musk, correa, blanket leaf, austral mulberry, blackwood, silver wattle, and dogwood. Soft and rough tree-ferns and ground ferns were conspicuous, particularly below 3,000 ft. These forests away from the ridge tops were dense and many were not penetrated or cleared until the late nineteenth century.

Above 3,500 ft the montane forest of alpine ash and shining gum became increasingly grassy up to the sub-alpine snow gum woodlands at 4,500 ft. In drier areas (40 inches) and below the mountain ash zone were tall stringybark and gum forests with fairly tall shrubs, bracken, and wiregrass. These forests were dominated by messmate, grey gum, and manna gum in the central districts; blue gum, mountain gum, and narrow-leaf peppermint in the north-east; mahogany gum, yellow stringybark, and blue gum in eastern Gippsland; and messmate and manna gum in the wettest gullies of Mt Cole, the Grampians, and near Portland.

The wet sclerophyll forests in particular have suffered greatly from repeated fires, and many areas have been destroyed completely.

Closed forest (rain forest)

Cool temperate forests

Dense rain forests of beech occurred in the gullies with a rainfall over 55 inches, and on mountain sides with over 70 inches. The forests had dense canopies, with copious soft tree-ferns and ground ferns (shield fern, water fern). Sassafras was a common associate in the Central District and Gippsland and extended with blackwood as a riparian rain forest type into somewhat drier areas (45 inches). Progress of the explorers to the

headwaters of the major streams was impeded by these dense, ferny, and mossy forests. Beech occurred in the Otways, in the central highlands, and in southern Gippsland, and extended up to sub-alpine thickets at 4,800 ft on the wettest mountains (e.g., Baw Baw).

Warm temperate forests

Lilly pilly forests occurred in eastern Gippsland and on Wilsons Promontory at low altitude, both along gullies and on sheltered slopes of mountains. Most of these forests were close to the coast, with an annual rainfall of 30 to 35 inches, but with a higher contribution of summer rain and, therefore, a less severe summer than elsewhere in Victoria. These forests were rich in ferns, epiphytic orchids, and lianes. Along the rivers kanooka was co-dominant with lilly pilly. The tall wet sclerophyll eucalypts were, and still are, frequently found as a scattered or dense overstorey to both rain forest types. This is the result of past catastrophic fires. Today many rain forests have been destroyed by repeated fires and converted to wet sclerophyll forest.

Sub-alpine plateaux complex

The grasslands and woodlands and low forests of the " high plains " between 4,500 and 6,500 ft were opened up for grazing at a later date than the lowlands. Mallee-like woodlands occur up to 6,000 ft on rocky ridges. The snow gum areas were grassed with coarse-leaf and fine-leaf snow grass and were associated with shrubs and herbs. The lower slopes of the broad valleys were grasslands associated with abundant floriferous herbs of the Compositae and Umbelliferae. Dwarf shrubs of the pea family, Rutaceae, and Compositae were present, though not so commonly as today. Above the tree line at 6,000 ft herbfields of snow daisy and grasslands of snow grass were the chief vegetation types. In the swampy floors of the valleys and in seepage areas, sphagnum moss beds developed, with spreading rope rush swards and various Epacridaceae such as richea, alpine heath, and coral heath. These areas held much water and helped to regulate stream flow ; many have been irreparably damaged by fire and grazing.

Scrub

Heath and thicket

Heathlands occurred on poverty-stricken deep coastal sands and were dominated by silky tea-tree and dwarf she-oak. This rich flora included common heath, tassel rope rush, and bush peas, and was found from Portland to Mallacoota ranging in rainfall from 25 inches at Melbourne to 40 inches at Wilsons Promontory. Stunted eucalypts (brown stringybark, messmate, and manna gum) were sometimes present in more sheltered sites.

On rocky sites with shallow poor soils or areas with impervious subsoil at shallow depths, wet heath occurred (Grampians, Portland, Yanakie, and Wilsons Promontory). Such heath may have been dominated by manuka, dwarf she-oak, swamp heath, coral fern, and spreading rope rush. In swampy areas between 30 and 40 inches, thickets of swamp paperbark and woolly tea-tree occurred. Vast thickets at Koo Wee Rup were a barrier to the access to Gippsland until the swamps were drained at the turn of the century.

On calcareous dunes along the central-western coasts, scrub of coast wattle, beard heath, and tea-tree were dense or grassy. In the much drier climate of the inland dune systems of white sand of the Big and Little Deserts (12 to 18 inches), a sparser heath occurred dominated by green tea-tree, fringe heath-myrtle, wheel fruit, and desert banksia. In these areas copses of mallee and cypress pine occurred with yellow gum and yellow box in areas of better water supply.

Mallee

The occupation of the Mallee was generally delayed until the 1860s and 1870s. Explorers in earlier years such as W. L. Morton venturing into the waterless region beyond the pastoral fringe, recorded a wide variety of mallees, much the same as was seen in the region until the 1920s. Open mallee (red mallee) park-like areas with seasonal herbs and grass were common on the flat stretches. Low dense twisted mallee with porcupine grass occurred on sandhills and made progress difficult. Temporarily wet flats were clothed with yellow mallee and broombush. Red sandhills were covered with numerous and taller mallee species (oil mallee), with variable developments of wattles, salt bushes, and other elements of a rich though often ephemeral flora. Extensive areas of Murray pine, slender pine, and belah also occurred on the more loamy soils. On the clay pans, gypsum was present and shrub steppes or open shrublands of semi-succulent saltbushes and blue bushes were found. Where salt encrusted the surface in dry seasons, samphire dominated the shrub steppe. In general, the patterns described by Morton are still evident today in the areas which have been preserved.

Fires

Many of the early writers mention the frequent burning of the lowland forests by Aboriginals (Howitt), and others refer to the blackened state of the trees (Hume and Hovell, and Macalister). It is certain that lightning was a natural cause of fires, then as now. The openness of timbered areas might have been due to the absence of fire and to competition of grass with tree regeneration for limited water, but in some areas it might also have been due to very frequent light burns which inhibited the establishment of eucalypts. The adaptations of the various species in woodlands, heathlands, and grasslands suggest that they have long been exposed to fire. On the other hand, the species growing in the wettest areas are sensitive. The mountain ash forests have undergone catastrophic fires at intervals of 100 to 300 years, and although the trees were killed the fires have served to perpetuate the forests through re-seeding. At the wettest extreme, beech forests flourished only in the complete absence of burning.

Thus, the pattern of the original vegetation was related to climate, soil, and fire. Man's subsequent entry into these ecosystems has had far-reaching effects during the last 130 years.

Glossary of plant names

Alpine heath	*Epacris bawbawiensis*
Austral mulberry	*Hedycarya angustifolia*
Beard heath	*Leucopogon parviflorus*
Beech	*Nothofagus cunninghamii*
Belah	*Casuarina cristata*
Black box	*Eucalyptus largiflorens*

Blackwood	*Acacia melanoxylon*
Blanket leaf	*Bedfordia salicina*
Bloodwood	*Eucalyptus gummifera*
Blue bush	*Kochia sedifolia*
Blue gum	*Eucalyptus st-johnii*
	Eucalyptus maideni
Bracken	*Pteridium esculentum*
Broombush	*Melaleuca uncinata*
Brown stringybark	*Eucalyptus baxteri*
Buloke	*Casuarina luehmannii*
Bush pea	*Pultenaea* spp.
Candlebark gum	*Eucalyptus rubida*
Cane grass	*Eragrostis australasica*
Coast wattle	*Acacia sophorae*
Common heath	*Epacris impressa*
Coral fern	*Gleichenia microphylla*
Coral heath	*Epacris microphylla*
Correa	*Correa lawrenciana*
Cypress pine	*Callitris columellaris*
Desert banksia	*Banksia ornata*
Dogwood	*Cassinia aculeata*
Dwarf she-oak	*Casuarina pusilla*
Forest red gum	*Eucalyptus tereticornis*
Fringe heath-myrtle	*Micromyrtus ciliatus*
Geebung	*Persoonia linearis*
Grass tree	*Xanthorrhoea australis*
Green tea-tree	*Leptospermum coriaceum*
Grey box	*Eucalyptus microcarpa*
Grey gum	*Eucalyptus cypellocarpa*
Gum myrtle	*Angophora floribunda*
Hazel	*Pomaderris aspera*
Kangaroo grass	*Themeda australis*
Kanooka	*Tristania laurina*
Lignum	*Muehlenbeckia cunninghamii*
Lilly pilly	*Eugenia smithii*
Mahogany gum	*Eucalyptus botryoides*
Manna gum	*Eucalyptus viminalis*
Manuka	*Leptospermum juniperinum*
Messmate	*Eucalyptus obliqua*
Moira grass	*Pseudoraphis spinescens*
Mountain ash	*Eucalyptus regnans*
Mountain gum	*Eucalyptus dalrympleana*
Murray pine	*Callitris columellaris*
Musk	*Olearia argophylla*
Narrow-leaf peppermint	*Eucalyptus radiata*
Oil mallee	*Eucalyptus oleosa*
Phebalium	*Phebalium bullatum*
Porcupine grass	*Triodia irritans*
Red mallee	*Eucalyptus calycogona*
Red ironbark	*Eucalyptus sideroxylon*
Red stringybark	*Eucalyptus macrorrhyncha*
Richea	*Richea continentis*
River red gum	*Eucalyptus camaldulensis*
Rough tree-fern	*Cyathea australis*
Samphire	*Arthrocnemum arbusculum*
Saltbush	*Atriplex vesicaria*
Sassafras	*Atherosperma moschatum*
Saw sedge	*Gahnia radula*
She-oak	*Casuarina stricta*
Shield fern	*Polystichum proliferum*
Silky tea-tree	*Leptospermum myrsinoides*
Silvertop	*Eucalyptus sieberi*
Silver wattle	*Acacia dealbata*

Slender pine	*Callitris preissii*
Snow daisy	*Celmisia longifolia*
Snow grass	*Poa australis* (fine)
Snow gum	*Eucalyptus pauciflora*
Soft tree-fern	*Dicksonia antarctica*
Spear grass	*Stipa* spp.
Sphagnum	*Sphagnum cristatum*
Spreading rope rush	*Calorophus lateriflorus*
Swamp gum	*Eucalyptus ovata*
Swamp heath	*Spengelia carnea*
Swamp paper bark	*Melaleuca ericifolia*
Tassel rope rush	*Hypolaena fastigiata*
Tea-tree	*Leptospermum* spp.
Tussock grass	*Poa australis*
Wallaby grass	*Danthonia* spp.
Water fern	*Blechnum procerum*
Wheel fruit	*Gyrostemon australasicus*
White stringybark	*Eucalyptus globoidea*
Woolly tea-tree	*Leptospermum lanigerum*
Yellow box	*Eucalyptus melliodora*
Yellow gum	*Eucalyptus leucoxylon*
Yellow stringybark	*Eucalyptus muellerana*
Yertchuk	*Eucalyptus consideniana*

WILDLIFE

(*Including fish*)

Most of Victoria has a temperate climate and forms a major faunal region with Tasmania, eastern New South Wales, and south-eastern Queensland, but the north-western part of the State exhibits the botanical and faunal characteristics of the semi-arid fringe of the inland. To the early white settlers the most remarkable items of the fauna were the conspicuous or unfamiliar forms such as the kangaroo, platypus, lyrebird, and emu. Worldwide interest in Australian wildlife has always centred on the remarkable diversity of its marsupials. The present-day vertebrate fauna of Victoria (excluding the whales, dolphins, and marine fish) comprises approximately 40 species of freshwater fish, 30 frogs and toads, 3 tortoises, 65 lizards, 35 snakes, 420 birds, 2 monotremes, 33 marsupials, 9 rodents, 12 bats, the dingo, and the fur seal.

As early as 1800 professional sealers from Sydney had operated on the Victorian coast, but before Melbourne was founded the seal herds had been so depleted that the industry ceased. By 1850 the " squatters " were grazing six million sheep on huge runs in western and central Victoria, altering much of the open forest and grassland ecology and reducing the food and shelter available to many birds and ground feeding marsupials. During the 1850s gold attracted many thousands of people to the central districts, and large areas of forest were cut for fuel, building, and shoring and other mining works. In Melbourne and on the diggings pigeons, brolgas, cockatoos, lyrebirds, emus, and kangaroos all provided a cheap alternative to mutton; and wild duck from West Melbourne, Altona, and Mordialloc also helped supply the town market. Kangaroos, possums, koalas, water-rats, and platypuses were taken for leather and fur. The Land Acts in the 1860s opened the way for intensive farming and by 1881 more than one third of the State's area had been alienated. Ringbarking of trees, land clearing, drainage of swampland, burning, and a lack of knowledge of appropriate agricultural techniques changed the countryside and often damaged the soils.

The Acclimatization Society was founded in 1861 and over the next thirty years introduced many exotic species such as the fox, hare, rabbit, squirrel, antelope, blackbird, minah, thrush, white swan, skylark, partridge, pheasant, ostrich, seventeen species of deer, and at least ten species of fish. The first Game Act in 1862 was designed to protect these introduced animals, but only three species of deer and three or four fish can now be considered useful additions to the fauna. At least ten species which had been introduced purposely or accidentally, or had escaped from domestication, became pests and reduced the number of native animals by preying on them or competing with them for food and shelter. Attempts to control rabbits, foxes, dogs, and mice continue up to the present day using traps and poison, but these imprecise techniques inevitably kill many native species as well.

Much reliance is still placed on the old Game Act concept of protecting individual animals against wilful destruction. The idea of protecting habitat for animals to live in was slow to evolve. The Land Act of 1869 provided for the establishment of national parks, but an authority to plan and administer a system of parks was not set up until 1956. In 1959 the State wildlife reserves system was introduced to cater primarily for the reservation and management of wildlife habitat. State forest reserves are managed primarily for timber production but they provide important habitats for a diverse fauna, particularly in eastern Victoria.

Fish are now the only native vertebrates regularly used for commerce, although occasional licensed seasons to take water-rat or possum furs are proclaimed, primarily as a control measure. Apart from fish, ducks and quail are today the only recognised native game animals, and when drainage of wetlands caused a gradual decline of waterbirds it was the hunting clubs in the 1950s and later which strongly supported habitat reservation. Similar interest by angling clubs had long promoted the conservation of introduced trout as game fish, and deer populations may ultimately benefit from the same kind of interest. Wide sympathy in the 1940s and 1950s led to a successful project to rehabilitate koalas in suitable forest land, but most support for general conservation ideals still comes from amateur naturalist clubs and conservation organisations. Until the 1960s considerable uncertainty about their aims limited their efforts, but they are now exercising much more influence in the community.

From 1860 to 1940 an important commercial fishery used native species from northern rivers. However, with the high priority given to the use of water for irrigation, town supplies, and industry, native fish have declined in numbers ; introduced fish are better adapted to the relative stability of managed streams and reservoirs. Murray cod, Macquarie perch, silver perch, golden perch, tupong, blackfish, and catfish are all becoming less common, and the Australian grayling is in danger of extinction. Such a process is typical of the many changes in the environment which adversely affected most elements of the fauna. As forests, heaths, grasslands, and swamps diminish, birds become fewer and their distribution more limited, and although no species are yet extinct several are in danger, including the State's emblem bird, the helmeted honeyeater. Eleven species of bats appear to be safe but five rodents and fourteen marsupials (mainly from western Victoria) no longer survive. Over large areas of the Mallee which were stripped of natural vegetation the reptile fauna dwindled from thirty species to three.

In the latter part of this century new influences will undoubtedly further affect wildlife habitat. More Crown land will need to be alienated for many purposes; the massive use of agricultural chemicals and the disposal of industrial and domestic wastes pose the major identifiable problems at present. In anticipation of such problems related either to human health or conservation generally, the Government received a report in 1966 from a committee inquiring into the effects of pesticides; it later set up a Pesticides Review Committee, and in 1970 passed the Environmental Protection Act to control all forms of pollution. The *Land Conservation Act* 1970 was designed to control the further alienation and use of the State's remaining Crown land.

NATURAL DISASTERS

Long before the advent of European settlement Victoria had suffered from flood, fire, and drought. Hume and Hovell on their journey from Lake George to the sea recorded that the trees had been burnt, and very early in the era of European settlement drought was experienced. The 1838 drought, however, did not have any lasting effects. There was relatively little stock in Victoria; it sufficed to move a few miles to fresh pastures. Similarly with the floods of 1839; there was very little to be damaged. In the early days the effects of flood and drought were relatively easy to counter; fire, however, engulfed all in its wake. The worst fire in the early years was that of "Black Thursday", 6 February 1851, when virtually the whole Colony was on fire. This series of fires followed on a period of nearly four months of abnormally dry weather; it is not known how much damage was done, but inquests were held into the deaths of ten persons. For some twenty years after this the settlers did not have to contend with much Colony-wide disaster.

The following list indicates those natural disasters which have occurred since 1849 and which in most cases have caused sufficient damage to necessitate the granting of relief.

Floods

Floods have occurred in many years but early records are meagre for areas outside Melbourne.

November 1849. Severe floods on the Yarra and nearby rivers. Great loss of livestock and damage to buildings.
December 1863. In central parts of the Colony; gales and high tides together with flooding caused some damage in Melbourne.
September 1870. Wide-spread flooding caused much damage.
December 1893. Heavy flooding on Snowy River.
June 1917. Severe floods in north, to the east of the Goulburn River.
October 1917. Floods on Murray River and tributaries caused much damage to crops.
January 1934. Severe flooding on Snowy River with main road bridges being washed away.
December 1934. Severe flooding on Yarra, La Trobe, Thomson, and Goulburn Rivers.
June 1952. Severe flooding in Gippsland on the Snowy, Thomson, and La Trobe Rivers; much damage in Goulburn valley; some loss of life.
April to June 1956. Serious flooding with much damage on northern flowing rivers and the Murray.
September 1959. State-wide flooding with considerable damage.
February 1971. Severe flooding in central and east Gippsland: Snowy River reached record height, causing over $2m damage in Orbost area.

Fires

Fires have occurred in most years, but have not often been of disastrous proportions; in many cases reports have tended to magnify the events or their results.

January–February 1898. Fires widespread throughout the Colony, but most severe in Gippsland; Neerim and Thorpdale townships destroyed; hundreds of settlers burnt out; great loss of stock; no loss of life.
January–February 1919. Severe fires ranged over the northern, central, and north-eastern parts of the State, the Otway Ranges, and the Maffra–Rosedale area.
November 1919–April 1920. Fires burnt about 120,000 acres of forest land, much of it in the Grampians.
December 1922–May 1923. Fires broke out continually in the mountain areas of the State, burning over 500,000 acres of forest.
January–February 1926. Fires most severe in Gippsland; 976,000 acres of Crown land burnt; over fifty lives lost.
January–February 1932. Severe fires in Powelltown–Noojee–Erica area; 510,000 acres of forest and Crown land burnt throughout the State; eighteen lives lost.
January 1939. Disastrous State-wide fires, severest in western Gippsland; over 3 million acres of forest and Crown land burnt; over 700 houses destroyed; seventy-one lives lost; about 1,500 people homeless.
January–February 1944. Severe fires in Western District, also in Gippsland and the north-east; Yallourn open cut coal mine on fire; over 350,000 acres of forest and Crown lands burnt, heavy stock losses; over 700 houses destroyed; forty-nine lives lost.
January 1962. Fires in the Dandenongs burnt only a small area but destroyed 470 houses and damaged sixty others in three days; six lives lost.
March 1965. Severe fires in Gippsland; 808,000 acres of forest, farm land, and national park burnt.
January 1969. Many outbreaks State-wide (except Gippsland) on 8 January; 1,000 square miles of grassland and 7,200 acres of forest and national park burnt; 230 houses destroyed; 22 lives lost.

Droughts

The major droughts which have beset Victoria are noted. Again records of the early years are meagre.

1865. Rainfall less than two thirds normal; north-western parts of the Colony particularly affected.
1877. Severe drought in the western and northern parts of the Colony.
1902. Rainfall less than two thirds normal, particularly in north and north-west of the State; average wheat yield for the State fell to 1.29 bushels per acre.
1914. State-wide; almost no winter rainfall; northern part of the State particularly affected; average wheat yield only 1.38 bushels per acre.
1944. State-wide; much crop failure in the north-west; hand feeding of stock necessary.
1967. Severe in northern and western areas of the State; evacuation of stock necessary from the most affected parts.

The impact these natural disasters have had is shown by the attempts of man to control them or at least alleviate their effects. Flood control, river improvement, and water conservation programmes to a large extent control the flow of water and eliminate much flooding; Lake Eildon impounded some 2.3 million acre ft of water during the floods of 1955 and 1956, thereby easing the flood position in the Goulburn valley; and Rocklands Reservoir near Balmoral, besides providing water for the Wimmera–Mallee Domestic and Stock Water Supply, now ensures that the areas downstream do not suffer periodical flooding as formerly. Access roads in forest areas and the provision of four-wheel drive vehicles have facilitated the movement of fire-fighters and equipment in the event of a fire. The modernisation of fire-fighting equipment of the rural brigades, together with the installation of modern communications equipment, has provided a basis on which a sizeable body of fire-fighters can be built up quickly in times of need. The recent use of aircraft for fire spotting has also speeded up the response to fire calls. Greater water storage, pasture improvement, and better fodder conservation help mitigate the effects of drought. The speedy evacuation of livestock from the most affected areas to less affected parts, and even to other States, or the importation of baled

fodder for hand feeding can save countless head of stock; when the drought has run its course these can also help in the speedy re-establishment of the country.

Fires of January 1939 and their aftermath

The summer of 1938–39 was the culmination of two years of abnormally dry conditions with poor pastures and depleted water storages. The forests were tinder dry. The first warning of danger came in August 1938 when a destructive fire caused serious damage to State forests in the Ballarat–Creswick district. From then on fires broke out in timbered areas on both private and Crown land with increasing frequency and intensity and, early in January 1939, led to what the Royal Commission later described as " the most disastrous forest calamity the State of Victoria has known ". The numerous fires alight at the time " reached the climax of their intensity and joined forces . . . on Friday the 13th of January ". Seventy-one people died, sixty-nine sawmills were burnt, and some 700 dwellings, one hospital, and ten guest houses were destroyed. Of the State forest, about 3,900,000 acres including the prime mountain ash forests of the central highlands, a vast resource of untapped timber, were destroyed. Fires on grass country were of little consequence because of the little fuel there.

Mr Justice Stretton was appointed as the Royal Commission to investigate the cause of the fires and to propose measures to eliminate the possibility of a similar recurrence. The Commission sat for eleven weeks in Melbourne and in country centres, and its report stressed the fact that the disaster was caused by man in that practically all fires had been deliberately lit. It made many recommendations including the establishment of a State fire authority and the complete control by the Forests Commission of fire prevention and suppression in all State forests. Towards the end of 1939 an amending Forests Act was passed. National parks were placed on the same legal basis as State forests and it became an offence to light a fire in any national park or reserved forest at any time of the year except by direction or as prescribed.

The involvement of Australia in the Second World War diverted public attention from many of the local problems which developed as an aftermath of the fires, but it made the Forests Commission's task more difficult as machinery and labour became increasingly scarce. It was only because timber was recognised as an essential commodity for the war effort that it was possible to build any roads. Meanwhile the Commission began an educational programme directed towards the public as well as its own staff to take the fullest advantage of the lessons learnt from the January 1939 disaster. Continuous staff training, the introduction of the most modern equipment available from overseas, and the demonstration of repeated successes in the suppression of fires by new methods gradually built up public confidence. Nevertheless a false sense of security could have followed the January 1939 disaster had it not been for the events of 1944.

The spring of 1943 was one of the most bountiful ever experienced in Victoria. The height of grass on the basalt plains of the Western District and the pasture lands of the north and north-east was astonishing. At the end of November 1943 the rains ceased and dry winds, especially from the north, sprang up. The long grass became tinder dry. On 23 December 1943 a grass fire, accidentally started near Wangaratta, took the lives of twelve people. The town of Beechworth and the valuable pine plantations of Stanley

and the Ovens valley were threatened. Fires of great intensity swept the Western District pastures, and by the end of summer the toll was fifty-one people dead, 240,000 sheep lost, 927 dwellings destroyed, 7,460 miles of fencing burnt, and a total material loss of £2.6m. The State forests had remained moist long after the grasslands had become tinder dry and were relatively safe within themselves. Nevertheless 351,000 acres of State forests were severely burnt.

Victoria had never faced grass fires of such intensity before. Losses had been of a minor character although there had been occasional fatalities, but this disaster, coming so soon after January 1939, finally convinced public opinion of the need to support the fire authorities. The Royal Commission's recommendations relating to a State fire authority were promptly implemented by establishing the Country Fire Authority and co-ordinating the volunteer brigades into an efficient force.

2

SETTLEMENT

DISCOVERY AND EXPLORATION

The coast

The main purpose of Tasman's voyage of 1642 was to discover the extent of " The Great South Land ". However, he touched only the southern half of Tasmania (Van Diemen's Land), and therefore believed that this formed part of the continent's southern coast. In 1770 Captain James Cook, on his first voyage to the South Seas in the *Endeavour* to observe the transit of Venus at Tahiti, explored and charted New Zealand and then ran west towards New Holland, by which name Australia was then known. At 6 a.m. on 19 April by nautical reckoning *, Lieutenant Hicks sighted land which Cook named Point Hicks. By noon on the same day a round hillock was sighted further east, and Cook named this Ram Head. He proceeded easterly to Cape Howe which he named, and then continued northwards, charting the coast as he sailed.

In February 1797 the *Sydney Cove,* under the command of Guy Hamilton, ran ashore on Preservation Island in the Furneaux group. Hamilton sent a long boat under Hugh Thompson, the mate, with sixteen others to Port Jackson for help. Reaching the Victorian coast Thompson was cast ashore and the boat broke up approximately 20 miles west of the entrance to the Gippsland Lakes. Although only three survivors reached the Sydney settlement, they were the first Europeans to traverse the east Gippsland coast. In October 1797 fourteen convicts, having heard news of the wreck, left Port Jackson in a stolen boat, hoping to float the ship or claim the cargo. They reached an island to the west of Wilsons Promontory, where seven deserted their companions, returned to Sydney and surrendered.

In December 1797 George Bass, who was surgeon on the *Reliance* and had explored along part of the New South Wales coast, received permission from Governor Hunter to sail a whaleboat along the unexplored section south of Botany Bay. This voyage led to the discovery of Wilsons Promontory and Western Port, the latter so named because of its situation relative to every other known harbour on the coast at that time. Eventually, Bass found the remaining seven convicts and took two of them aboard his boat. As far as the existence of a strait was concerned, Bass only knew that Van Diemen's Land was not connected to the mainland as far west as

* As recorded in the log of the *Endeavour.*

Western Port, and he also observed the ebbing tide towards the east and the swell from the south-west. Bass returned to Port Jackson, reaching there on 24 February 1798. Later in the same year Bass and Flinders in the *Norfolk* circumnavigated Van Diemen's Land, and the strait was named after Bass at the instance of Governor Hunter.

As a result official instructions were sent from London to James Grant, in command of the *Lady Nelson* at the Cape of Good Hope and on his way to the Colony, to survey the newly found strait. He reached the western shores of Victoria on 3-4 December 1800, and from Cape Bridgewater examined the coast eastward to Cape Patton. From there the coast ran northward and Grant, presuming he had found another bay, named the area between Cape Patton and Cape Liptrap after Governor King, successor to Governor Hunter. Although he had not sighted the coast continuously in the vicinity of Port Fairy and Warrnambool, the western part of Victoria became known as Grant's Land. At the time it was popularly believed that the interior of Australia was a vast inland sea stretching from the Gulf of Carpentaria to the Southern Ocean, and King, interested in the depth and size of Portland Bay, again sent Grant to investigate. However, he sailed no further than Western Port.

By 1800 the whole coast of Victoria had virtually been discovered, apart from the gap known to Captain Grant as Governor King's Bay. Lieutenant John Murray in the *Lady Nelson* was ordered to explore the Bass Strait area, and on 4 January 1802 he sailed west from Cape Schanck, on the western side of the entrance to Western Port, and bore 12 miles along the coast to the mouth of a bay. He did not enter, but made for Cape Otway and King Island, returning later to Western Port, where he anchored. A launch was sent on 31 January to explore, and it returned on 4 February to report that the bay was larger than Western Port, and that there were probably several rivers. Murray then sailed the *Lady Nelson* into the new harbour on 15 February and named it after Governor King, who later altered the name to Port Phillip, honouring the first Governor of New South Wales.

A French expedition under Nicolas Baudin also made extensive explorations of the Australian coast, and, travelling from east to west, passed the entrance to Port Phillip Bay on 30 March 1802. Following the coast closely to Cape Otway, Baudin completed its discovery, as well as the Port Fairy–Warrnambool area which had not been seen earlier by Grant. Meanwhile fears of French conquest prompted further exploration, and on 18 July 1801 Matthew Flinders left England in the naval vessel *Investigator*. On his way to Port Jackson he traversed the southern coast from west to east, making an inspection of Port Phillip in May 1802. He climbed Station Peak in the You Yangs and reported on the good soil of the surrounding country. Baudin, having spent several weeks in Port Jackson, had met Flinders at Encounter Bay, and raised further suspicion about the intentions of the French Government. An account of his voyages was published later. French presence hastened a further investigation of Port Phillip in 1803 by Charles Grimes, Acting Surveyor-General. In the schooner *Cumberland* under the command of Lieutenant Robbins he surveyed the shores of the bay, and, discovering the Yarra River, followed it upstream by boat to its fresh water reaches.

R.B.S. 3A **VICTORIAN RAILWAYS BOOKSTALL DIVISION**

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AUSTRALIA

SOUTH

VICTORIA

SHOWING EXPLORERS' ROUTES

Scale of Miles

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PREPARED BY DEPARTMENT OF CROWN LANDS AND SURVEY, VICTORIA, 1961

It was unfortunate that reports of this survey had not reached England by the time Lieutenant-Colonel Collins left with the first settlers on the *Calcutta* and the *Ocean*. Landing on the Nepean Peninsula near the site of the future Sorrento in October 1803, Collins found the fresh water supply inadequate for 400 persons, and no better site could be found on an excursion to Western Port. Fearing the Yarra Aboriginals if he moved the settlement further round the bay, he remained for four months, then left for Hobart. However one of the 299 convicts, William Buckley, escaped on 27 December 1803 and travelled round the bay to the Geelong area where he remained with the tribes for thirty-two years. When John Batman arrived in 1835, Buckley's experiences furthered knowledge of the Port Phillip area.

The interior

By the 1820s settlers in the Colony of New South Wales had spread as far south as Lake George and the Monaro plains. Hamilton Hume, a skilled bushman who occupied the most southerly station of the Colony, was approached by Sir Thomas Brisbane, the Governor of New South Wales, to lead a party from Wilsons Promontory to Sydney. Hume preferred to attempt to reach the coast from Lake George, and agreed to take Captain Hovell with him, to share men and expenses. They began their journey on 24 October 1824, and reached what they believed was Western Port on 16 December. In fact they were not far from the site of Geelong or "Jillong", as the Aboriginals called that area. The journey was important for the discovery of the Rivers Hume (later named Murray), Mitta Mitta, Ovens, and Hovell (later Goulburn), and the the naming of Mount Disappointment, prompted by a reversal of fortune in crossing the Great Dividing Range. This discovery of rich land was not publicised and further settlement south of the Murray was delayed until after 1834. However, one settlement, prompted by rumours of French occupation, was attempted at Western Port by Captain Wright under orders from the Governor of New South Wales. Settlement Point on the eastern side was chosen on 24 November 1826, but the site was abandoned in January 1828.

Captain Charles Sturt traversed the course of the Hume River from its junction with the Murrumbidgee to the sea in January 1830, and named this section the Murray to commemorate Sir George Murray, then Colonial Secretary. Major Mitchell, then Surveyor-General of New South Wales, set out in March 1836 to test the validity of Sturt's claim about where the Darling entered the Murray, and, returning to his base at the junction of the Murrumbidgee, he crossed the Murray and camped at Swan Hill on 30 June. Ascending Pyramid Hill, he saw rich plains. During the following years, many squatters, travelling from across the Murray, were to find the tracks of his drays in the dark cracking clay soils of the Wimmera plains and Glenelg valley. Near the junction of the Glenelg and Crawford Rivers, Mitchell's party embarked in two boats and followed the Glenelg to its mouth, reaching the sea at Discovery Bay on 20 August. He then returned to the main expedition on its route eastwards. He left it again to move south to Portland Bay, near which he found the Henty brothers' thriving community. Going homeward Mitchell passed east of the Grampians, and named the prominent peaks; he ascended Mount Macedon, and later crossed the Campaspe, Goulburn, and Ovens Rivers, finally reaching the

Murray about 20 miles west of the site of the future Albury on 17 October. His report of his discoveries in " Australia Felix " and New South Wales was published in London in 1839.

Squatters arriving over the Murray from the north-east then became explorers, giving names to mountains and streams as they sought pastures. Mountainous areas in Gippsland had prevented many settlers from travelling southwards, but in 1835 George McKillop crossed the Snowy River from the Monaro district and travelled as far as Lake Omeo. Droughts in 1838 also caused Andrew Hutton to move 500 head of cattle from Nungatta along the Genoa River to the sea, and from Mallacoota Inlet westerly along the coast to Lake King, but he was forced back by Aboriginals. Edward Baylis later discovered the pastoral lands at Buchan and Gelantipy, but it was Angus McMillan, engaged by Lachlan Macalister, who finally established a passable route from the Monaro Plains to Lake Victoria. He had his first sight of " Caledonia Australis " from the top of Mount McLeod on 3 June 1839, and had penetrated as far as Port Albert by 14 February 1841.

Meanwhile Count Strzelecki had followed McMillan down the Tambo River. Skirting Mount Wellington he made for Western Port and finally reached Melbourne on 28 May 1840. He gave his own names to rivers and creeks previously discovered by McMillan, as well as the name Gipps' Land to the area traversed.

The Mallee had first received significant attention in 1847 when an agreement had been made to mark the boundary between Victoria and South Australia. Surveyor Henry Wade went to the edge of the country explored by Edward John Eyre in 1832. Pastoralist J. M. Clow made several excursions into the Mallee before occupying Pine Plains station and his reports aroused interest. Surveyor E. R. White completed Wade's task along the boundary in 1849.

F. J. H. Mueller also explored extensively while collecting botanical specimens, and was the first to climb certain peaks in the Victorian Alps. In September 1853 he was on the Horn and the Hump in the Buffalo Ranges and on Mount Buller, and he also travelled along the La Trobe River. Two months later he visited the Grampians and the Serra and Victoria Ranges. During 1854 and 1855 he again explored the Alps, then visited the Baw Baw area in 1860 and the Macalister River valley with Angus McMillan in 1861. By this time most important features of the Colony had been explored.

SURVEYING FOR LAND SETTLEMENT AND MAPPING

Three men were sent to Port Phillip from Sydney in 1836 with instructions to prepare a plan showing the natural features and the positions of the dwellings of settlers who had come from Van Diemen's Land. One of the party, Robert Russell, prepared a plan of their survey.

Early in 1837 Sir Richard Bourke came from Sydney to Port Phillip with Robert Hoddle. They decided upon locations for the two new towns, which Bourke named Melbourne and William, after Viscount Melbourne, England's Prime Minister, and William IV, respectively. Hoddle rapidly laid out the first portion of Melbourne by marking the alignments of the future Flinders, Spring, Bourke, and Spencer Streets. For this survey

he used a Gunters measuring chain and a circumferenter. He was appointed surveyor-in-charge at Port Phillip, but all the survey plans were sent to Sydney for the approval of the Surveyor-General.

The nucleus of a map of the Port Phillip District was established in the early years from the marking of the boundaries of town and suburban sections. From these surveys, traverses were made along streams, thus obtaining the location of the settlers' huts, the tracks, and the natural features.

Mapping began with a trigonometrical survey which was made in 1839 to determine the longitude of the mouth of the Glenelg River near the 141st meridian which had been proclaimed as the eastern boundary of South Australia. This determination was formally accepted as a portion of the border by the South Australian Government, but was disregarded later, when observations with larger and more precise instruments showed that the boundary should have been marked about two miles further east. The resulting dispute, which began in 1868, was not resolved until 1914 when the Privy Council rejected a South Australian appeal against a High Court decision in favour of Victoria.

In the early years settlers who had purchased or leased Crown land frequently complained that surveys were in arrears. Generally the Government could not be convinced of the importance of accurate surveys, and administrators who did realise this necessity did nothing because accurate surveys meant slower surveys. The lack of competent surveyors meant, therefore, that many squatters who held their runs under pastoral licence never received the leases promised. Many surveyors were in fact unsuited to Australian conditions, while some were appointed for political reasons with no regard for their lack of qualifications. The system of contract surveying also meant that no check was made of the survey field work.

Twice the Imperial Government ordered "Special Surveys", but they had little effect and were very unpopular with Port Phillip settlers. The first was for a sale of blocks, each being of eight square miles. This entailed only a boundary survey, the task of internal subdivision being left to private surveyors. English investors were encouraged to lodge £5,120 in London and later to come to Port Phillip to choose a 5,120 acre block where they desired. As a result several surveys were carried out in the 1840s including Dendy's Special Survey at Brighton, Elgar's at Kew, and Unwin's at Bulleen. Clarke's Special Survey of 31,375 acres near Sunbury was made possible when blocks of land of not less than 20,000 acres were put up for sale at £1 per acre without competition.

Surveys were further confused by the use of unsuitable instruments. Several theodolites had been imported from England in 1840 to replace circumferenters but the Governor of New South Wales, Sir George Gipps, did not enforce their use, largely because more scrub clearing was necessary for a theodolite survey and thus fewer surveys would be made. Before the 1870s, therefore, no reliance could be placed upon the land settlement surveys, and it was often impossible to obtain agreement of two adjacent surveys for issue of Crown grants, unless they had been made at the same time by the same surveyor.

By 1851 the Victorian survey administration was in great confusion. The rise in population from 77,000 to 539,000 within the succeeding decade was to cause more difficulties; it was almost impossible to satisfy demands

for topographic surveys of the goldfields, for geological surveys, for surveys for railways, electric telegraph, and public works, and for marine surveys. Only surveys defining land boundaries were being carried out, while no survey framework had been established with which surveys for settlement could be co-ordinated.

In the 1850s the Government recognised that basic surveys on trigonometrical principles were essential for accurate mapping and survey. As a preliminary to a detailed survey for the public works of Melbourne, the Government directed that a trigonometric survey be carried out, and another was then made in preparation for improvements in Hobsons and Port Phillip Bays. A small party from the Corps of Royal Sappers and Miners from England cleared hilltops and erected beacons for trigonometric stations. This was the beginning of a proposed primary, secondary, and tertiary triangulation of the whole Colony, and it formed the framework for future topographic and cadastral surveys. In 1858 a variation of the proposed triangulation was approved by the Government. Geodetic surveyors were to be appointed to proceed with geodetic triangulation from a base line near Werribee ; from that survey the Colony was to be divided into " geographical squares " of one degree each of latitude and longitude, each " geographical square " in turn to be divided into a hundred blocks (parishes) of about 24,000 acres. The parishes were to be subdivided for land settlement, the work being done by contract surveyors who were to use the block boundaries as base lines.

The establishment of the survey framework was not successful. Some meridional lines and parallels were laid down over country too rugged or too heavily timbered to be suitable for agricultural settlement, while public demand for surveys in distant fertile agricultural land could not be satisfied. Furthermore, the geodetic divisional lines were generally disregarded by the contract surveyors conducting settlement surveys.

In 1868 the Government decided to abandon the geodetic survey, although it was far from complete. It was considered necessary, however, to define the New South Wales–Victoria boundary from the source of the Murray River to Cape Howe, as the authorities wanted to know whether those engaged in mining operations on the Delegete, and on other streams near the border, fell under New South Wales or Victorian jurisdiction. The definition of the boundary on the ground was a difficult and intricate survey covering rugged country in the most isolated part of the Colony, and it required an extension of the major triangulation from east Gippsland into New South Wales. Although far from complete the Victorian geodetic survey provided a basis for scientific mapping. Following the border survey some geodetic work was done through the Mallee by contract surveyors, but proof of accuracy was difficult to obtain because the country lacked elevations suited to triangulation.

Following the introduction of the Torrens land title system in 1862, land legislation in 1865 permitted free selection before survey within 30 miles of the goldfields, and in one year several thousand occupation licences were granted for a total area of more than 2 million acres. The result was that public requirements, including the retention of water frontages for the Crown, reserves, and access roads were often disregarded, while many allotments were left unnecessarily irregular in shape ; surveying

became slower, and small, inferior portions of Crown land were often left without access. Moreover, since the occupation licensees demanded that their land should be surveyed, inexperienced contract surveyors were often employed.

In the Survey Department the charting of the surveys was much in arrears and there were numerous cases of the same land having been sold twice by the Government. A Royal Commission in 1870 found that the compilation of the Melbourne district plan was twelve years in arrears, that original surveyors' plans were being mishandled, and that detached surveys were often unchecked and frequently worthless. Reforms included the periodic checking of equipment and the preparation of a re-survey programme. For several years afterwards, up to 50 per cent of the Department's survey expenditure was for re-surveys. In every district the re-survey of numerous blocks, and in some districts of whole parishes, had to be effected before the issue of Crown grants. Re-survey was found to be essential for all goldfield townships which had not been abandoned.

In the following fifty years changes were made in the type of settlement surveys, and variations were made in the original programme of surveys of townships, roads, and subdivisions of unimproved Crown land. There were the village settlements; swamps were reclaimed and subdivided for intensive cultivation; freehold lands were re-purchased and subdivided for workmen's home sites; much larger areas of re-purchased rural land were subdivided for closer settlement; and lands suitable for dairying and fruit growing by irrigation were re-purchased and subdivided.

During this century the topographic mapping of Victoria has mainly been independent of surveying for land settlement. It has become a joint activity of the State and Commonwealth Governments: the State uses it as a basis for its own maps, and for co-ordinating geodetic and cadastral surveys; the Commonwealth uses it for mapping for defence needs and to ensure mapping co-ordination between States.

Production of strategic maps was first attempted by a branch of the Royal Engineers who attempted unsuccessfully to use the Victorian cadastral plans by adding contours and other topographic detail. Between the two world wars aerial photography for mapping was carried out by the Royal Australian Air Force, and photogrammetry supplemented the plane table, finally replacing it. Victoria's map coverage was still entirely inadequate in 1939, and an emergency mapping scheme resulted in compilation of hastily prepared topographic maps of certain previously unmapped localities.

In 1940 Victorian legislation provided for the co-ordination of Victorian cadastral surveys and for increased co-operation with the Commonwealth in a national mapping scheme. It also provided for the establishment of standard permanent survey marks with which later surveys would make connection for the laying down of standard traverses as a subsidiary to major triangulation.

After the end of the Second World War a precise geodetic survey for mapping of proposed developmental areas was begun. Aerial photography was used, and later, electronic measuring devices. The progress of land boundary definition during the same period was much less spectacular, although a great deal of work was done on the subdivision of re-purchased estates for the settlement of former members of the Armed Services.

Names of counties, parishes, settlements, and natural features are interrelated with the survey and mapping of a country. Before the proclamation of the *Survey Co-ordination (Place Names) Act* 1965 and the establishment of the Place Names Committee, naming was unsystematic : some places had received the names of local natural features and some had Aboriginal names ; others were named according to prevalent flora or fauna, or with historical names given by the explorers; the name of the first resident of a locality might also be used, or that of an innkeeper, or of a driver whose bullock team had often camped in a certain spot ; and many places had been named by the early surveyors. In assigning names the Committee ensures, as far as possible, that no duplications are created, and that careful discrimination is exercised to avoid the introduction of names void of significance and inappropriate to the permanent nomenclature of the State.

NAMING OF RIVERS

In Australia, with the notable exception of the Murray River downstream from Yarrawonga, rivers are too small for any major navigation and the early explorers and settlers more often crossed than followed them. Where crossing places cannot be identified, it is not easy to decide whether the rivers crossed and named by the explorers are those now known by the names given them. Because of the nature of major rivers with numerous tributaries, their naming is more controversial than the naming of localised geographical features. Different names can and do apply to the different parts of a stream ; where streams unite, the name of one may continue to be used for the lower part, or a new name may be given ; and streams or parts of streams may also have different names at different times in their history. Sometimes a multiplicity of streams have the same name: in Victoria the name Stony Creek appears 63 times; Back Creek, 45 times; Deep Creek, 35 times ; and Sandy Creek and Spring Creek, 32 times each.

By 1803 the coastline of Victoria had been delineated by Flinders, Bass, Grant, and Murray. Bass, landing and searching for water in 1798, discovered and showed on a map the stream on the east coast of Western Port which now bears his name. Grimes, sailing round Port Phillip Bay in 1803, referred to streams but did not bestow any names.

In 1824 Hume and Hovell journeyed southward from Lake George to the sea and named the Hume (now Murray), Ovens, and Hovell (now Goulburn), and gave other names including King Parrot Creek and Sunday Creek to streams north of the Great Dividing Range ; the names Arndell and Exe which they used south of the Range have disappeared as their location of the streams was vague.

In 1836 Major Mitchell, passing through "Australia Felix" on his journey of exploration to the sea, gave names to many streams. The Loddon, Avon (near St Arnaud), and Avoca were named after streams in England and Ireland ; he named the Richardson, Norton, McKenzie, Chetwynd, Stokes, and Glenelg after various persons; and he used the native names Wimmera and Wannon. On his return journey he named the Crawford, Fitzroy, Surrey, Grange, Hopkins, Barnard (now known as Coliban), and the Campaspe.

Run holders had entered Gippsland from the Monaro plains before 1840, but did not publicise their activities. However, in 1835 McKillop, in a sketch

of his route to Omeo, showed nearby Livingstone Creek (named after a member of his party). Although McKillop's Crossing on the Snowy was named after him it is possible that he crossed this river further north in New South Wales and that it was McMillan in 1839 who crossed near McKillop's Crossing. The name Glengarry, for many years applied to the La Trobe River, is normally attributed to McMillan. In 1839 the native name Bukkin (Buchan) was used by Baylis, another run holder from Monaro.

Strzelecki's route in 1839 and 1840 from Monaro to Western Port followed Cowrang (Corryong) Creek for part of the way. Although Corryong takes precedence historically, this stream is known on various maps as Nariel Creek, Zulu Creek, Jeremal Creek, and Wheelers Creek. Strzelecki, never modest in his claims, showed on his map the entire courses of the rivers he crossed. These alignments were soon proved faulty, thus providing argument in favour of McMillan's names. McMillan had made various journeys in Gippsland; by January 1840 he had reached the Macalister and by February 1841, Port Albert. He presumably kept a journal, and he described his journeys in letters a number of times, often many years later. A letter to his employer, Macalister, in 1850 mentions the Nicholson, Mitchell, and Avon Rivers. Tyers used Strzelecki's names on a map in 1844; McMillan's names, with the addition of Macallister [*sic*] were published in Sydney in 1845. Ham's map of Victoria published in 1847 generally used Strzelecki's names but later maps often showed both sets of names.

To resolve early conflicts in bestowing names, Mitchell as Surveyor-General had sought advice from the Church authorities as to who was entitled to bestow names. The relevant section in the Victorian *Land Act* 1869 remains and permits the Governor in Council to alter names but apparently not to give them. Under the *Survey Co-ordination (Place Names) Act* 1965 a six member committee representative of several departments now carries the responsibilities connected with the naming or re-naming of geographic features, including the spelling of the names. It works in consultation with municipal councils and other authorities. Since the Place Names Committee has been in operation determinations have clarified the position regarding the Maribyrnong and the Yarra, Mount William, Deep and Jacksons Creeks, and tributaries of Dandenong Creek. The Committee has also conferred with the Geographical Names Board of New South Wales about the Murray River being so named from its source near Forest Hill to its mouth at Goolwa, South Australia.

LAND SETTLEMENT

Early settlement

The first official attempt at settlement in the Port Phillip District, which eventually became the State of Victoria, was under the leadership of Lieutenant-Colonel David Collins, whose party established a camp near the site of the future Sorrento in 1803, and who described the area as an unpromising and unproductive country. After four months Collins departed with his party to Hobart. A second attempt at settlement was instigated in 1826 when a party led by Captain Wright landed in Western Port. This settlement was abandoned early in 1828. The first lasting settlement was

established by the Hentys at Portland in 1834 ; this was followed by Batman's landing at Indented Head and later at the head of Port Phillip Bay in 1835, and by Fawkner's expedition in the same year. These settlements were not, however, authorised by the Government, nor did they conform to Bourke's proclamation of 1835 providing for prosecution of trespassers on Crown lands. Despite this, Bourke, acknowledging the facts of the situation, sent a police magistrate to report on conditions in 1836 ; he found 177 people with more than 25,000 sheep established with stations as far as 80 miles inland. Captain William Lonsdale was sent to act as magistrate later that year ; in 1839 Charles Joseph La Trobe took office as Superintendent.

Unauthorised pastoral settlement continued to expand to new areas, and in 1836 an Act designed to legalise squatting was passed. Territories outside the previously determined settlement boundaries were divided into Districts under the control of a Commissioner of Crown Lands. Each squatter was allowed to occupy as much land as he could obtain for a yearly payment of £10. When the alienation of Crown land in country areas began the land was auctioned at 12s per acre. The first country land was sold in the Parish of Will-will-rook, north of Melbourne, in September 1838, and under this system the land was acquired at once in fee simple on payment of the purchase money. The first sale of town lots had been held in June 1837 ; it was of land in Melbourne and Williamstown. In 1839 the Legislative Council passed an Act providing for a tax on stock, the proceeds of which were to be used to finance the Border Police. In return for the annual fee and the stock tax, the squatter was to receive protection and supervision.

By the 1830s settlement in New South Wales had passed the Murrumbidgee, and for a time southward movement slackened. However, Major Mitchell's journey through the Wimmera and the Western District (Australia Felix) and his published reports of vast areas of open plains, together with the Acts of 1836 and 1839, stimulated further rapid expansion. Squatters (the overlanders) moving from the north reached Carlsruhe and the Coliban in 1837, and runs were established in the Goulburn valley as far south as Seymour. By 1838 stations had spread to the Campaspe, and within two years country as far west as the Pyrenees had been taken up. Settlement of southern Victoria from Melbourne and Portland was proceeding at the same time. From 1836 to 1840 the squatters occupied the area from Werribee to the Grampians and virtually all of the Western District. After 1844 there was a move by pastoralists to take over the less favoured Wimmera and Mallee. Between 1840 and 1844 the Gippsland plains between the mountains and the sea were occupied, and by this time almost three quarters of Victoria was held by the squatters.

However, the existing system of tenure was seen by the Governor, Sir George Gipps, as being unfair and as imposing a penalty on small land holders. In 1844, for example, four of the largest squatters occupied 7.7 million acres carrying 1.2 million sheep, and paid £560 in licence fees, whereas fifty-six of the smaller squatters, paying the same fee, depastured 68,000 sheep on 433,000 acres. To overcome the situation two sets of regulations were drawn up in 1844. The first limited the size of runs to 20 sq miles or 4,000 sheep, and provided that each licence should cover only one run. The second, the purchase regulations, were designed to give security of tenure and provided that after occupying the land for 5 years, the

squatter could purchase 320 acres of his run at £1 per acre. In return, he was to be given possession of the run for 8 years, when he could purchase a further 320 acres, and occupy the run for a further 8 years. If the squatter did not buy, any other person could do so and thus obtain possession of the whole run.

There was a violent reaction to these proposals from the squatters; they held that the fees and purchase prices were too high, the powers of the Land Commissioners too great, and the stock tax illegal. The report of Cowper's 1884 Committee on Land Grievances supported these views, but the Colonial Office did not act on the report. However, agitation continued and in 1846 the Waste Lands Occupation Act was passed. This retained some features of Gipps' system relating to security of tenure but omitted the safeguards. It was brought into operation by Orders in Council in 1847, and was intended to apply generally to Australia. The Act divided New South Wales into three districts—the settled, intermediate, and unsettled districts. The settled districts included most of the area in the existing nineteen counties, the nearer areas surrounding Port Phillip and Portland Bays, and land within three miles of the coast. The intermediate districts comprised parts of certain counties which had not been taken up and thirty-one new counties stretching from Brisbane to Portland Bay. The unsettled districts comprised the country beyond.

In the settled districts leases were to be granted for one year, and in the intermediate districts for not more than 8 years, with the Crown having the right to sell all or part on 60 days notice at the end of each year. However, the lessee had a pre-emptive right to purchase, or to receive compensation for improvements if he did not exercise this right. In the unsettled districts the runs were to be leased for not more than 14 years at the rate of £10 per annum for not more than 4,000 sheep, with an extra £2.10.0 for every additional 1,000 sheep carried. The lessee was to have a pre-emptive purchase right during the currency of the lease and could purchase portions of not less than 160 acres at a minimum price of £1 per acre. If the runs were sold at the end of the lease, the lessee was to receive compensation for improvements.

The 1847 Orders in Council should have clarified the position of the squatters and given them security of tenure, but in the Port Phillip District there were differences of opinion on the interpretation of the Orders. In particular, the squatters held that leases for definite periods of 8 or 14 years were implied, and that pre-emption meant that the squatter had the general right to purchase land within his run at any time during his lease. On the other hand, the Government held that leases were to be for periods of 8 or 14 years, and that pre-emption gave only the right of purchase, confined solely to the homestead, at the end of the lease. These differences of interpretation led to legal action, with the result that, although a workable compromise was put forward by the Colonial Office in 1853, and leases were granted to squatters in New South Wales in 1854, no leases were issued in Victoria. In their place, and as a result of a Royal Commission of 1854, yearly licences carrying the privileges of pre-emptive purchase of homestead and compensation for improvements were issued.

By this time Victoria had been created an independent Colony. The discovery of gold in 1851 resulted in a dramatic increase in the population

from 77,000 in 1851 to 539,000 in 1861, and emphasis on land policies changed from definition of the rights of squatters to the problem of opening the land for agricultural rather than pastoral production. As the surface gold diggings became less profitable, the greatly increased population began to demand the release of the land for agricultural purposes. Until this time land transactions were legally very cumbersome, and it was fortunate that in 1858, when most Colonies were considering Acts for small settlers, the Robert Torrens' Real Property Act was passed in South Australia. The merits of the system of registration of title certificates with details of encumbrances appearing on the titles were recognised, and in 1862 similar provisions were introduced into Victorian law.

Selection Acts

The general pressure, together with government concern about the slow rate of agricultural development, resulted in Nicholson's *Land Act* 1860, the first legislation passed by the Victorian Parliament concerning the disposal of Crown lands. Land could be selected after survey and payment, but no one could select more than 640 acres within a year unless the additional area had been open for selection for over a year. The price was £1 per acre, and where two or more applicants applied for the one block, a limited auction (confined to the applicants) was held. The selector had the option of paying cash for the whole of his block, or for half and renting the second half for 1s per acre with the right to purchase later. When the Act was passed about 4 million acres of the best land had already been sold. However, the squatters were in a better financial position to buy their land, and the problem of settlement of smaller farmers remained unsolved.

Approximately 800,000 acres, mainly in the Western District and around the goldfields, had been disposed of under this Act by 1862, when a further attempt was made to prevent competition between squatters and farmers by setting aside agricultural areas for selection. It was hoped that instead of the land passing to large landed proprietors it would be taken over by tenant farmers, farm labourers, and the large number of persons who had initially been attracted to the Colony by gold.

The Duffy Land Act was introduced by Charles Gavan Duffy who was then responsible for lands. As before, the price was £1 per acre, but the drawing of lots was substituted for limited auction in the event of there being more than one applicant. Half the area was to be paid for at once, and the remainder of the purchase price, at the annual rate of 2s 6d per acre, was to be paid over a period of 8 years. No more than 640 acres could be selected by any one person each year. Three alternative conditions on occupation were imposed; each selection was to be enclosed with a substantial fence, a habitable building was to be erected on the land, or one acre out of ten was to be cultivated within twelve months. In the three years of the operation of the Act almost 2 million acres were sold, but the squatters, through " dummy " purchasing, were able to obtain large areas, and it was not possible to enforce the restrictions designed to retain the land as agricultural. Consequently most of this land passed into the hands of the squatters and the alienation of the western plains was almost complete. In 1863 the improvement clauses were withdrawn because they could not be enforced.

Wheat harvesting at Cope Cope near St Arnaud, using auto-header, with silo in the background.

Australian Wheat Board

Hop field in the Ovens valley near Myrtleford.
Department of Agriculture

Hay cutting with reaper-and-binder, and stooking, at Werribee, *c.* 1938.
Department of Agriculture

Grading apples for export, c. 1910.
Department of Agriculture

Spreading sultanas on drying racks at Red Cliffs.
State Rivers and Water Supply Commission

Row crop irrigation in northern Victoria (top). Ploughing before potato planting at Mt Evelyn (centre). Aerial application of seed retention chemical to phalaris grass crop at Alexandra (bottom).

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It was not until 1865, however, that the problem of settlement on small holdings was overcome by Grant's Act, which added a provision to the existing legislation requiring the land to be taken up on a leasehold for 3 years before purchase, and requiring residence on the block during the 3 years. Rental was 2s per acre each year, and improvements to the value of £1 per acre had to be carried out within 2 years. If the conditions were complied with, the lessee had the right to purchase at £1 per acre. If he did not wish to exercise this right, he could require that the land be offered at auction and he could recover the value of improvements made. The Act stimulated settlement, but did not eliminate the "dummy" purchases. Under this Act, approximately 3 million acres were selected, although because of forfeitures only 1.5 million acres matured into freehold titles. Provision was also made for the licensing of land for residence and cultivation purposes in areas of up to 20 acres adjacent to the goldfields. Eventually the licensees of each area were given the right to convert their areas to freehold providing that no mining objections existed.

In 1869 Grant's second Land Act was passed and became operative in 1870. Selection before survey was introduced, the area to be selected was reduced to 320 acres, and a person was allowed to select only once. The three year preliminary lease and requirement for carrying out improvements were retained. The lessee was required to enclose the block and to cultivate 1 acre in 10 before the end of the three year period. The rent payable was 2s per acre, which was credited to the selector as part payment of the £1 per acre purchase price. At the end of three years, on certification of compliance with the conditions, the selector could either purchase his block outright by paying 14s or take out a 7 year lease at 2s per acre per year, the amount to be credited as payment of capital. The Act also contained provision for sale of up to 200,000 acres of Crown land each year by auction at an upset price of £1 per acre. The ballot system of obtaining priority for simultaneous applications was abolished, and public hearings, called Local Land Boards, were instituted. Dissatisfied applicants could appeal for a hearing from the Minister. This Act checked the earlier abuses and the more liberal conditions made it very effective.

Apart from encouraging agricultural settlement, the 1869 Act clarified the provisions governing pastoral occupation. Runs on unalienated and unselected Crown lands were divided into two types. "Existing runs", those in existence before the operation of the 1869 Act, were unlimited in size, and were held under pastoral licence, renewable annually. "New runs" were to be held under any term not exceeding 14 years, the right to the lease having been purchased at auction in the first instance. They were limited in size to a capacity of 4,000 sheep or 1,000 cattle and carried the pre-emptive right to purchase 320 acres at £1 per acre. The former were by far the most extensive and numerous. The annual rent for both types was based on carrying capacity (1s per sheep or 5s per beast). The establishment of new runs without conditions was not popular and was discouraged by the Government, which later offered an alternative of "grazing rights". The possessor of a right could graze livestock on Crown lands not forming part of a run. Under this system unoccupied pastoral lands were divided into blocks and offered for tender annually.

There were economic difficulties during the 1870s, as well as a long

drought during the decade. A Committee of Inquiry in 1879 found that the drought and the need for improvement in the first 3 years caused hardship to the selectors on agricultural land. Consequently the 1869 Act was amended by Longmore's Act, which removed the need for unproductive expenditure in the early years. The drought broke in 1878 and settlement went ahead rapidly, aided by an Act of 1877 which imposed a land tax to attenuate the large estates. Grant's Act of 1869 as amended expired in 1880, but it had largely achieved its objectives of safeguarding selection for agricultural purposes. Almost all of the then recognised agricultural land had been allocated, including 11 million acres (mostly in the Wimmera, Goulburn valley, and Gippsland) between 1869 and 1880. The only substantial areas remaining were in the hill country of Gippsland and the Otways, and in the Mallee.

The Mallee

Because the legislature was preoccupied with other matters, land tenure problems were held in abeyance for several years. However, circumstances directed attention to the Mallee—in particular rabbits and wild dogs which were using it as a breeding ground and had reached plague proportions. The Mallee had been partly settled since the late 1840s but because of the vermin there were only 145 runs carrying 122,000 sheep and spread over 9 million acres. The area produced 5,000 bales of wool in 1875, and only 900 in 1882. To cope with the situation the *Mallee Pastoral Leases Act* 1883 came into force on 1 December in that year. The Act divided the Mallee into two divisions—one of about 10 million acres being known as the "Mallee country", and the other, of about 1.5 million acres, along the southern and eastern fringes, called the "Mallee border". The "Mallee country" was divided into blocks of various sizes and each block into two parts. At the option of the applicant a lease was granted for one of these and carried the obligation of occupying the other. The main conditions were that the lessee was to destroy vermin on the whole block within the first 3 years, surrender to the Crown the unleased portion after 5 years, and maintain improvements in good order. The time of the lease was not to exceed 20 years, and on expiration the land and improvements reverted to the Crown. Annual payments for "Mallee blocks" leased portions were fixed at 2d per sheep or 1s per beast for the first 5 years, 4d or 2s, respectively, during the second 5 years, and 6d and 3s over the remaining period. For the unleased portion, rates were 2d per sheep and 1s per beast carried, over each of the 5 years of occupancy. The "Mallee border" was subdivided into "Mallee allotments" (of less than 2,000 acres) which were available for lease on the same terms as the leased portion of a "Mallee block". The Act proved to be entirely successful and previously abandoned country was reoccupied.

Approximately 25 million acres had been alienated when the *Land Act* 1884 replaced the *Land Act* 1869, and subsequent Acts (except, of course, the Mallee Pastoral Leases Act) dealt with the remaining fragments of unalienated Crown land. It classified those lands into pastoral lands, grazing and agricultural lands, auriferous lands, lands which could be sold by auction, forest reserves, timber reserves, and water reserves. The pastoral lands were leased as pastoral allotments, capable of carrying from 1,000 to 4,000 sheep, for a term not exceeding 14 years,

after which they reverted to the Crown. Rental was 1s per sheep or 5s per beast, and the lessee had the right to purchase 320 acres as a homestead during the period of the lease. The agricultural and grazing lands were leased in areas not exceeding 1,000 acres for periods of up to 14 years. Rental was fixed by appraisal at between 2d and 4d per acre. The lessee had the right of selection of 320 acres.

In 1887 it was discovered that the Mallee had great potential for crop production. This, together with the development of cheaper clearing and cultivation methods using the scrub roller and stump-jump plough, led to a land rush to the Mallee. The Mallee Act of 1889 permitted the lessees of " Mallee allotments " to select 320 acres under the same conditions as selections under the 1884 Land Act. This privilege did not apply to lessees of " Mallee blocks "; however, many of these subdivided their leases into allotments and sold them to newcomers.

Under the Act of 1883 subdivision of " Mallee allotments " as a means of permitting selection to continue was held to be illegal. By 1891 the new settlers were paying the lessees as much as £1 per acre. As a result of a Committee of Inquiry this practice was officially stopped in 1891, but it unofficially continued although the settlers had no legal right of selection. They and others, however, agitated for the right for all Mallee settlers to select 640 acres of their leases. This right was eventually granted under Cuthbert's Act in 1895. The Act also reserved all land within 3 miles of the Murray River and prohibited the single ownership of more than 3 square miles of Mallee land. As a result of the concession, and despite the drought, there were 60,000 persons in the Mallee by 1898. Acts of 1898 and 1899 fostered the advance by allowing classification of Mallee land and by setting up small settlers in the Little Desert. By 1907, 3.25 million acres of Mallee country had been taken up.

Gippsland

The settlement of the hill country of Gippsland had been delayed because the area was densely timbered and when cleared the country was suited to dairy farming rather than to cropping. As early as the 1870s the local market was over-supplied with butter, and with no other market available there was little interest in developing the area. Innovations in the 1880s, including refrigeration and the factory manufacture of butter, made exports possible. Rough roads were gradually developed for transport to the factories and the south Gippsland railway was opened in 1891. Under these conditions and the provisions of the Land Act, settlement, although still difficult physically, went ahead rapidly.

Other land legislation

Besides legislation outlined above and that concerning closer and soldier settlement, various Acts have been passed in Victoria to regulate the sale and occupation of Crown land. Since 1860 there have been ninety Acts (including the consolidations) which have dealt with some aspect, although many, having served their purpose, have been repealed. Furthermore, even in the earliest legislation there was provision for residential industrial licences and leases, and for the reservation and management of Crown lands for public parks, recreation, etc.

Apart from closer settlement legislation the next major amendment to land legislation was the *Land Act* 1911, which introduced a system of selection by purchase leasehold. The area of allotment varied according to the quality of the land, the maximum being 960 acres outside the Mallee and 1,600 acres within that territory. Purchase money ranged from 5s to £1 per acre and was payable over 20 years (or 40 under special circumstances). This continued until 1956, when the Improvement Purchase Lease was introduced. Under this, the lessee had to carry out more improvements than necessary under any previous legislation before freehold was permitted.

PROPERTY DISTRIBUTION

There was a continual demand for agricultural land even after the initial process of alienation had been virtually completed by the 1880s. This could only be met by resumption and subdivision of alienated land which the squatters, by " dummy " purchasing and circumventing the intention of the early land legislation in other ways, had built up to relatively few large pastoral " runs "; they did not establish small farms devoted mainly to agriculture. A policy of acquiring this private land and re-distributing it was first put into effect by the Victorian Government in 1898. The Land Act of that year authorised the purchase of private lands suitable for closer settlement, and thus gave the first authority for government schemes which were to be of considerable importance, particularly after the First and Second World Wars. The provisions of the 1898 Act were incorporated in the Act of 1901. These Acts allowed the Crown to repurchase land, but each individual agreement had to be ratified by Parliament. This was a cumbersome procedure, and, without powers of compulsory acquisition, progress was slow; in six years of operation to 1904 less than 34,000 acres were acquired. The main provisions were that sale was to be by agreement, and that new settlers were to pay a price sufficient to cover the costs of the land, subdivision, roads, clearing, draining, and fencing or other improvements. The purchase money plus interest at 4.5 per cent was payable in 63 half-yearly instalments. The conditional purchase lease included provisions for personal residence for 8 months during each of the first 6 years ; improvements to the extent of 10s per acre which were to be carried out before the end of the third and sixth years ; and a stipulation that the land was not to be transferred, assigned, or mortgaged within 6 years. The land so acquired was generally subdivided into agricultural farm allotments, but in some localities small holdings of up to 20 acres were made available to enable farm labourers and their families to obtain part of their living from the land. Several areas were also purchased for subdivision into workmen's home sites.

A new Act designed to overcome problems in the earlier Acts was passed in 1904. This Act introduced the concept of compulsory purchase and for administration of land allotment by a Board, thus removing the necessity for Parliament to approve individual transactions. The Minister administering the Act could direct the Board to acquire the land (at auction, by direct purchase, or by exchange of land) at a price not exceeding the Board's valuation. Should the owner refuse the offer, then by resolution of both Houses of Parliament the land could be acquired compulsorily. The owner could claim exemption of land up to £10,000

in value, and the price payable for the remainder would be fixed by a Judge of the Supreme Court. The Board could dispose of acquired lands as agricultural allotments at fixed prices on terms similar to those under earlier legislation. The Act also provided for finance for the scheme to be raised by the issue of government stock or debentures up to £500,000.

The *Closer Settlement Act* 1906 relaxed provisions covering repayments in the event of hardship. The Act of 1907 empowered the Board to grant allowances (at 5 per cent interest repayable over 16 years) to lessees who had used all their capital on improvements. The Act was further amended in 1909 when the powers of the Land Purchase and Management Board were expanded to permit acquisition of land in irrigation districts for future settlement on the recommendation of the State Rivers and Water Supply Commission. The Water Acts of 1905 and 1909 entrusted management of all irrigation works (except the First Mildura Irrigation Trust) to the newly created State Rivers and Water Supply Commission. The Commission had power to collect rates and to allot water as a right to properties in channel districts. A vigorous policy of closer settlement was undertaken, and more extensive use of water occurred. The area irrigated increased from 86,000 acres in 1910 to 245,000 acres in 1915. In 1915 and 1916 a Royal Commission investigated the progress of settlement schemes and this led to many administrative changes. By 1917 over 570,000 acres had been resumed and about 4,500 settlers were in occupation, but in the next few years land acquisitions for soldier and civilian settlement and for other schemes sponsored by the Government were on a much larger scale.

Closer settlement progressed rapidly because of government policy to settle discharged soldiers on the land. This settlement was based on legislation introduced in 1917 and amended several times in minor ways until 1924. Conditions of settlement were similar to those operating under the ordinary scheme, but there were several concessions, one of the most notable being that no payments were required during the first three years of occupancy. The operation of the Acts was under the control of the Closer Settlement Board, with the limitation that closer settlement areas under irrigated conditions and situated within an irrigation and water supply district were managed by the State Rivers and Water Supply Commission. In 1925 a Royal Commission appointed by the Victorian Government investigated soldier settlement, and this resulted in deferment of instalments and the writing off of some debts. The Discharged Soldier Settlement Acts were consolidated and incorporated into the *Closer Settlement Act* 1928. Over the period of independent operation almost 10,500 soldiers were settled on the land. Unfortunately many of the settlers met difficulties because the scheme had been based on over-optimistic price expectations. In fact, many of the areas were not sufficient for what was known as a " home maintenance area ". The prices for a number of products had fallen by 1924, and in 1927 a Royal Commissioner, Mr Justice Pike, was appointed by the Commonwealth to inquire into losses owing to soldier settlement and the respective responsibilities of the Commonwealth and States. In 1929 he estimated that only 83 per cent of settlers remained on their blocks and that losses (principal, interest, and administration) from the scheme in Victoria were close to £7.7m.

A Royal Commission in 1933 inquired into the position of about 300 migrant settlers and concessions were made to them. By this time many

settlers suffered great hardship caused by a cycle of adverse seasons, by the uneconomic size of holdings which were not proving as productive as originally estimated, and above all, by the prevailing financial depression. The difficulties had become so great that the Government launched a five year plan to increase areas where necessary, to revalue all properties, and to write off sufficient debts so that settlers would be able to meet their commitments and ultimately obtain freehold titles. This plan was completed in 1938 and the remaining settlers, about 11,000, were given new terms of repayment of adjusted liabilities. This virtually finalised the settlement schemes at the time with the following results :

VICTORIA—ASSISTED LAND SETTLEMENT TO 1938

Particulars	Soldier settlement	Closer settlement
	acres	acres
Non-irrigable areas—		
Purchased land	1,771,183	1,150,991
Crown land	584,028	69,214
Irrigable areas—		
Purchased land	125,186	181,144
Crown land	1,889	1,219
Total area	2,482,286	1,402,568
	number	number
Settlers who had—		
Fully repaid their liabilities	803	4,827
Left their holdings	6,677	6,663
Remained under contract	5,448	5,240
Total settlers	12,928	16,730

The second major period of closer settlement took place after the Second World War. Although legislation was similar in many ways to that of the earlier period, the administration of the scheme was based on recommendations made by the Rural Reconstruction Commission. In Victoria the enabling legislation was the *Soldier Settlement Act* 1945. The Act established a Soldier Settlement Commission and provided for the raising of an initial £15m for soldier settlement. The Commission had powers to acquire land for development and subdivision, and to make advances to soldiers for the purchase of single unit farms. Under the provisions of the War Settlement Land Agreement (an agreement between the State and the Commonwealth) the State undertook to develop the resumed land to a stage where it could be brought into production quickly. The agreements also provided for financial arrangements between the Commonwealth and the States in relation to soldier settlement. The Commission acquired over one million acres of freehold land, and set apart 50,000 acres of Crown land for the purpose. Over 3,000 holdings were allotted to ex-servicemen for all forms of farming, both under rainfall and irrigation conditions. Before allocation, the Commission advanced holdings to a stage of development by providing houses, out-buildings, and basic farm improvements. Practically all settlers under this scheme have been successful, largely because of the care taken in their selection, favourable seasons and prices over the ensuing

years, a concessional interest rate of 2 per cent on the capital liability placed on each holding, and a repayment period of 55 years. At the conclusion of the scheme, 3,292 soldiers had been settled on Commission estates, and in addition the Commission had made advances to 2,878 settlers to assist in the purchase of single unit farms.

After the conclusion of soldier settlement the *Land Settlement Act* 1959 provided for general settlement under provisions broadly similar to soldier settlement, but without advances for single unit farms. The Rural Finance and Settlement Commission, formed in 1962 by merging the Soldier Settlement Commission and the Rural Finance Corporation, adopted a policy of developing unproductive virgin Crown land, and of acquiring and re-subdividing areas opened up for irrigation, where dry farming had previously been carried out. The first type of development on such a large scale was unique in Australia. In the Heytesbury area south of Camperdown over 100,000 acres of virgin land was set apart for development which began in 1956, and over 71,000 acres had been cleared and sown to pasture by 1966. Other large projects included Yanakie (Wilsons Promontory), and the East Goulburn Irrigation Settlement where eighty-eight dairying and seventy-nine orchard blocks have been allotted. Until 1966 the Commission had acquired 20,489 acres of freehold land and set apart 106,681 acres of Crown land for " civilian " settlement schemes, and 421 holdings had been allotted. The target for future allocation is fifty holdings each year.

RURAL DEVELOPMENT

Victoria is the most intensively farmed State in the Commonwealth. Its 38 million acres of farm land produce annually more than 100 million bushels of cereal grain, about 0.25 million tons of potatoes and many thousands of tons of other vegetables, fruit, and other produce. Its pastures are grazed by more than 33 million sheep and 4.5 million cattle, producing some 300 million lb of wool, 100,000 tons of butter, large quantities of milk, cheese and other dairy products, and over 500,000 tons of meat each year.

In the early 1800s whalers operating along the coast grew crops sporadically for their own use, and in 1834 Henty settled at Portland Bay and set up a farm. By 1836 Captain Griffiths had settled at Port Fairy to combine farming with whaling, and in the same year Thomas Manifold landed sheep at Point Henry near Geelong. This embryo farming community did not remain near the coast for long. In 1837 the Learmonths set out for Lake Colac and J. H. McLeod discovered Lake Corangamite, and in 1838 Hugh Murray with 100 sheep occupied the site of the future town of Colac. The following year David Fisher and the Mercer brothers established Mt Shadwell Station, and in 1839 the Brown brothers, with sheep from Tasmania, settled at Brown's waterhole (now Lismore). In the same year the Hopkins River was reached by Watson, and the first land in the Terang district was occupied. By the early 1840s the squatters had reached the Grampians.

The Western District was not the only part of Victoria to be settled during this period. C. H. Ebden established the Bonegilla run on the river flats at the junction of the Murray, Kiewa, and Mitta Mitta Rivers about 1835. In 1836 Major Mitchell explored the Wimmera, also the north-east of

the State to where, as a result of his reports of excellent grazing land, pastoralists moved from New South Wales. George Faithfull settled in the Wangaratta district in 1837. A severe drought north of the Murray in 1841 accelerated the southward movement. By the mid-1840s most of the best grazing land had been claimed as runs, many up to 250,000 acres in extent. An economic depression early in the decade caused wool prices to slump, but by 1850 wool production was re-established as a profitable enterprise with ready markets in England, and was the basis of the rural economy.

The potato shortages in Ireland in the 1830s and 1840s, culminating in the disastrous famine of 1847, caused migration to Australia, and the migrants mainly settled on small holdings purchased from the Crown in the vicinity of the developing towns of Warrnambool, Port Fairy (then named Belfast), and Koroit ; however, it was the discovery of gold in the early 1850s which prompted the first major change in Victorian agriculture.

Cultivation before the discovery of gold had been confined to the production of feed for horses and of produce for household use, but large numbers of miners created an opportunity for rich returns from dairy farming and cash cropping. Wheat, oats, and vegetables were grown, and dairy herds were established on land adjacent to the goldfields. Barley was a crop which found a ready market in the malt houses of the mining towns. The demand for horse feed increased dramatically with the growth of mining, and many graziers turned to the production of hay and oats. It is only in comparatively recent years with the decline in the use of horses for farm power and transport that this demand has declined. The gold rush brought some hardship to the pastoralists, who found it difficult to keep shepherds, but it gave them a chance to diversify their activities and consolidate their fortunes by supplying meat, and later flour, to the diggings. Gold was also the catalyst of the beef and lamb industries ; its discovery led to a change in the type of livestock carried on pastoral runs. Because of the demand for meat, cattle numbers increased on pastoral runs and Merino sheep were crossed with British breeds, although after the gold boom the breeding of fine wool Merinos reached a new peak.

Interest in agricultural development intensified as the amount of easily recovered alluvial gold began to decline. Many of the diggers needed a new source of livelihood and agitated for the release of land, and the squatters wanted legal title to the areas they held. A series of Land Acts in the 1860s and the 1870s sought to satisfy both these demands. The opening of pastoral runs for selection during these years brought about a wider diversification of the agriculture practised. Cereal production became more important, and flocks of dual purpose sheep continued to increase on the arable land while beef cattle tended to be restricted to areas unsuitable for cultivation. Horse breeding became a profitable occupation as the demand for horses for farm work and transport expanded ; orchards and vineyards were planted ; and dairying and tobacco and hop growing were established in the river valleys. The general pattern of land use which emerged by the 1880s has since remained basically the same, at least until the early 1970s, except for the development of irrigation districts, the extension of wheat growing and animal husbandry into the Mallee, and some minor changes in other parts.

Cereal growing began in the higher rainfall districts near the centres of population. This was partly because the environment in the future wheat belt was not suited to the late maturing varieties which had been evolved in Europe, and partly because wheat was not valuable enough on a weight basis to cart long distances by bullock and horse teams. Initial attempts to grow wheat in the Wimmera were abandoned after crop failures in the 1850s. Purple-strawed wheat imported from England about 1860 was better suited to the lower rainfall districts, and afforded the potential for extending wheat growing in these areas, but transport was still the barrier and often it cost more to carry a bushel of wheat to the seaboard than it did to ship it to England. Initial expansion of wheat growing took place in the northern part of the State and was associated with the completion of the railway line through Bendigo to Echuca in 1864. By the early 1870s the Wimmera was included in the wheat growing statistics. A railway line through Maryborough to St Arnaud was opened in 1878, a line to Stawell built in 1876 was extended to Horsham in 1879, and lines were built to Warracknabeal in 1886 and Serviceton in 1887. By 1900 most of the Wimmera was served by railways, which encouraged growers to take advantage of new techniques to increase production.

The early cereal growers had problems in a land where animal production was the main enterprise and unwanted animals a dominant pest. In the absence of adequate fencing, squatters' sheep were prone to graze crops ; the rabbit, a newly introduced pest, reached plague numbers in the late 1870s and caused some properties to be abandoned. The Government erected a rabbit-proof fence in 1885, so cutting off the Mallee from Swan Hill to South Australia, and rabbits were brought under control in the Wimmera. By the end of the 1880s hope had revived, but drought and outbreaks of rust were features of the last decade of the century. From 1892 to 1896 the average wheat yield for the three Wimmera counties was 7 bushels an acre, and landholders turned to other sources of income, notably prime lamb raising and butter production.

In the 1890s development in the Mallee took place. The first meeting of the Closer Settlement Board to receive applications for wheat growing blocks in the Mallee was held in 1893 ; selections were first made in the southern Mallee and later in the central and northern parts of the region. Railway lines were also extended to the area during this period.

In the late 1890s the value of phosphate application for crop production became apparent and the benefit of bare fallowing, a practice brought from South Australia, was also demonstrated, especially in the dry season of 1902. The establishment of wheat growing in the Mallee and Wimmera was helped by development of agricultural machinery. The wheat stripper invented by Ridley in South Australia in 1843 was in general use from the beginning. The stump-jump plough was introduced in the late 1870s, and the seed drill made its appearance in about 1890. The introduction of Federation wheat soon after the turn of the century enabled wheat growing to be extended still further into the lower rainfall areas, and provided growers with a variety which could take full advantage of the improved fertiliser and cultivation techniques.

The use of pasture legumes was the most important innovation of later years. Until the late 1920s wheat growers enjoyed good yields and favourable

prices. However, prices fell rapidly during the depression in the early 1930s and at the same time deterioration of soil fertility and structure, caused by intensive cropping methods, began to show in reduced wheat yields. In addition, soil erosion caused serious problems in the Mallee, and the 1944–45 drought brought further hardship. Work at Rutherglen Research Station during the 1930s and 1940s encouraged the introduction of a ley system of farming. In the late 1940s the value of medic pastures in increasing soil fertility and boosting crop yields in the Mallee became apparent; in this region the release of the new wheat variety Insignia in 1946 played a major role in lifting average wheat yields further.

Cattle for both meat and milk occupied a place of minor importance in the grazing industries during the early days of settlement when the only outlet was the local market. Refrigeration opened up new possibilities. In 1880 the first consignment of Australian frozen meat was delivered in England, and the following year a shipment of butter fetched a good price in London. The butter was consigned from a farm at Egerton, near Ballarat, by David Wilson, who was later to become the first dairy expert appointed by the Victorian Government. Total cattle numbers were about 1.5 million at the turn of the century. This population showed no marked change during the next thirty years, as the increase in dairy herds was offset by a decline in beef cattle numbers.

Sheep flocks brought in by the early settlers multiplied rapidly during the first four decades to reach a plateau of about 10 million from which there was little permanent upward movement until the 1920s. Outside forces—local demand, export prices, refrigeration, gold, and drought—all exerted an influence on the development of the State's grazing industries, but their long term development and expansion depended primarily on a fundamental change in the pastures the animals were to graze. The pasture which was native to Victoria comprised mainly hardy perennial grasses growing in tufts and surrounded by bare ground. Species which had evolved under conditions of light spasmodic grazing were satisfactory for sheep for wool where there was plenty of land and not too many sheep, but they were unsuited to more intensive grazing. Efforts had been made to introduce pasture species from Europe, and success was generally limited to the more fertile soils in the high rainfall districts. Perennial ryegrass, cocksfoot, Timothy grass, Yorkshire fog grass, white clover, red clover, lucerne, and many other species were established during the first forty years or so, some deliberately, some by accident, but they did not contribute a great deal to the total needs of flocks and herds. Soil phosphate levels were too low and summer rainfall too meagre for these plants to flourish over a wide area.

Superphosphate and subterranean clover were to be the basis of a pasture revolution which occurred between the First and Second World Wars. The value of superphosphate for cereal crops had been demonstrated just before the turn of the century in South Australia. About 20 years later its trial on pasture land was fortuitously coincidental with the introduction of subterranean clover. By 1925 the use of "sub and super" was gaining momentum, and this continued into the 1930s. Subsequent research demonstrated the need for potassium and for certain "trace" elements on

certain soil types. The most important discovery in the early 1950s was of a widespread deficiency of molybdenum in the soils in the highlands which extend through central Victoria. These soils did not respond to superphosphate by itself, and the correction of a molybdenum deficiency, together with the development of aerial top-dressing, has encouraged the establishment of productive pastures on land which previously had a very low carrying capacity. The total area of sown pasture increased steadily from 1 million acres in 1920 to 3.5 million acres in 1940 and 10 million acres in 1960. It continued to rise during the 1960s and exceeded 18 million acres in 1969. During the same period total livestock numbers rose from 14 million sheep and 1.6 million cattle in 1920 to over 33 million sheep and 4.5 million cattle by March 1970. The subdivision of large holdings for closer settlement following the First and Second World Wars provided further stimulus for pasture improvement, and the introduction of myxomatosis to control rabbits in the early 1950s made higher stocking rates possible.

Most of the early settlements in Victoria had a dairy herd which provided milk, cheese, and butter for the settlers. In areas of rainfall above 25 inches dairying was stable and expanded to meet local needs ; it was virtually impossible to market perishable goods far from the source of production. However, the dairying industry in both western Gippsland and the Western District was greatly stimulated by the introduction of refrigeration and by the use of the cream separator from the 1880s. Exports of butter to England realised 16d per lb as compared with 1d per lb before refrigeration. In 1888 the Gillies Government allocated money for bonuses for the establishment of butter and cheese factories in Victoria. As a result, exports of dairy produce rose from £50,000 to £1.1m five years later. Between 1891 and 1901 the number of cows in the State increased from 395,000 to 522,000. Following the First World War closer settlement schemes gave further stimulus to dairying in the southern parts of the State and in the northern irrigation districts. Low returns for dairy produce early in the 1930s reduced many farmers to a subsistence level, but by the end of the decade returns had improved, and cow numbers rose to 890,000. After the Second World War prices improved further, and soldier settlement schemes in the irrigated Murray valley, Goulburn valley, and Nambrok–Denison areas, as well as in natural rainfall areas in Gippsland and the Western District, greatly increased dairy output. Victoria now produces more than half of Australia's dairy products. Factors which have enabled the Victorian dairy farmer to improve output in spite of rising costs are pasture improvement, mechanisation in the milking shed and on the farm, herd improvement through artificial breeding and herd testing, improved shed design, and the use of bulk transport between the farm and the factory. By 1969 the cow population in Victoria had reached nearly 2 million. Prospects on the world market have been causing some decline in dairying in marginal areas throughout the Commonwealth. Future agricultural development in view of changing world trends is likely to be slower than during the past fifty years. In all fields fewer persons are tending to produce more goods largely because of improved technical knowledge, the increased use of fertilisers, improved varieties of plants, selection of stock, and increased mechanisation.

NATIONAL PARKS AND RESERVATIONS

Although the National Parks Authority was actually established in 1956, the history of reserving Victoria's national parks goes back for many years. As early as 1866 Tower Hill near Warrnambool had been temporarily reserved under the Land Act; in 1873 it was permanently reserved and in 1892 was granted to Koroit Borough to manage as a national park. In 1882 part of the Ferntree Gully National Park was reserved under the Land Act, but it was not until 1928 that it was permanently reserved as a national park. Two of the State's most spectacular areas, Wilsons Promontory and Mt Buffalo, were first reserved in 1898, followed by Bulga (1904), Wyperfeld, Tarra Valley, Mallacoota Inlet, and Wingan Inlet (1909), Alfred (1925), Lind (1926), The Lakes (1927), Kinglake (1928), and Churchill (1930). The total of thirteen national parks of 313,166 acres when the National Parks Authority assumed control in 1956 did not include Tower Hill. Previously national parks had been under the control of the Lands Department, and day to day management was usually the responsibility of a committee; in some cases a ranger or part-time caretaker was employed. During these early days progress was slow because there was little public demand to develop the areas and finance was not readily available. In some ways this was advantageous because at that time there was no definite policy on the use and management of national parks, and rapid unplanned development could have impeded the conservation value of these areas.

In 1949 a deputation to the Minister of Lands requested the Government to establish a constituted authority for the control of national parks, and following an investigation by the State Development Committee, Parliament passed the *National Parks Act* 1956. It provided for a National Parks Authority of eleven members representing government bodies and other interested organisations. An initial establishment grant of $50,000 was made by the Government. Since then the allocation has been gradually increased, and in 1970–71 it was $287,000 for works, $117,000 for administration, and $100,000 for roadworks. The Act also provided the first guide lines for managing national parks by setting out the duties of the Authority. These were to provide for the establishment and control of national parks; to protect and preserve indigenous plant and animal wildlife and features of special scenic, scientific, or historic interest; to maintain the existing park environment; and to encourage visitors and provide for their education, enjoyment, and control. In 1971 the Authority was abolished and the organisation was re-named the National Parks Service.

Increasing interest in national parks has been reflected in both the visitor statistics and park revenue. Wilsons Promontory National Park had 28,000 visitors in 1958–59, but by 1969–70 the number had risen to 94,000. Development of tourist facilities is the most costly item of expenditure in national parks. Between 1959 and 1969 more than $1m had been spent at Wilsons Promontory, most of it aimed at bringing the existing facilities up to acceptable standards rather than increasing accommodation for visitors. Other national parks have shown a similar increase in visitors. Since its beginning the Authority has continued to formulate policies on management, many of these being attempts to reconcile the conflicting aims of conservation and recreation. This is the reason for the recent introduction

of a classification scheme which will allow parks, and parts of parks, to be set aside for specific purposes and managed accordingly.

Between 1959 and 1969 the Authority spent $155,000 on the construction of fire access tracks and fire breaks, on the provision of fire-fighting equipment, and on training personnel in fire protection.

BOTANIC GARDENS

Botanic gardens have been intended to fulfil three main purposes. First they have a scientific use. The maintenance of a collection of growing plants, from as many parts of the world as are climatically comparable with the region concerned, means that they are always available for scientific study. Second, the botanic garden should be an educational institution. The public is supplied with the correct names of trees and shrubs and the interested gardener may view all the various kinds of plants which can be grown in the particular climate where the garden is established. Third, a botanic garden may serve as a place for relaxation and peaceful contemplation.

In Victoria the foundation of such gardens originated with the early settlers who missed the particular kind of trees which grew in their native country. These were mostly deciduous with lush green foliage in the spring and brilliant leaf colour in the autumn. Gardens laid out in Melbourne, such as the Flagstaff, Fitzroy, and Botanic Gardens, were typical of that period. In addition, country centres such as Ballarat, Bendigo, Geelong, Colac, and Portland also began their own gardens.

The Royal Botanic Gardens in Melbourne were begun in 1846 on a site at South Yarra adjoining the Yarra River. The area was selected by the Superintendent of the Colony, C. J. La Trobe, and the Gardens have now been expanded to an area of approximately 88 acres. Noted for their collection of trees, and beautifully landscaped into a park setting, they are the product of the labours of two famous directors, Baron Sir Ferdinand von Mueller from 1857 to 1873, and William Guilfoyle from 1873 to 1909. Mueller, a scientist, brought to the country many thousands of plants, hoping that at least some would be of economic importance. Among others, he introduced *Pinus radiata,* now widely grown and used commercially. Guilfoyle used many of Mueller's trees and shrubs as the basis for what later became an outstanding piece of landscaping. The granting of the prefix " Royal " to the Gardens in 1958 was a recognition of their importance in the botanical and horticultural life of Australia.

Mueller and Guilfoyle also influenced botanic gardens throughout Victoria. The botanic gardens at Ballarat, Kyneton, Castlemaine, and Bendigo, with their fine plantings of northern hemisphere deciduous and evergreen trees, are typical of the Mueller era; on the other hand, the memorable landscaping of the gardens at Colac and Warrnambool, much later than the others, is the product of Guilfoyle's work.

The oldest of the other botanic gardens in Victoria is at Geelong, where in 1849 an area of land at Eastern Beach was set aside for the purpose. Under the directorship of Daniel Bunce, an English nurseryman who came to Victoria from Tasmania in 1839, the area rapidly became established as a high standard garden known locally at the time as " the Garden of Eden on a small scale ". Although many changes have taken place since then, these gardens are still regarded as among the best in

Victoria. Modern improvements have included the construction of a new conservatory.

Closely following Geelong, Portland set aside an area of 45 acres for a garden in 1851. This was quickly established by a local committee, with several members of the Henty family playing leading parts. Later, the Botanic Gardens in Melbourne and the Royal Society in Tasmania supplied many plants to supplement the existing collections. By 1866 William Allitt, the Curator, claimed that he had 2,000 plants representative of 700 different species growing in his gardens.

The well-known Ballarat botanic gardens, now famous for their annual Begonia Festival, began in 1856. After an initial period of slow development the Botanic Gardens in Melbourne again provided many thousands of plants and cuttings, and it was from this source that many of the now famous giant Californian redwoods came. The later addition of fine pieces of Italian marble statuary, combined with the development of the growing of tuberous begonias and the annual Begonia Festival, has made these gardens famous throughout Australia.

At Warrnambool and Colac serious development of botanic gardens came about the mid-1860s. The emphasis was on English landscaping, as would be expected in an area that had been developed largely by settlers from Great Britain. William Guilfoyle influenced both these gardens, particularly at Colac, where, as late as 1910 he prepared plans for the reorganisation and redevelopment of the area. A similar pattern was to be seen at Hamilton and in parts of central Victoria where good gardens were established at Kyneton, Castlemaine, and Malmsbury. These, however, have never developed to the same extent as the others.

During the last half century a number of other gardens of quite different calibre have been laid out in Victoria, particularly in the north-eastern part of the State : at Wangaratta the King George V Memorial Garden and a smaller one in the inner city have sought to help visitors by providing named plants ; at Bright the emphasis has been on gardens providing spectacular autumn foliage ; and at Benalla, in addition to a fairly comprehensive collection of general trees and shrubs, special emphasis has been placed on an extensive rose garden.

3

LAND USE AND FARMING

FORESTRY

Records left by the pioneer European settlers indicate that at the time of their arrival forests covered much of Victoria. Timber was available freely and abundantly to all, with no controls or limitations. The pioneers marvelled at the size of the unfamiliar trees they encountered, particularly the towering mountain ash, *Eucalyptus regnans,* which often soared to heights of over 300 ft. During the gold rushes in the 1850s large areas of these forests were exploited for mining timber and fuel. As farming developed, forests were treated as a hindrance and prime areas were extensively destroyed by axe and fire.

The sporadic attempts of far-sighted legislators and conservationists to introduce some semblance of control met with little encouragement. The *Land Act* 1869 contained a schedule of lands reserved for timber production, but these gazetted reserves were of a temporary nature and revocable at short notice. Various attempts were made from 1870 onwards to legislate for proper management and conservation of the reserves, but the situation deteriorated. The Government engaged two foresters from India, Vincent in 1887 and Ribbentrop in 1896, to investigate the causes of the poor condition to which the forests had been reduced and to recommend measures for improvement. A Royal Commission " to investigate the general question of forestry and forest control and management in Victoria " was constituted in 1897. Its final report, presented in 1901, resulted in the first effective forest legislation in the form of the *Forests Act* 1907. Until this time nominal control of State forests had been exercised by a Forests Branch which at various times was attached to the Departments of Agriculture, Lands and Survey, and Mines.

The principal provisions of the *Forests Act* 1907 included constitution of a Department of State Forests under a Minister of Forests, appointment of a conservator with necessary staff, confirmation and creation of permanently reserved forests and provision for future dedications, placement of control of timber on unoccupied timbered Crown land in the hands of the Forests Department, and authorising collection of royalties on forest produce. These and other provisions were closely in line with the pattern recommended by the Royal Commission of 1897. From 1907 to 1918 steady but unspectacular progress was made in permanent forest dedication, strengthening control of timber utilisation, silvicultural improvement of forests which had suffered abuses from unrestricted cutting in earlier decades, extension of softwood

planting, and in the provision of fire protection safeguards. However, lack of assured finance and a shortage of qualified staff prevented full attainment of all these objectives. In 1910 the Victorian School of Forestry was established for the training of professional foresters.

The year 1918 marked a milestone in the history of Victorian forestry when the Forests Commission, consisting of a chairman and two commissioners, was established by the *Forests Act* 1918. Control of State forests was vested in the Commission and a statutory Forestry Fund was established for the improvement and development of State forests. The Commission was authorised to recruit, employ, and organise all staff. These provisions for the first time enabled a sound, constructive, and continuous forest policy to be followed, with assured funds to carry it out. The *Forests Act* 1918 was the basis of the *Forests Act* 1958 and its later amendments.

Soon after the formation of the Commission, softwood planting was transferred from areas of coastal sands to the foothill areas which carried low quality eucalypt forests. Planting had been increased because of the need to employ returning ex-servicemen ; the Commission started new plantation projects at Ballarat and Castlemaine, and plantations at Creswick, Scarsdale, Bright, and Macedon were expanded.

Mountain ash came into general use for moulding and cabinet work in the early 1920s, following the discovery of new seasoning techniques. Many firms constructed kilns and used steam to recondition the boards after they had been dried in the kilns. Licensed and State tramways were extended deep into the ash forests during the 1920s and 1930s to haul logs and sawn timber. Their construction often called for engineering skill of a high order as well as heavy investment. Logs were dragged to forest tramlines by horse or bullock teams or by steam winch. Winching was still used to a very great extent until the 1930s. Crawler type tractors were first used in a Victorian forest in 1934. By 1937 several diesel tractors had brought a new mobility to logging. The depression years prompted a substantial increase in planting, since reforestation was an activity which could absorb large numbers of men at comparatively short notice and with very little capital expenditure.

Serious fires occurred in 1926, after which the Commission was given additional power to protect forests. The Commission first used fixed-wing aircraft for spotting fires in 1929. The holocaust of January 1939, when fire damaged over three million acres of forest and killed 71 people, caused the whole fire protection system to be overhauled. The Commission first used radio communication experimentally in 1940; communications have since been developed to provide this facility in district fire offices, fire towers, and most field vehicles.

On 28 June 1939 the Government created a Department of State Forests with the Chairman of the Commission as the permanent head. The staff of the Department was no longer recruited, appointed, and employed by the Commission, but was transferred to, and became an integral part of, the Victorian Public Service. Two other events in 1939 initiated a new era of forestry utilisation and protection : in September the Second World War broke out, and in October Victoria's first wood pulping mill went into production in an ambitious effort to salvage a huge volume of timber which had been killed in the fires of January 1939. The Commission

built 50 miles of major roads and 18 miles of tramlines within the first two years to provide access for log haulage. By mid-1941 a total volume of 39 million cu ft of timber had been salvaged from the trees killed by the 1939 fires.

In the early 1950s significant changes took place in silvicultural practices being applied to indigenous forests. The Commission began fundamental studies on the major commercial forest types to define the silvical characteristics of the principal species. These studies laid the foundation for applied research to evolve techniques which regularly provide satisfactory stockings of regeneration on over-cut and poorly stocked areas. Direct seeding occupies a prominent place in these techniques, and during the period 1964 to 1968 seeding of eucalypt forests from the air was developed for a range of forest types. Apart from its application in regeneration programmes following clear-felling, aerial seeding is being applied with advantage in reforestation of potentially highly productive forest lands at present covered with scrub species.

The stringybark and gum forests of the foothills of the Dividing Range, of Gippsland, and of the western highlands, cover ten million acres, comprising two thirds of the total State forest area. These forests produce the timbers used in housing and general construction, poles for electricity and telephone lines, and pulpwood for manufacture of hardboard and paper. Within the stringybark–gum forests there are several areas where a steady yield is being maintained after over eighty years of utilisation, and there are some virgin areas, but much of this forest requires rehabilitation to regain its productivity after many fires and heavy cutting over past decades.

The mountain and alpine forests produce fine light hardwood timbers and occupy about 500,000 acres. They are confined to good soils in areas of high rainfall, are very productive crops, and form the protective cover of most of the important water catchments. These " ash " timbers are seasoned and moulded for use in joinery, flooring, and weatherboards ; they also produce good veneers, and make strong hard paper. Young regrowth stands at present comprise the greater part of the ash forests. The forests of ironbark and box trees in central and northern Victoria were very important in the early days for use as fuel and for heavy durable construction timber for mining and railways. There are now 800,000 acres of these forests, but the firewood, durable sleepers, and poles they produce are not in strong demand. The red gum forests on the flood plains of the Murray River and its tributaries still produce a steady output of sleepers and durable construction timber.

The area of softwood plantations now exceeds 115,000 acres. The softwood timber is very versatile in joinery, veneers, housing, and light construction work ; it is also suitable for paper pulp, particle boards, and when chemically impregnated, for posts and electricity poles.

Each year more Victorians rely on their forests for supplies of timber and other wood products, outdoor recreation, greater supplies of pure water, forage for livestock, safe habitat for native animals and birds, and for other forest products such as honey and eucalyptus oil. To meet these many and varied demands, foresters apply multiple use management to the 16 million acres of State forests. This ensures the maximum benefit to the community, while at the same time the continuing health and well-being of the forests is sustained.

TIMBER MILLING

The earliest supplies of " squared " local timber were probably provided by splitting the more fissile local eucalypts into slabs for walls and floors, as well as into palings for walls and shingles for roofing. The slabs were often adzed to provide smooth and regular surfaces, and adzing was also used to fashion split members into " squared " framing timber, a method which was still widely in use in isolated country areas as late as 1900. Pitsawing was the means by which the first sawn timber was produced, but production was limited by the labour shortages which plagued the District's early development. Steam power introduced to sawmills in Melbourne in the early 1840s increased the production of sawn timber, which then sold at lower prices than previously. Elsewhere in the Colony, production of sawn timber grew rapidly, especially for the goldfields where it was a necessary commodity for the extraction of gold. By 1859 there were 71 sawmills in Victoria (of which nine were in operation in or near Melbourne); during the 1860s the number reached 141.

Power was supplied by steam using stationary, portable, or traction engines, except for a very few water powered mills ; few mills had mechanical aids, even in the largest and most advanced milling operation. The simplest mill comprised a saw bench on which the logs were broken down into flitches which were then sawn to the required dimensions. At some mills logs were often " spotted " (hewn to provide a flat side) with a broad-axe prior to being sawn, to facilitate handling on the bench. Mills were usually located close to or in the forest, and logs were snigged by horse or bullock power, but over longer distances logs were carted by either horse or bullock drawn wagon. Occasionally steam traction engines were used for snigging and carting. Tramways also operated to carry logs to the mill ; horses, steam locomotives, and later petrol driven tractors were used to haul the tramway trucks which transported the sawn timber. In the early years the only restriction placed on operation of mills on public land was generally the payment of a nominal annual licence fee ; there was no limit to the quantity of logs to be used, but in the early 1900s payment of royalties for specified quantities of forest produce was introduced.

The location of the mills closely followed the growth of population in various parts of the State, particularly in the gold mining districts ; it also followed the development of the State railway system, and sawn timber became a major item of rail freight. Early sawmilling centres were located in and around Melbourne and the Dandenong Ranges, the mining districts, Portland, Yarram, the Otway Ranges, and the red gum forests along the Murray River. From Yarram, a tramway transported high quality sawn timber to Port Albert from where it was shipped to Melbourne, but an attempt to ship sawn timber from the Otways failed for lack of a suitable harbour. A use of sawn timber which created employment for mills from the 1890s until the 1930s was the provision of wooden blocks, each approximately the size of a household brick, to form level and solid foundations for many of Melbourne's streets.

During this period there were many developments in logging and milling operations. The axe and crosscut saw were still used for felling, but snigging by horses and bullocks was largely replaced by steam powered winches using steel cables to haul the heaviest logs over considerable distances. These

winches, together with forest tramways, made log procurement possible and economic in some of the State's most difficult mountain terrain, and brought about the development of milling in the major forest regions at Warburton, Powelltown, Noojee, Erica, Rubicon, and the Otway Ranges. This made available large supplies of the lighter type eucalypt hardwoods such as mountain ash, alpine ash, manna gum, and shining gum ; these comprise the best " appearance " and most easily seasoned hardwoods.

Two major developments in the utilisation of these seasoning-quality eucalypts have been the application in the 1920s of the kiln-drying and reconditioning process (this was further improved by research by the C.S.I.R.O.) and the introduction of tariffs on imported timbers in 1931. Before this, it was necessary to import high grade timbers for joinery, flooring, furniture, mouldings, etc. The tariffs enabled the use of the new techniques to replace imported timbers with the lightweight, high quality Victorian hardwoods, and drying kilns with planing and other equipment were established in Melbourne and in country areas.

Since 1934 the major logging developments have been the general replacement of the steam winches by crawler tractors (a limited number of logging winches powered by diesel motors are still used), and the replacement of the tramways by logging roads carrying specialised motor vehicles for hauling logs and sawn timber ; mills can now be located at conversion centres, usually in country towns outside the forest area. The former mill settlements have almost disappeared ; changing living standards, the demand for more and better amenities, and the loss of life in the disastrous bush fires of 1926, 1932, and 1939 have been factors contributing to their disappearance.

Since the late 1930s there have been radical changes in the mechanisation of sawmills. Generally, diesel and electric power have replaced steam power, with the diesel giving way to electric power when this became available. Sophisticated equipment was installed where the size and life of the log supply warranted the financial outlay involved, and mobile machines for handling logs replaced the earlier primitive manhandling. The chain saw, much faster than the crosscut or the axe, was adopted for felling and for trimming logs. Early in the century the twin breaking-down saw had become common equipment for milling large logs ; those saws have now often been replaced by bandsaws to reduce saw-kerf. Fast log carriages with pneumatic log turning, adjusting, and dogging devices have largely replaced the Trewhella hand jack and hand dogs as well as the log turning winch.

The four-man breast bench, which is uniquely Australian, still operates in most hardwood mills ; its flexibility permits recovering the best sawn material from faulty logs and avoids excessive " spring " in the sawn product. It is cheap to instal, but is labour-intensive when compared with the highly mechanised techniques employed in softwood mills. With the increasing availability in recent years of softwood logs, mostly of *Pinus radiata,* these specialised mills have been introduced giving cheaper milling costs.

In recent years the number of mills has been reduced but overall output has remained fairly constant. Some have closed through lack of log supplies, others through amalgamations. In 1938–39 a total of 327 mills produced 118 million super ft of sawn timber ; by 1955–56 there were 636 mills producing 342 million super ft ; and by 1969–70, 314 mills had an output of 323 million super ft, much of it graded according to the rules of the

Standards Association of Australia and assembled into easily handled packages. The total number of men employed in country sawmilling operations in Victoria was then approximately 12,000.

IRRIGATION

Early settlement in Victoria was hampered by insufficient and unreliable natural water supplies, and success or failure came to depend on the attention the early pioneers gave to water storage and use. On the farms many of the early settlers who lived near streams built small weirs and dams. Although some water was used to irrigate natural pastures, the main purpose was to conserve drinking water for stock. As early as 1857 David Milburn of Grange Farm, Keilor, was irrigating two acres of orchard with water pumped by hand from the Maribyrnong River.

With the passing of the *Land Act* 1869 settlement expanded considerably. Most of the well-watered lands of Victoria had previously been occupied by the squatters, and thus land was rapidly taken up along the creeks of the northern plains. By this time the surface alluvial diggings on the goldfields were coming to an end, and many miners took full advantage of the new land legislation to begin farming. Most began by cropping wheat, oats, and barley, while others grazed sheep and cattle or established dairies where fairly reliable supplies of water could be obtained, if necessary by pumping from creeks or swamps. Only in a few instances did settlers use the water for irrigating their land. Fortunately for them rainfall from 1870 to after 1877 that great losses were experienced because of insufficient water. additional water was not realised by most of the settlers, and it was not until after 1877 that great losses were experienced because of insufficient water.

One of the earliest farmers to irrigate a large area was John Garden of Cohuna, a pioneer of irrigation in Victoria. He built an earthen dam across Barr Creek near Cohuna, and in 1882 irrigated 300 acres of wheat and 600 acres of grass with about 5 inches of water. The yield he obtained reached over 20 bushels per acre (the average district yield being about 2 bushels per acre) and the income cleared the cost of his plant.

The drought years of the 1870s provided a marked contrast. Crop and stock losses were heavy, and the farmers agitated for the Government to improve water supplies. In 1880, therefore, an engineer and a surveyor were appointed to report on the best means of conserving water in the dry northern areas. Their report led to the Water Conservation Acts of 1881 and 1883, the first Victorian legislation to provide for the construction of irrigation works. Several projects were started, including weirs on the Broken, Loddon, and Avoca Rivers, and the Wartook Reservoir in the Grampians. Other works were begun by the Echuca and Waranga irrigation trusts founded in 1882 to irrigate from the Goulburn River.

By 1884, however, only 163 farmers were irrigating 7,000 acres, mainly in the Swan Hill shire (which then included Kerang and Cohuna). Most of this land was sown to wheat. In 1884 the Commissioner of Water Supply, Alfred Deakin, persuaded the Government to set up a Royal Commission on water supply in Victoria. Its recommendations led to the *Irrigation Act* 1886, which stipulated that the waters of all Victorian rivers, streams, lakes, and water courses belonged to the State, and also provided for the establishment of irrigation trusts. The State was to advance funds to the

trusts to meet the cost of irrigation works, but the more important works of regulation and storage would be undertaken by the Government. In 1886 Cohuna, Wandella, and Tragowel Plains, the first trusts, were set up, and by 1899 ninety irrigation and waterworks trusts operated in Victoria, watering about 100,000 acres. The first construction undertaken by the State was the Goulburn Weir near Nagambie, where work began in 1887. Two years later construction of the Laanecoorie Weir began on the Loddon River, as did works for the diversion of water from the Murray River to Kow Swamp and the Loddon River.

In 1890 the first irrigation conference in Victoria was held. Convened by Deakin, it gave farmers an opportunity for exchanging ideas on methods of preparing land for irrigation, on the types of crops and pastures to grow, and on watering practices. At Deakin's invitation, two young but experienced and successful irrigation engineers, George and William Benjamin Chaffey, had come to Victoria from California in 1886. Their arrival inaugurated a new era in the history of Victorian irrigation. At Mildura they demonstrated that the arid regions of the Murray valley could be permanently settled in small holdings for growing vines and citrus fruits. This project was one of the earliest of its kind, and the Chaffeys put over £300,000 into the venture ; by 1890 there were over 3,000 persons living in the settlement, whose subsequent fortunes, though chequered, came ultimately to be profitable.

However, the development of irrigation under the trusts was not very successful, and landholders, who usually had large areas, could not really be called irrigators. When the seasons were good they did not want the water, and when they were bad insufficient water was conserved. Most people had little knowledge of irrigation techniques, and the local trusts were unable to compel irrigators to use the water properly. When George Swinburne became Minister of Water Supply in 1904 he asked Parliament to approve legislation to set up a new form of public authority to plan the use of water resources and to handle irrigation and stock and domestic water supply for the whole State. The resulting establishment of the State Rivers and Water Supply Commission was most significant in the development of irrigation, and in the intensification of settlement in Victoria. Dr Elwood Mead, an American, was Chairman of the Commission from 1907 to 1915. During 1910-11 he introduced a system of farm water rights which had to be paid for whether the water was used or not. This was to ensure that the farmers used the water which had been provided, paid for it if they did not use it, or sold their farms to those who wanted to be irrigators and would use the water.

Mead also believed in intensive irrigation on small farms, and that irrigation should not merely be an adjunct to large area " dry " farming, as was the case on most properties at that time. His policy of acquiring and subdividing large holdings for closer settlement was followed from 1910 to 1930. During that period more than 4,000 new farmers were established on irrigated holdings at Merbein, Shepparton, Tongala, Rochester, Cohuna, Werribee, and Red Cliffs. After the Second World War land acquisition and disposal was in the hands of the Soldier Settlement Commission, but the task of planning subdivisions and carrying out the works for irrigation remained with the Water Commission. Since 1945 the soldier settlement

areas of the Murray valley, Robinvale, and central Gippsland have been developed and have provided farms for more than a thousand ex-servicemen.

Concurrent with this development and improvement in the management and techniques of irrigation farming, large " carry-over " storages were built. In Victoria, where the seasonal flows of rivers and streams can vary greatly over a number of years, it is necessary to conserve surplus and flood flows in the wet years to compensate for the large deficiencies in drier years. The Commission, from the time of its inception in 1905, had built a number of major storages which saved winter flows for release during the summer. But, as irrigation became more accepted and the demand for water increased, even these could not cope with long periods of drought. The first of the carry-over storages, the " Big Eildon " reservoir, increased the storage capacity of Eildon from 306,000 acre ft to 2,750,000 acre ft. This increase enabled a significant volume of water to be carried over each year in storage as an insurance against a run of dry seasons. Eildon was followed by Eppalock, Tullaroop, Buffalo, Nillahcootie, and others, which together form a grid of water storages operated on the carry-over principle.

The following table lists the major rural water supply reservoirs in Victoria :

VICTORIA—MAJOR RURAL WATER SUPPLY RESERVOIRS

Storage	Maximum capacity	Year of completion	Location	Main use (*a*)
	acre ft			
Eildon	2,750,000	1955	Goulburn River	I. ; H.E.
Hume (*b*)	2,500,000	1936	Murray River	I. ; H.E.
Waranga	333,333	1905	Goulburn River	I.
Mokoan	300,000	1971	Broken River	I.
Rocklands	272,000	1953	Glenelg River	D. and S.
Eppalock	250,000	1964	Campaspe River	I. ; Bendigo W.S.
Glenmaggie	154,000	1929	Macalister River	I.
Cairn Curran	121,000	1956	Loddon River	I. ; D. and S.
Yarrawonga Weir Pool(*b*)	95,000	1939	Murray River	I.
Toolondo	86,000	1952	Glenelg River system	D. and S.
Bellfield	60,000	1966	Fyans Creek	D. and S. ; I.

(*a*) I. : Irrigation
H.E. : Hydro-electric generation
D. and S. : Domestic and stock water supply
W.S. : Water supply
(*b*) Half share under River Murray Agreement.

A significant factor in water conservation has been the development of large earthmoving machinery. Fifty years ago steam engines, horses and drays, and wheelbarrows were used for dam building. Today, high-speed diesel-powered machines permit very large dams to be constructed in a few years with minimal risk from flooding during construction, at costs which are lower, in relation to wage rates and material costs, than could have been achieved in the earlier years. Dam sites which would not have been considered (on grounds of economic viability rather than engineering difficulty) can now be quite feasible for this reason. Since 1963 the State Government has guaranteed an allocation of funds to make possible a ten year storage programme.

Murray River waters

The Murray River and its tributaries form the largest river system in Australia. The Murray catchment exceeds 400,000 sq miles in area, or about a seventh of the Australian continent. It includes most of New South Wales, about half of Victoria, and portions of Queensland and South Australia. The length of the Murray is about 1,600 miles and two principal tributaries, the Darling and the Murrumbidgee, are 1,760 and 1,050 miles long, respectively. For much of its length the Murray is of very slight gradient and the river is slow moving. Several inquiries into the sharing of the Murray waters preceded an interstate conference of engineers in 1913, when an agreement was reached which was later to be ratified by River Murray Waters Acts in the Parliaments of the Commonwealth and the States of New South Wales, Victoria, and South Australia. These Acts provided for the construction of water supply works, the allocation of Murray waters between the three States concerned, and the appointment of the River Murray Commission to give effect to the Agreement.

The River Murray Commission, which consists of four commissioners representing the four contracting Governments, is not a constructing authority, but arranges for the design and construction of works by the existing State authorities. Works under its control comprise Lake Hume above Albury, Lake Victoria near the South Australian border, sixteen weirs on the Murray and Murrumbidgee, and barrages to prevent salt water from entering the Murray estuarine lakes and the lower river in South Australia. The Dartmouth project to construct a new 3 million acre ft storage on the Mitta Mitta River was started in 1972.

SOIL MANAGEMENT

The early settlers found that the soils were naturally low in productivity. North of the Great Dividing Range and in the Wimmera this was mainly a result of the low and uncertain rainfall, but south of the Divide inherent infertility was the cause. As the soils are geologically old, there has been ample time for the essential nutrients to be leached downward beyond the reach of the roots of plants, especially in the south where the rainfall has generally been so much higher and the inherent soil impoverishment is accordingly greater.

Soil science was undeveloped in the early days of settlement, and soil analysis involving total analysis in terms of chemical elements and particle sizes was the principal method of soil examination. The first chemist for the Department of Agriculture, appointed in 1873, carried out the analysis of soils from different geological formations, and demonstrated that there were low reserves of nitrogen and phosphorus. Later, field trials showed that phosphorus and nitrogen were indeed important soil deficiencies for cultivated crops. It was also realised that soil analysis was insufficient for making fertiliser recommendations, and in 1887 widespread fertiliser trials with cereals, sugar beet, and other cultivated crops were initiated.

Soil surveys and land use

Modern soil science was not developed in Victoria until the late 1920s. The Council for Scientific and Industrial Research established its Division of Soils, and in 1928 a soil survey was made of the vine settlement of Woorinen

in the Mallee. In the same year the Department of Agriculture began co-operative soil surveys with the C.S.I.R. and initiated other soil investigations. Pedology was introduced and soil science expanded in the teaching of agricultural chemistry at the University of Melbourne.

This was the beginning of soil classification and soil surveys which have had a marked impact on land use in the State. First examined were the irrigated horticultural settlements along the Murray River where there were soil problems following the expansion of settlement after the First World War. Between 1939 and 1942 the Shepparton irrigation district was investigated ; here periodic waterlogging of the soils had caused the death of peach and apricot trees. Soil surveys have also been made of all the irrigated pasture land and associated non-irrigated land in the constituted irrigation districts of the State Rivers and Water Supply Commission. Landholders are now able to obtain more reliable advice on the suitability of different soil types for growing different crops and pastures. The surveys have also led to the better use of water which the Commission allocates on the basis of defined areas of soils classified as suitable for irrigation. Soil surveys have been used in the planning of irrigation settlements since the Second World War, notably at Robinvale and Nambrok–Denison. To avoid the mistakes of earlier settlement schemes, such as unsatisfactory irrigation, uneconomic subdivision, and the planting of unsuitable crops, the State Rivers and Water Supply Commission, the former Soldier Settlement Commission, and the Department of Agriculture all combined to integrate planning and preparation. It is now accepted that soil surveys should precede the allocation of water to any large area proposed for irrigation.

By 1972 twenty-five soil survey reports with accompanying soil maps covering irrigated, cultivated, and grazing land had been published. These cover 3,750 square miles soil-surveyed in detail and include, with only minor exceptions, all the irrigated land in the State.

Soil conservation

Before the Second World War wind erosion in the Mallee caused the loss of fertile top soil, while property was damaged by the shifting sand. Soil movement was caused mainly by an alternating system of cereals and bare fallow coupled with the burning of wheat stubble. However, research at the Mallee Research Station at Walpeup and the work of the Soil Conservation Authority have helped to prevent soil movement so that dust storms have practically disappeared, and the cost of protecting structures is now relatively small. A pasture phase, based on annual medics, has been introduced into the rotation, and there is a more stable system of land management, with less reliance on monoculture. Sheep are used to control weed growth on fallows when the soil is too dry to cultivate, and greater use is made of stubbles and other trash to protect fallowed land. The sowing of cereal rye and lucerne on light sandhills has stabilised these areas.

The Mallee Research Station was established in 1932 by the Department of Agriculture. In 1938 an inter-departmental Erosion Investigation Committee was formed, and, mainly as a result of its report, a Soil Conservation Board was established in 1940 to initiate action in appropriate departments. In 1950 the Board was replaced by the Soil Conservation Authority as the official organisation responsible for preventing soil erosion. Many landholders, individually or in group conservation projects, now accept the principles of

conservation farming, and have adopted appropriate systems of land use and management, as well as erosion control techniques such as contour cultivation, pasture improvement, soil stabilisation, and gully protection. The Authority is also concerned with the preservation of water catchment areas and exercises legal control over land use in proclaimed catchments. Hydrological experimental areas have been established to provide information about the effects of land use on the yield and the quality of water available.

The Authority has made land studies on areas covering 44 per cent of the State. These surveys have been a study of the ecology of environmental or land systems in which the relation between climate, topography, soils, and vegetation are portrayed, explained, and used as the basis for assessing the potential productivity of various kinds of land, and the hazards associated with different forms of use. Five publications describe sixty-three land systems, covering 26,600 sq miles in south-western and north-western Victoria, the Grampians area, the catchment of Lake Hume, and the Mt Buffalo National Park. In addition, a survey of a further 7,000 square miles has been carried out, but the results have yet to be published.

Soil deficiencies

Field experiments have demonstrated deficiencies of nitrogen, phosphorus, potassium, sulphur, copper, zinc, and molybdenum, and considerable information has been acquired about the soil situations in which particular deficiencies occur. By far the most widespread and agriculturally important deficiencies are those of moisture, nitrogen, and phosphorus.

Soil moisture

The introduction just prior to 1900 of bare fallowing to conserve soil moisture was a major step towards raising production in the wheatlands. It was believed then that frequent cultivation was necessary to prevent evaporation of stored moisture directly from the soil surface. Adverse effects of intensive cultivation on soil structure, leading to erosion of some soils, were disregarded in the face of the immediate benefits. However, in 1929 and 1930 it was shown that benefits accrued from the elimination of competition by weeds for moisture and available nitrogen. As a consequence, soil management of fallows now includes alternative methods of weed control using sheep and, in some cases, weedicides.

Phosphorus

Basically, the correction of phosphorus deficiency has presented no real problems since superphosphate is relatively cheap and its importance has long been recognised. Experimentation has therefore been directed towards greater efficiency in the use of phosphatic fertilisers by determining the optimum economic rates of application for the different crops and pastures in particular soil and climatic environments. Considerable success has been achieved, but outside the irrigated lands the unpredictability of rainfall complicates the studies and the application of results. Since the 1950s research has demonstrated that current applications of superphosphate to pastures and cereals may be reduced, without loss of production, where residual phosphorus in the soil is appreciable.

Before the 1930s superphosphate was not widely used on grazing land because the prevalent native grasses, adapted to low fertility soils, responded

only slightly to topdressing. However, outstanding responses by various sown and volunteer clover species led to an increasing interest in fertilising pastures, and in 1932 the Department of Agriculture commenced a series of fertiliser trials financed by the Victorian Pasture Improvement League. These trials demonstrated that there was a vast potential for increased productivity from pastures using superphosphate to maintain introduced clovers, and as a result the fertility of the soil over millions of acres has been raised materially.

Nitrogen

The use of nitrogen fertiliser until recently was quite uneconomic on all but high priced crops such as vegetables, tobacco, and fruit crops. Clover leys were developed to provide nitrogen in both pastoral and wheatland soils, but with cheaper nitrogen fertiliser, research into the use of inorganic nitrogen on pastures and wheat crops is being carried out.

The early exploitive rotation systems of wheat growing in the Wimmera and north-western Victoria had led to a decline in yields and quality of wheat due to gradual depletion of the soil's already low organic matter and to deterioration of soil structure. Because of this, soil depletion and regeneration experiments involving rotations of various durations of subterranean clover–Wimmera rye grass pasture, cropping, and fallowing were initiated at the Rutherglen Research Station in the 1930s. Soil fertility and structure trends were assessed by soil analyses. The principles of clover and medic ley farming have now been determined and accepted widely, and further research concerns the most suitable rotations for the Wimmera and Mallee.

Not all soils can carry improved pastures using superphosphate alone. This is most likely because of a trace element deficiency, or inefficient nodulation of the clover resulting from the effect of soil acidity on the nodulating bacteria. Lime-coating of clover seed or the drilling of seed with agricultural ground limestone are practices developed to counteract these effects of soil acidity.

Potassium

The increased production from improved pastures imposes a strain on other plant nutrients in the soil, and the drain on soil potassium, in particular, necessitates the use of potash, an expensive fertiliser, to prevent the degeneration of pastures over an area which is increasing annually. It is only the soils in southern Victoria and some in the north-east which are marginally deficient in potassium. Sandy soils in these regions are the most likely to be affected.

Trace elements

Molybdenum, copper, and zinc in that order are the most important trace element deficiences. In the early 1950s spectacular establishment and growth of clover was obtained with 2 ounces per acre of molybdenum applied with superphosphate in trials on the poor ironstone gravelly soils of the central highlands. Other soils in southern Victoria have since been shown to be molybdenum deficient. As it costs only a few cents to treat an acre with molybdenum, landholders use molybdenised superphosphate over large areas. Occasionally excessive molybdenum in the soil is responsible for ill-health in grazing stock.

The copper deficient soils occur along the coastal fringe and in far western Victoria. Most are sandy soils now supporting pastures. Extensive trace element trials during the 1950s determined the areas where pasture responded to copper, although copper is necessary over a wider area for the health of stock. Herbage analysis has assisted in defining these deficient areas. Cobalt deficiency is occasionally associated with copper deficiency. Responses to zinc have been obtained with wheat on the grey clays of the Wimmera and with some pastures on sandy soils in the Western District. However, there is enough zinc in superphosphate to correct the deficiency in most soils.

PASTORAL AND LIVESTOCK

Early sheep breeding

Cattle and sheep were first kept for the production of milk, butter, cheese, and meat for local consumption ; working bullocks served for local use ; and wool, hides, skins, tallow, and bones were exported.

The Western District had excellent open plains which were natural grazing land, and this was rapidly taken up. The flocks which spread over the western plains were very variable in fleece characteristics and in type, and reflected the mixed origins of the sheep originally imported to the Australian colonies. In the early days of the settlements at Sydney and in Tasmania sheep were required principally for meat, and many were brought from the nearest ports, which were in India and South Africa. Sheep from India comprised most of the sheep in 1797 when a small flock of Spanish Merinos was imported from Capetown. These Merinos were crossed with the local sheep and whilst John Macarthur and later his son William subsequently closed the Camden flock and bred for fineness of the wool, others continued to cross breed, in some cases with British breeds such as Southdown. Subsequent importations included coarse-woolled sheep from Ireland, and representatives of the English breeds, particularly the Leicester.

During the early decades of the nineteenth century meat continued to be more important than wool and by the late 1820s there was very little premium for wool quality or fineness. In these circumstances the Camden flock of fine Merinos made little impression on the flocks of the colonies as a whole. However, in the 1830s and 1840s the prices for all wool improved and fine wool became much more valuable. Saxon sheep were imported, particularly to Tasmania where a few farmers began to develop fine wool flocks. In the conditions applying during the early occupation of the western plains there were few opportunities to control the breeding of the flocks, although as early as 1839 John Aitkin, an early squatter, was noted for his experience and judgment in sheep and wool. He imported finely bred rams from Tasmania and his breeding work influenced some other early squatters such as George Russell of Golf Hill. Sheep were shepherded by day and penned by night to protect them from dingoes and the Aboriginals, and all facilities for handling them had to be improvised with much labour under difficult conditions. A severe drought in the mid-1840s added to the problems of the early settlers. By 1848 the flocks were a motley of mongrels producing very little wool, most of which was of very poor quality.

In 1844 the London firm of J. T. Sims sent Thomas Shaw, a wool expert

from Yorkshire who had twenty years experience with Australian and foreign wools, to Australia. He travelled widely in the new wool growing areas, and soon became very knowledgeable in breeding sheep here to produce quality wool. In 1848 he began a campaign to improve Australian wool, and in letters to newspapers and in a treatise on the Australian Merino he described the flocks as a mongrel breed, and the stockholders as incompetent. Furthermore, he told in precise terms how to breed better sheep, and described the type of sheep he believed could be produced. Thomas Shaw became an adviser in sheep breeding to many settlers who later became renowned for their excellent flocks. His method involved inspecting the ewes and selecting a small nucleus for breeding rams on a basis of fineness and density of the fleece; he advocated weighing fleeces as an aid to this selection. He urged growers to obtain the best possible ram to join with the selected ewes, and in many cases he chose the rams on their behalf from established flocks such as those based on Saxon Merinos in Tasmania and the Camden flock of William Campbell.

Gradually these ideas became accepted, and conditions for the settlers improved so that it was possible to control the breeding of the flocks. During the 1850s fencing wire became available and fenced paddocks replaced the shepherd.

With the formation of pastoral and agricultural societies sheep breeding became a community activity, and the showing of sheep and other livestock helped to develop accepted standards of excellence for individuals to breed for. The first sheep show was held at Skipton in 1859 and during the 1860s the Skipton ram fair brought buyers from all parts of the Australian colonies, and the highest prices for rams were paid there. The success of the Skipton show depended on the support from a high proportion of the properties in the region, and it is clear that almost all properties had small stud flocks from which they bred their rams. The development of communal standards led to the formation of distinctive regional strains of sheep. Subsequently this process was repeated elsewhere in Australia, and in the Riverina the development of the Peppin strain was associated with the Jerilderie sheep show which became famous during the 1870s.

Eventually the dominant sheep shows migrated to capital cities, prices for rams reached extremely high figures, and stud breeding became a highly specialised and competitive occupation. More and more properties gave up breeding their rams, and purchased from the major studs which came to dominate Australian sheep breeding. However, before this occurred the major strains of the Australian Merino had emerged. The mean fleece weight per sheep in Victoria had increased to 5 lb per head by 1875. This was partly scoured wool and partly greasy wool, but it represented almost double the clean wool production of the sheep which originally occupied the western plains.

Stock numbers

During the gold rush of the 1850s the demand for milk and meat rose rapidly, and livestock farming prospered with fat bullock prices soaring to £10 a head when delivered to the goldfield towns. By 1860 there were 722,000 cattle and 5,780,000 sheep in Victoria.

The thirty year period from 1860 to 1890 was generally one of development and speculation, with ample labour available from the former gold-

fields. Land was cleared and the Government took steps to control and subdivide the farming land on which the large graziers had squatted. Most cattle were owned by small farmers who sold milk and home-made butter and cheese to the townsfolk, as well as beef and veal to the local butchers. The sheep were concentrated on the larger grazing properties where the Australian Merino sheep, as known today, was developed. Wool became a valuable export commodity. Generally this period was a prosperous one in which cattle numbers rose to 1,783,000 head (of which 395,000 were dairy cows), and sheep to 12,692,000. It was the period in which James Harrison of Geelong discovered the process of mechanical refrigeration during 1856 and 1857. In 1873 he exhibited a machine capable of freezing mutton, and took 25 tons of frozen beef to London. However the process which he had developed to suit mutton did not suit the larger beef carcasses and the cargo was found to be unusable.

In 1876 a group of pastoralists planned to send meat to England on the *Northam*. Owing to a defect in the refrigerating machinery the shipment was not forwarded, but a shipment of 40 tons of beef and mutton sent in the *Strathleven* arrived in satisfactory condition in February 1880.

The period from 1891 to 1921 was generally one of stagnation and hardship brought about by the end of the land boom in the early 1890s and aggravated by the droughts of 1902 and 1914, as well as by the First World War. By 1921 there were only 1,575,000 cattle and 12,171,000 sheep in Victoria, fewer than there had been 30 years earlier. The financial crises accompanying the land boom and the 1902 drought resulted in a deeper appreciation of the importance of Victoria's rural industries, and speculation gave way to sounder thinking and more stable planning. Although the First World War and the 1914 drought hindered progress, the rural community began to recognise the need for pasture improvement.

Dairy farming was developing, and 620,000 of the cattle were dairy cows. Some prime lamb had been exported and the smaller sheep owners were thinking in terms of prime lamb as well as wool, rather than wool alone. Machinery had been developed to mechanise many tasks formerly done by hand or carried out on the farm by horses and bullocks. (It is interesting to note that the highest number of horses ever recorded in Victoria was 562,000 in 1913.)

Pasture improvement

The prosperity of the 1920s reflects the technical advances made in those years when dramatic results were achieved. The use of the annual pasture legume subterranean clover (*Trifolium subterraneum*) in conjunction with superphosphate applications produced a sharp rise in pasture yields, and in some instances annual fodder production increased as much as tenfold.

The potential of this clover as a pasture plant was first recognised by A. W. Howard of Mount Barker, South Australia. In 1898 Howard noted the production of the plant in a pasture which developed after an oat crop which had been fertilised with a phosphate fertiliser. He endeavoured to draw attention to the plant in South Australia and Victoria, particularly in the period from 1906 to 1914. However, he did not associate the use of superphosphate with the successful establishment of the plant, and for this reason his efforts had less effect than expected. Later research showed that

many soils in South Australia suffered from trace element deficiencies not encountered in Victoria.

Although superphosphate had been manufactured in Melbourne since the 1870s and had been used extensively on cereal crops, its use on pastures hardly developed until well into the twentieth century. The Department of Agriculture demonstrated the superiority of superphosphate in pasture topdressing tests carried out in 1905, and the value of topdressing with superphosphate was confirmed in 1912. The practice of topdressing pastures with superphosphate at first spread slowly, and it was from about the mid–1920s onward that topdressing began to be widely adopted.

In the early 1920s farmers had begun sowing a little subterranean clover with the grain crops, and spreading the seed with the superphosphate through the spinner. Before long the demand for seed exceeded the limited supply and new methods of harvesting were sought. This was difficult as the seeds when ripe are on, or even in, the ground. In Western Australia and later at Narracoorte in South Australia sheep skin rollers were used for picking up clover burrs. Later, rotary brooms and stationary threshers were widely used in Victoria until replaced by the suction harvester in the 1960s. This early activity in the Narracoorte region was supported by the Kybybolite experimental farm where topdressing experiments on virgin land began in 1919 and on subterranean clover in 1921. Messrs Shepherd and Schinkel, neighbouring farmers, had successfully established subterranean clover on their properties. By 1925 groups of farmers from the Western District were driving to Narracoorte and Kybybolite to see the pastures; and during the 1930s the Department of Agriculture established pasture species and fertiliser trials in many locations throughout the State.

The first important scientific study of subterranean clover was undertaken in 1926 by J. E. Harrison of the Department of Agriculture. He initiated the work which resulted in the isolation of the separate strains of the species, and their classification according to flowering date and leafiness. This work helped define the suitability of different strains for areas of widely differing climates and later led to the development of a seed certification scheme.

Natural pastures and sown fodder crops for cattle and sheep gave way to permanent pastures of perennial species in the higher rainfall and irrigation districts, and to self-establishing annual species such as subterranean clover and several medics. Where the annual rainfall exceeded 17 to 18 inches subterranean clovers were grown to supply nitrogen for the soil and protein rich herbage for the livestock, but in areas where the rainfall was too low or the soils unsuitable for subterranean clovers, several medics were successfully introduced. These included lucerne (*Medicago sativa*) for a more permanent pasture, and the annuals barrel medic (*M. truncatula*), harbinger medic (*M. littoralis*) and to a lesser extent, the self-introduced burr medic (*M. denticulata*).

By 1970 Victoria's pastures supported nearly three times as many sheep and cattle as in 1924, and less than 30 per cent of the total occupied area could still be classified as native pasture. Subterranean clover seed, available in a great variety of strains, was being exported to the Mediterranean countries where it was being used for pasture improvement.

Developments since the 1920s

During the 1920s production was buoyant and exports of butter and fat lamb meat rose steeply. The economic depression affected the pastoral industries by about 1930; prices dropped to unexpectedly low levels, but farmers tended to improve their farming methods and increase their output. Cattle exceeded 2 million in 1935, of which 952,000 were dairy cows. Beef production was mainly from dairy bred cattle and little was available for export; since beef was cheap, local consumption was high. In fact beef was the cheapest meat and was to remain so until the end of the 1940s.

The meat exporting firms had big establishments to handle the large number of lambs which reached prime condition between October and December, the cast-for-age dairy cows which were used for canning, and the bobby calves which were boned, frozen, and exported. These firms also handled all classes of stock for the local market. The demand for meat increased greatly during the Second World War, and at its end Britain again became the main buyer of Victoria's surplus meat.

The Jersey breed became prominent in the early 1920s and largely replaced the Ayrshires and Shorthorns. New breeds of beef cattle, such as the Angus and the Poll Hereford, began to replace or add to the Herefords formerly concentrated in the highlands; Shorthorns grazed on the large wool producing properties, and the Red Polls, so popular for their dual purpose characteristics, on the smaller mixed farms. In this period many farmers supplemented their income by milking some cows and selling cream.

Changes also took place in the sheep industry which expanded rapidly, entering first the traditional cereal growing areas and later the irrigation and higher rainfall areas. By 1941 sheep numbers exceeded 20 million and rose to a peak of 20,598,000 in 1942, but the Second World War and the drought of 1944–45 reduced numbers to a low level of 14,655,000 in 1946. The sheep which spread into the cereal areas and on to the smaller farms consisted mainly of crossbred ewes for prime lamb production. During this period, research and its application played a large part in pasture improvement and in the utilisation of the improved pastures by grazing animals.

In 1932, under the auspices of the newly established Victorian Pasture Improvement League, the Victorian Department of Agriculture investigated fertiliser needs for pastures and carried out much research into pasture improvement in the higher rainfall or dairying areas of the State. It was discovered that potash fertiliser was needed in certain districts on land from which hay had been removed for several successive years. The development of ley farming in northern Victoria enabled more livestock (mostly ewes for prime lamb production) to be carried and enriched the soil for the production of higher yields of cereals.

In the late 1940s prices rose and farmers were able to implement better methods of pasture improvement to increase livestock production. In the 45 years between 1925 and 1970 Victoria's flocks increased from 12.6 to 33.2 million, and cattle numbers from 1.6 to 4.5 million. During this period there was little variation from a steady rate of increase in numbers, except for two minor checks in the 1930s and two major declines caused by the

droughts of the 1944–45 and 1967–68 seasons. Since 1946 sheep numbers have doubled ; this dramatic change from the previous period of steady stock numbers (less than 15 million) was primarily due to changes in the productivity of the pastures, although it was assisted by the clearing of additional land.

The period after 1951 was one of the most spectacular in Victoria's agricultural history, and by 1966 Victoria had over 15 million acres of improved pasture and, of this area, 11.7 million acres had been topdressed with about 800,000 tons of superphosphate annually. The following year cattle and sheep numbers had reached record levels of 3,528,000 and 31,239,000, respectively. There had been twenty-two successive good seasons, but 1967–68 was one of the driest on record, with cattle and sheep numbers receding to 3.5 and 27.9 million, respectively, by 31 March 1968. The drought broke in April 1968 leaving few permanent scars, and was followed by good winter growth.

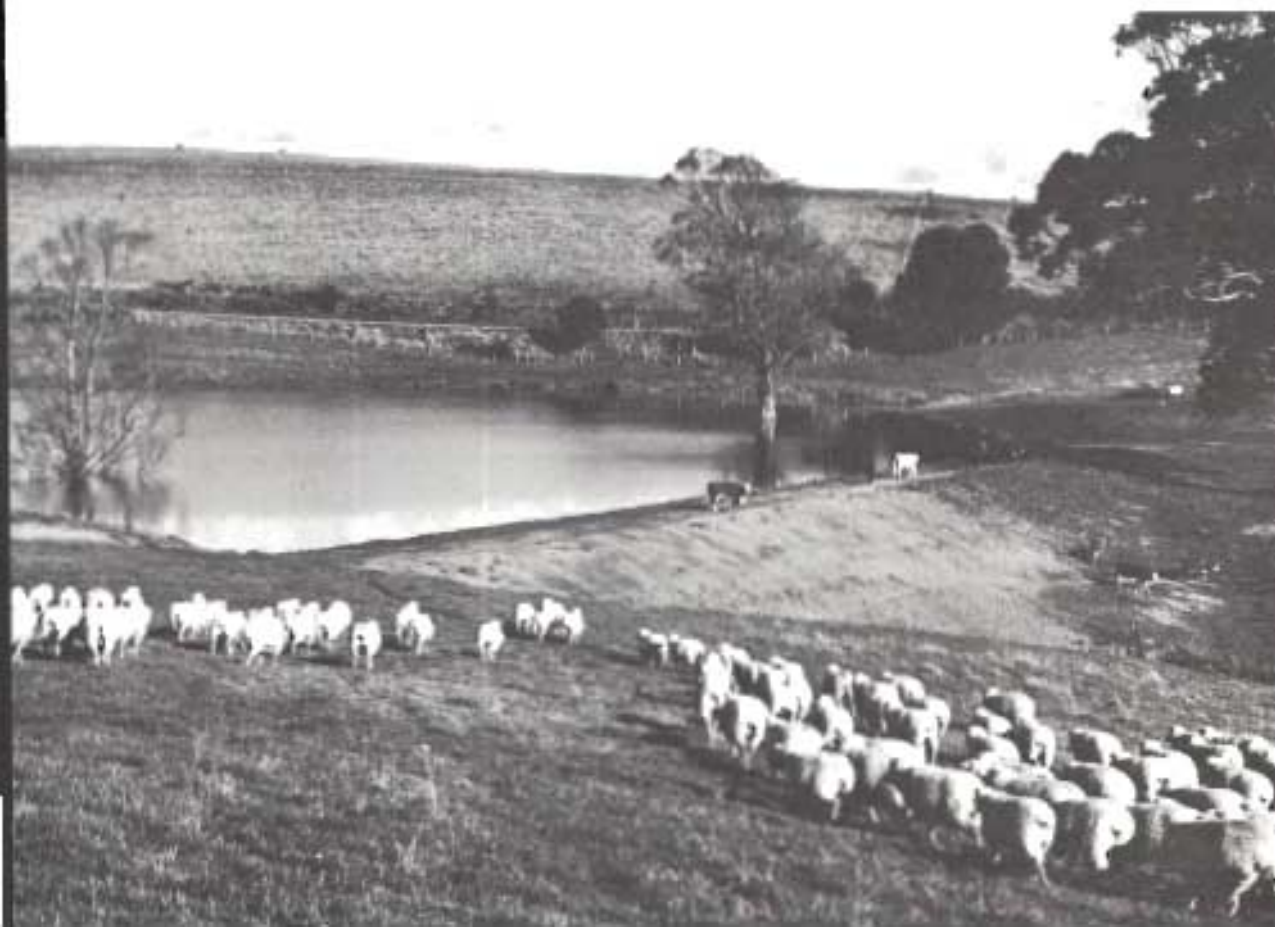
The most remarkable change in this period was in beef production. Beef was soon to become the most, instead of the least, expensive meat to the local consumer, and at the same time there was demand from the United States of America for frozen boneless bull and calf beef, with not more than 10 per cent of visible fat. This new export outlet created an unprecedented demand for a class of meat formerly regarded as inferior. Bulls and old cows from the dairy and beef breeding herds became nearly as valuable, per pound, as prime bullocks, and prices of $300 for bulls, $250 for bullocks, and $200 for cows were not uncommon. A proportion of Victoria's beef has always come from dairy cattle. Most of the cattle were dairy-bred, and beef-bred cattle were confined to a few areas, which were not suitable for dairying or grazing sheep, such as the eastern highlands, and to the larger properties where they were used to trim the pastures for sheep. Bullocks were often six years old before marketing. The demand for baby and yearling beef has changed the composition of beef herds, which are now mostly cows, replacement heifers, and calves. The calves are usually sold, at weaning, for baby beef, and the cows prove most valuable for trimming pastures for sheep. Nearly all of this high quality baby and yearling beef is consumed locally. The local demand for beef also followed world trends, cuts with plenty of lean meat and little fat being most popular. Dairy-bred cattle were recognised as good lean meat producers and were crossed with beef breeds to produce bigger, faster growing progeny. Between 1950–51 and 1970–71 beef production rose from over 132,000 tons to 290,000 tons a year.

POULTRY

Victoria now produces over 20 per cent of Australia's eggs and poultry meat and is second only to New South Wales in the production of poultry products. Initially, poultry raising was largely a sideline industry with most birds in small flocks on farms or on the outskirts of the cities. Since the early 1940s, however, the industry has undergone fundamental changes. The application of the latest techniques in genetics, nutrition, management, and veterinary practice has improved performance. Since 1954 the average annual egg production for Victoria has increased from 144 eggs per bird to about 220 eggs in 1971. Laying stock is mainly a specially produced White

Hereford beef cattle in the Kiewa valley near Mt Beauty
Department of Agriculture

A well constructed farm water storage at Melbourne North
State Rivers and Water Supply Commission



Carting milk in Gippsland early this century.
La Trobe Collection, State Library of Victoria

Selector's hut built of logs, slabs, and bark (but without nails) in east Gippsland.
La Trobe Collection, State Library of Victoria

Stripper and winnower, early grain harvesting machinery.

Department of Agriculture

Early " spinner " type fertiliser spreader mounted on a motor vehicle chassis.

I.C.I. Australia Ltd

Tunnelling, a type of erosion occurring where trees have been removed and the pastures overgrazed.

Soil Conservation Authority

The hare-wallaby, one of the twelve species of marsupials from western Victoria which are now extinct in the State.

Fisheries and Wildlife Department

A Gippsland selection hewn from heavily timbered country

Department of Agriculture

Leghorn–Australorp crossbreed, the Australorp being a well-known laying breed developed in Australia.

The introduction in the early 1930s of large electric, mechanically ventilated incubators allowed the large scale hatching of chickens in specialised hatcheries. This was the key to poultry industry expansion. Before this each producer laboriously hatched small numbers of his own chickens in kerosene incubators or with broody hens. At the same time Japanese chicken sexing techniques were introduced, which allowed the recognition and disposal of unwanted day old cockerels. The use of artificial lighting in laying pens in the later 1930s removed the seasonal nature of the fowls' laying period, and permitted the development of year round egg and chicken production. Continuous production of eggs and chickens had previously been restricted by outside weather conditions.

In the 1950s fully intensive housing of layers, growing birds, and brood chickens became popular. Both egg and poultry meat production are now large specialised industries with year round factory-type production almost independent of season, climate, or soil type. Some poultry houses are totally enclosed with full environmental control (temperature, ventilation, humidity, and light), and most layers are housed in cages for greater efficiency. Laying cage houses are now fully automated with mechanised feeding, egg collection, and manure removal. In all phases of production the trend is to fewer but larger units. One man can now tend approximately 10,000 layers, compared with 2,000 in the 1950s.

Egg production areas have tended to concentrate around areas of consumption or of readily available feed ingredients, the Melbourne and Bendigo areas being the main production centres. The rapid expansion of the egg industry soon brought marketing problems. A system of State Egg Marketing Boards was established under the *Marketing of Primary Products Act* 1937 to bring orderly marketing to the industry. These Boards developed the profitable export of surplus eggs and egg products in cold storage to Britain, and Australia, therefore, became a major world exporter of eggs. Government advisory and research services, including official egg laying tests, were also established in the early years of this century.

Large scale broiler raising emerged only after the mid-1950s, since when broiler chicken has become a staple item of the Australian diet. In 1959 it took twelve weeks to produce a 3 lb broiler chicken, with a feed conversion of 3¼ lb of feed to produce 1 lb of broiler chicken liveweight. A 4 lb broiler is now produced in only 9½ weeks at a conversion of 2.3 : 1. Broiler production is centralised almost exclusively around poultry processing factories which are situated close to the metropolitan area. Chickens are hatched throughout the year in hatcheries which are large and use modern automatic incubators each holding 50,000 to 75,000 eggs. The organisation of the industry is now a continuous, factory-like operation, and this has been a key factor in the production of eggs and poultry meat for consumers.

AGRICULTURAL CROPS

Wheat

Although grazing was the main objective of the founders of settlement in the Port Phillip area in 1834, an early activity was the growing of wheat for food. Acreage and production increased slowly. In 1851 nearly

30,000 acres was grown, but over 100,000 acres was grown by 1859, and eleven years later the area sown was 284,000 acres. During this period wheat growing was mainly confined to the southern parts of the Colony where European varieties and methods were generally used. The first recorded yield was 9.7 bushels per acre in 1839. However, from the 1840s to the early 1860s average yields exceeded 18 bushels an acre, with a maximum of 28.1 bushels in 1841. In the northern part of the Colony the first wheat crops were sown in 1855, and subsequently the shift in wheat growing to this area and to the Wimmera increased. The first wheat in the Mallee was grown in 1871. In the Colony one million acres was sown in 1883 and 2 million acres in 1898, although by then yields averaged only about 9 bushels an acre.

The introduction of improved varieties and more advanced technology in the early years of this century resulted in improved yields which stabilised during the 1920s. Acreages increased during this period to a peak in 1930. During the 1930s and 1940s wheat acreages declined because of low prices and the effects of the Second World War. After a temporary increase following the end of the war, acreages fell in the early 1950s, largely because of buoyant wool and meat prices. A minimum of 1,565,000 acres was recorded in 1956. There was then a steady increase until 1968, when 4 million acres was sown. Following this, large crop acreages were again reduced under a quota scheme designed to limit wheat deliveries to match market requirements. In the early post-war period, State yields averaged about 16 bushels an acre, but increased to an average of 21 bushels an acre during the 1950s and 1960s, with a record of 25.3 bushels an acre in 1960.

The first wheat varieties were of the English Lammas type, together with Red Straw, Velvet, and Tuscan types. Purple Straw, a South Australian farmer's preference, was first cultivated during the 1860s. Purposeful wheat breeding in Victoria began with Hugh Pye's work at Dookie Agricultural College in the late 1880s. The Farrer wheats from New South Wales became available in the late 1890s, and Federation, named in 1901, became the main variety grown during the 1910s and 1920s.

The Department of Agriculture has bred wheats at the State Research Farm, Werribee, since 1912. During the 1930s varieties bred by the Department were mostly used, and during the last 30 years about 90 per cent of the wheat acreage has been sown to Departmental varieties. Varietal resistance to the flag smut disease was obtained in the variety Ghurka in 1932. Control of the disease has been maintained by the incorporation of this resistance in subsequent varieties produced. Wheat breeding also resulted in a steady increase in quality. By 1970 soft wheats for biscuit and general purpose flours and hard wheat for breadmaking were being segregated.

The English practice of using farmyard manure was not practicable in Victoria, and continuous cropping seriously depleted the low phosphate reserves of the soils. Following the successful use of superphosphate in South Australia, the Department of Agriculture as early as 1877 had recommended its use in Victoria, but it was hardly used during the ensuing 20 years. Eventually it did gain acceptance, and by 1905 was being used on 56 per cent of Victoria's crop acreage ; currently it is used on almost 100 per cent of the Victorian wheat crop. The only other fertilisers used on wheat land are compounds of nitrogen, which under current conditions have limited

application, and of zinc, which is used as a trace element, particularly on the grey soils of the Wimmera.

Bare fallowing was one of the technological advances which made possible the development of the drier areas of the wheat belt. The drought of 1902 gave impetus to the practice which in many areas doubled crop yields. About 85 per cent of the wheat crop is now grown on fallowed land, although the practice is not now necessary for areas with an annual rainfall exceeding about 21 inches.

In 1901 the Wimmera-Mallee Domestic and Stock Water Supply System began to operate, and its ability to carry water to farms through more than 6,000 miles of open channels has had far-reaching effects on the agriculture in these districts. Initially, wheat growing and flour milling tended to concentrate near the centres of population, and it was the development of rail transport after about 1870 which made possible the growing of wheat for export. The provision of rail facilities always preceded the expansion of wheat growing into new areas. The mechanisation of the various farming operations also assisted the development.

The maintenance of soil fertility has long been a problem, and suitable legumes were not initially available, although peas were tried from time to time from as early as 1874. Clover and medic ley farming, derived from experimental work in the 1930s, has solved the problem. Harbinger medic, a product of the Mallee Research Station at Walpeup, has extended medic ley farming into the sandier and drier parts of the Mallee.

Oats

Until 1947 oats were grown primarily for feed purposes, and were particularly important when horse transport was pre-eminent. For over fifty years before the Second World War, about 60 per cent of the oat acreage was cut for hay and a little over 30 per cent was stripped for grain, while less than 10 per cent was grazed out completely. With the decline in the number of horses, use has moved from hay to grain. Less than 15 per cent of the crop is now used for hay and a similar acreage is grazed out, while about 71 per cent is used for grain, over half of which is sold for milling or for export.

Varieties grown before 1900 were of English or European origin. Algerian was introduced from South Africa in 1901 and quickly became the most widely grown, occupying 90 per cent of the acreage during the 1930s. Early maturing varieties, mainly from New South Wales, proved more suitable in the early districts. Orient, released from the Mallee Research Station, Walpeup, in 1947, proved an adaptable grazing and grain variety, and became most popular during the early 1960s. Avon, an excellent yielding variety from Western Australia, has occupied the main position since the mid-1960s.

Barley

In Victoria two-row barley of suitable quality has been used locally for malting and brewing and is the preferred type ; lower grade grain has been sold as feed. The six-row variety has been used primarily for feed. Until 1918 Victoria was the largest producer of barley in Australia, but with the rapid growth in barley production since 1900, South Australia consis-

tently increased production and since then has been the largest producer.

When transport facilities were limited and technological control in breweries was difficult to achieve, malting and brewing were undertaken near the centres of consumption and beer was produced in small units. For instance, in 1883 Victoria had seventy-eight breweries and production was 13.5 million gallons.

The varieties first grown were of English origin and best suited to southern Victoria. Prior, which spread from South Australia where it was first grown about 1900, was the dominant variety in the northern Wimmera and the Mallee until after the introduction of Weeah after 1968. Research type varieties were almost exclusively grown in southern Victoria for 30 years before a changeover to Lara occurred after 1970. The six-row variety Cape has been grown on a limited scale for over a century. Production of two-row barley in the late 1960s averaged nearly 5 million bushels, but increased in the early 1970s. About 40 per cent is maltable quality. Local maltsters require about 8 million bushels, and when local supplies of suitable quality grain are inadequate the balance is obtained from South Australia and the Riverina.

Tobacco

Tobacco was reported as first grown during the gold rush by miners who produced it near the diggings for their own use. This leaf, air-cured in crude bark sheds, was dark and strong and used mainly for pipe smoking. Commercial production of tobacco began in the 1850s, and the area increased from about 90 acres in 1860 to just over 2,000 acres in 1887. There was a decline to only 73 acres in 1917. The industry has mainly been identified with the alluvial soils in the Ovens and King valleys.

Bright leaf, for which there developed a major demand, can only be produced by the flue-curing process. This was first seriously attempted in Victoria in 1917, and was adopted fairly generally by 1920. Under the inducement of a bonus for bright leaf, plantings exceeded 2,500 acres in 1930. Revision of tariff policies resulted in a record 13,500 acres in 1932, but another decline followed, and the area fell to less than 1,000 acres by 1950. A statutory percentage-concessional duty scheme was introduced at a modest level in 1936, and its later application to ensure complete crop clearances gave renewed stimulus to tobacco production after about 1950. The area planted approached 10,000 acres by 1960. The Tobacco Stabilisation Plan of 1964–65 provided for a guaranteed sale of 26 million lb (green weight) of Australian leaf annually for an initial four year period, with an average minimum price of 104 cents per lb based on the grade fallout from a normal crop and was extended in 1968 for a further 5 year period at a higher level of price and production. This scheme has given economic stability to the industry which is now technically efficient.

Potatoes

The first crop of potatoes in Victoria was planted at Portland Bay in December 1834 by Edward Henty using a home-made plough drawn by a team of bullocks. The first statistical record of the crop in 1838–39 shows that 20 acres were then under cultivation, and three years later the area had increased to 932 acres producing 3,734 tons. Growth was gradual until 1927–28, when a peak of 77,649 acres was reached, but it fell to 32,177 acres in the late 1930s, the lowest for 74 years. The Second World War increased

the demand and during the 1944–45 season 83,238 acres was planted, giving a total yield of 305,216 tons, a record not since surpassed. After the war the industry struggled to maintain stability, but has now reached a new peak of efficiency and the average yield per acre has doubled since the early 1950s. The main contributing factors are higher yielding varieties, the effect of seed certification, the use of balanced fertiliser mixtures, better cultivation methods, and most recently, the widespread use of sprinkler irrigation. For some years Victoria has been the main potato-growing State, producing some 40 per cent of Australian requirements.

Oilseeds

The successful commercial production of oilseed crops in Victoria began in 1947 when linseed was introduced following a post-war shortage of vegetable oils. Small areas of crops with an alternative use as oilseeds, e.g., rape, flax, soybeans, and sunflowers, had been grown earlier with limited success. The potential of these crops and of safflower was investigated further, but linseed proved the most suitable. Between 1959 and 1969 the average area sown was about 13,000 acres, with an average yield of about 12 bushels an acre. The growing of linseed was influenced during this period by better varieties, improved technical knowledge, and stability of prices under a contract system. There was some commercial production of safflower after the mid-1960s and a large increase in 1970 as wheat acreages were cut. Substantial areas of rapeseed have been sown for oil production since 1968 in the medium rainfall cereal districts. Small areas of sunflower are being grown under irrigation in northern Victoria.

Pasture seeds

Early statistical records of pasture seed production show that substantial quantities of ryegrass seed were harvested in the Western District during the 1880s. Historically, seed of *Phalaris tuberosa,* perennial ryegrass, and subterranean clover have been of greatest significance, but more recently the range of species from which seed is produced has increased considerably. For many years the industry was based on catch-cropping in association with other pastoral activities. As a result there was a marked seasonal variation in production and generally low yields. During the 1960s, however, there had been increasing specialisation, crops with considerably higher yields being grown specifically for seed production. The *Seeds Act* 1928 was introduced to control the quality of seed sold for sowing, and provides for certain minimum standards of purity and germination with which all seed must comply. Further protection was given to the purchaser with the introduction in 1936 of a seed certification scheme supervised by the Department of Agriculture to ensure the varietal purity of the seed.

Miscellaneous agricultural crops

Maize, field peas, blue peas, rye, hops, sugar beet, and flax have occupied a small, although at times an important, role in the agriculture of certain districts or in particular circumstances. For instance, sugar beet was an important local product of the Maffra district from 1910 to 1948, and flax for fibre was grown widely over southern Victoria during, and for some years after, the Second World War ; the production of both these crops has now ceased.

HORTICULTURAL CROPS

Horticultural cropping began in Victoria with the first settlement. By 1856 some 2,000 acres had been planted to horticultural crops, compared with about 200,000 acres planted in 1970 with fruit trees, vegetables, and vines. Factors which have stimulated expansion have been the development of irrigation, cool storage, canning, improved transport and shipping facilities, soldier settlement, and war-time vegetable production. The development of irrigation in the Goulburn and Murray valleys since the 1880s has influenced the location of the fruit industry, and most Victorian tree fruits, processing tomatoes, and some early vegetables are now grown in these areas.

Grapes

Over 20,000 acres of vines for wine had been grown within 50 miles of Rutherglen by 1899, with smaller plantings in the Lilydale, Geelong, and Great Western districts. Some of these dated back to the late 1830s. Phylloxera disrupted the industry, however, and the Victorian acreage fell to about 5,000 acres following the outbreak of the disease in Geelong in 1877 and in Rutherglen in 1899. The Wahgunyah nursery was established to produce vines on phylloxera-resistant stocks and still continues. Alfred Deakin, then Commissioner of Water Supply, brought the Chaffey brothers from California to develop an irrigation area in Victoria's arid north-western Mallee region using Murray River water. Plantings of fruit trees and vines began in 1887 at Mildura. Dried vine fruit became the most important grape crop, and soldier settlement after both world wars has expanded production to over 70,000 tons. As 80 per cent of the dried fruit crop is exported, the industry depends on overseas markets, and in 1964 the Commonwealth Government introduced a price stabilisation scheme designed to assist the economic control of the industry based on the average cost of production each year. Replanting with selected material, re-trellising, and mechanisation are now receiving particular attention. In the late 1960s the boom in wine sales increased interest in expanding wine grape plantings.

Citrus

Citrus trees were planted over wide areas of the State in the last century, but commercial production now centres on the irrigated Murray River areas from Cobram to Mildura.

Fruit for canning

Pears, peaches, and apricots are the most popular canning fruits, with production centred in the Goulburn valley where wide scale plantings followed the construction of the Goulburn Weir in 1888. Citrus and vines were grown initially, as well as apples, pears, peaches, and apricots. Since 1910 major developments have included the establishment of the three co-operative canneries between 1917 and 1926, and the organisation of canning fruit settlement schemes at Katunga in 1947 and Invergordon in 1958 following the completion of the Eildon Reservoir in 1955. Expanding production was checked by the wet years of 1931, 1939, and 1956, years in which two thirds of the peach plantings were lost. However, canned pear production has increased rapidly to an estimated total of 5 million bushels, for export and the home market, by the late 1960s.

Apples, pears, and other fruits

Doncaster and the traditional inner metropolitan fruit growing areas have largely given way to suburban development in recent years, and the Mornington Peninsula is now the major apple district, although dessert peaches, cherries, lemons, strawberries, and the soft fruits are still grown near Melbourne.

Apples were sent to Vienna and to other European exhibitions from 1873, and in 1888, 400 cases made up Victoria's first commercial consignment. Apple exports developed to nearly 1.5 million bushels by 1932, but pears are now Victoria's major fresh fruit export at 1 million bushels a year. Some 300,000 to 500,000 bushels of apples are exported overseas, while interstate markets are also an important outlet for Victorian apples and pears.

Cool storage has been vital to the development of the apple and pear industries. The first fruit cool store was built in 1900 and the first large-scale shipment of pears was made in 1911. From 1923 onwards research in fruit cool storage has played a major role, and some 4 million bushels of apples and 6 million bushels of pears are now being produced each year. Jonathan and Granny Smith apples now provide 60 per cent of the total acreage.

Vegetables

Significant recent developments in the vegetable industry have been an increase in production per acre because of the greater use of fertilisers, irrigation, and improved pest and disease control practices (including the use of selective chemical weedicides) ; the increase of direct marketing to supermarkets, with the associated development of frozen and other pre-packaging ; the development of out-of-season crops in the Mallee irrigation areas ; the expansion of canned and processed production for local markets ; the mechanical harvesting and processing of peas to provide a tenfold increase to 25,000 acres during the 1960s ; and the movement of many market gardens to the Cranbourne-Dandenong area from the traditional sand-belt district south-east of Melbourne.

Present developments

Important factors influencing the development of fruit and vegetable industries include the introduction of controlled atmosphere storage and the hydro-cooling of vegetables ; the effect of container shipping on the export fruit trade ; the developments in packaging, where cartons have largely replaced wooden cases, and in trickle irrigation using low-cost polyethylene piping ; the use of growth-regulating substances to control fruit size and setting as well as plant growth ; and the use of bulk handling techniques with forms of mechanical harvesting. Managerial skills are also becoming increasingly important in improving production per person and per acre, and in the economic control of properties where both production and costs are rising.

PEST, WEED, AND DISEASE CONTROL

In 1885 the Victorian Government established a Royal Commission on Vegetable Products to investigate the serious pest and disease problem which existed in the rural industry. In 1889 an entomologist was appointed, and a year later a vegetable pathologist, the two forming the nucleus of

what was to become the Biology Branch of the Department of Agriculture.

Developments after the Second World War marked the first real progress when less phytotoxic organic fungicides replaced the copper and sulphur compounds previously used. These fungicides made possible the control of fruit and vegetable fungal diseases such as peach brown rot, black spot of apples, pears, and grape vines, and leaf spot of tomatoes. Steam sterilisation and the use of wide spectrum chemicals are techniques which have proved successful on nursery and high value crops against soil-borne diseases caused by fungi and nematodes, while host management practices have been of value on cereal crops. The breeding of resistant cultivars has proved useful, offering a wide range of application from crops, such as wheat and lucerne, to carrots and beans. Viruses constitute a special problem as they affect so many crop types, and because crops affected do not recover naturally and cannot be cured by chemical treatment. The strategy evolved here has been to use virus tolerant varieties or virus-free seeds, to destroy weed hosts, and to control vector insects.

The first Government Entomologist, C. French, reported that many insect pests had been accidentally imported, e.g., phylloxera and codling moth, while native insects quickly adapted themselves to introduced plants. Chemicals made available early in this century, such as pyrethrum, rotenone, arsenates, cyanides, and spraying oils could only be used on high value crops, and efforts generally met with only minor success.

A significant phase of insect control began in the 1940s with the discovery of DDT, BHC, and parathion, followed by similar synthetic organic contact insecticides. With improved equipment and the advent of aerial spraying from about 1945 the economic control of nearly all pests was achieved for the first time. Through the toxicity of some insecticides, the danger exists of harm to man himself and also to his animals. To supervise this problem a Pesticides Review Committee was established in 1966.

The *Vermin and Noxious Weeds Act* 1922 marked the first concerted effort towards controlling these pests. In 1959 a destruction board of the Department of Crown Lands and Survey was set up for this purpose. Its resources are employed to combat the animal and plant pests which can seriously affect agricultural production. The rabbit, the most serious agricultural pest, has now been greatly reduced in numbers by myxomatosis, and the use of this virus disease is an example of successful biological control of a pest animal. The use of this form of biological control owes much to the pioneering work of Dame Jean Macnamara in the 1930s and in the late 1940s.

The task of eradicating animal diseases is no new one for Victorian farmers, and sheep scab was the first with which they were confronted. Acts introduced from 1851 introduced powers of inspection, branding of infected and in-contact sheep, and generally co-ordinated the programme of eradication with the result that scab had been completely removed from Victorian sheep by the mid-1870s. Lack of quarantine procedures allowed the introduction of bovine pleuropneumonia, and until its contagious nature was indicated and the C.S.I.R. developed an efficient culture vaccine in 1935, eradication was difficult. Nevertheless, this had been achieved in Victoria by 1929. About 1935 a blood test was also developed to isolate infected and carrier cattle, and, to offset the financial loss experienced by farmers

when their animals were compulsorily destroyed, the *Cattle Compensation Act* 1924 was passed. Foot and mouth disease and bovine tuberculosis were approached in a similar manner, regular inspection becoming a feature in the control of animal disease. The tubercular skin test came into wider use as a herd test until a State-wide eradication project was initiated in 1957, and by 1968–69 only 0.04 per cent of animals in a survey over the whole State gave positive reactions.

Beginning with the founding of the Melbourne Veterinary College in 1888, and after several changes in responsibility, the Department of Agriculture eventually became responsible for the control of animal disease through its Animal Health Division, while the Division of Veterinary Hygiene (Commonwealth Department of Health), concerned with animals in relation to the Quarantine Act, has powers of inspection and rejection of animals and plants coming into the country.

POWER AND MACHINERY

Machinery for rural use in the early days was basic farming equipment, ploughs and harrows being the most important and most numerous items. Sowing was purely a hand operation ; reaping was by hand using sickle or scythe. On grazing properties shearing was done by hand, using hand shears (blades). By 1866 there were some 15,000 ploughs and 13,000 sets of harrows in the Colony, also about 2,000 reaping machines, 200 Ridley type strippers, and 175 steam engines on farms. On grazing properties there were 30 wool presses. Sixteen establishments were engaged in making agricultural implements and a further 220 were connected with or dependent on agriculture.

Broad acre cultivation and harvesting

The shallow soils and the wide areas of the holdings called for breaking with the English tradition of deep ploughing with single or double ploughs : multi-furrow ploughs became typical with teams of up to ten horses, of which the Australian farmers became skilled operators. Against this established pattern of cultivation, a brief attempt at introducing the system of steam tackle ploughing met with little economic success, although the system was used for subsoiling as late as 1946 on the Board of Works Farm, Werribee, where thorough drainage was especially important.

Meanwhile, in the 1870s two South Australian inventions made possible the further and rapid expansion of wheat growing : the mallee roller of Mullins which anticipated the modern ball and chain methods of land clearing by seventy years, and Clarence Smith's stump-jump plough which enabled newly cleared land to be cultivated before the tree roots had been grubbed. The stump-jump principle is still in use in many modern cultivating implements, whether mouldboard, disc, or tine type.

In much the same way the large areas sown to wheat and to cereal hay for the horse teams posed a daunting task to harvesting by scythe and sickle. It was this which Ridley overcame with his stripper in South Australia in 1843. With the stripper, which took off the ears and dumped them on a tarpaulin on the headland, was associated a portable hand-turned winnower through which the strippings were shovelled for cleaning.

Concurrently with the stripper the imported and local reaper or mower was used, though this did no more than cut the crop mechanically instead

of by scythe ; it still had to be sheaved and stooked and later brought into store for fodder hay, for chaffing, or for threshing for grain. By the late 1880s McCormick's reaper had developed in the U.S.A. into the mechanical reaper-and-binder which delivered the crop already bound into sheaves.

Notwithstanding the success and popularity of the stripper and its associated winnower, by the turn of the century the reaper-and-binder was the commonest harvesting machine in Victoria because it also made the hay for the work horses. Increasing numbers of steam engines appeared, and itinerant contractors, with chaff-cutters and threshing machines worked by steam traction engines, moved from farm to farm.

Labour was continually scarce, and prizes were offered by the Governments of South Australia in 1879 and Victoria in 1883 for the invention of a complete harvester, a machine which would strip the standing crop, thresh and winnow it, and deliver it into bags on the machine. After numerous successive trials, the most successful responses to these inducements were Morrow's design of a stripper–harvester made by Nicholson and Co. of Carlton, and H. V. McKay's design, made for the early trials by McCalman and Garde. At the turn of the century both Nicholson and McKay found export markets for their stripper-harvesters in the Argentine. Thus began the era of the stripper–harvester, known generally as the " harvester ", the last of which was made in Victoria in 1953.

Despite its apparent technical success, the harvester gained acceptance slowly at first, not only against the older stripper, but against the reaper-and-binder which remained popular until the 1920s. The limitations of the stripper-harvester in heavy crops and in crops flattened by wind, rain, and hail required that the crops be cut rather than stripped. The 1910s saw the development of the local variant of the American solution to this problem, the combined reaper–thresher, called in Australia the " header " because the heads were cut, not stripped, from the stalks.

Not until 1955 in the tractor age was the reaper-and-binder exceeded in numbers by the header and the harvester. Since 1953 the header has displaced the harvester ; since the 1950s the mower and pick-up baler, working mainly in hay from the greatly improved pastures, have replaced the reaper-and-binder for storing fodder, no longer for horses but for sheep and cattle.

Stationary power

Animal power was used in many places for driving stationary equipment ; the whim (horse-works) was a feature of many farms and was also used in mining. Windmills have been widely used in Victoria for pumping water, and over the thirty years preceding the general electrification of the State by the State Electricity Commission they frequently drove generators to provide electric power for rural homesteads. Steam power was used in stationary engines from the early years for threshers, chaff-cutters, and saws. The number of steam engines on farms and stations was 175 in 1866, averaging 8 hp. By 1873 the number had doubled. By 1910 there were 2,600 steam engines and 2,000 oil engines. Then came the general increase in internal combustion engines ; the numbers on farms rose to 25,000 in 1933, 36,000 in 1940, 40,000 in 1950, and 47,000 in 1955, at which point the record ceases. By this time electric power was widely spread in the rural areas and the electric motor became an increasingly important power source.

Tractive power

The use of mechanical power to tow the implements and machines of agriculture took a long course : the steam traction engine of low power and great weight served mainly as a mobile power plant for itinerant threshing machines and chaff-cutters. Slow speed oil engines led in effect to a scaled down version of the steam traction engine. The historical succession from steam to the nearly modern tractor is well illustrated in the Swan Hill Folk Museum.

The basic change came with a further scaling down, using a relatively high speed engine in a lightweight vehicle which appeared at the time of the First World War. Many models of these came from the U.S.A., but the Australian farmer preferred the horses he was accustomed to. They bred their own replacements and their food did not have to be bought. This reluctance avoided some difficulties in the depression of the 1930s when ready money was scarce. But the prosperity and expanding production after the Second World War, and the return to the land of men who had become accustomed to the machinery in use during the war, brought a different attitude ; farm work, like soldiering, was to become mechanised and the number of tractors rose to 10,000 in 1940, 24,000 in 1950, 60,000 in 1960, and over 80,000 in 1970.

From 1945 to 1950 the number of farm horses declined rapidly as the consumption of power kerosene rose. Similarly, after the early 1950s kerosene gave way to diesel fuel. Pneumatic tyres had arrived tentatively in the 1930s, and on new tractors had quickly replaced the lugged or barred steel wheels.

Wool and milk

Traditionally sheep were shorn by hand shears (blades). The only mechanical aid in the shearing shed was the wool press ; locally made and massive, it was successful. Only in the most recent times has it been modernised to hydraulic or electric drive.

Inventions and patents for power driven shears to replace the blades began to appear in the 1870s and 1880s ; F. Y. Wolseley successfully produced a workable machine which was first used in 1888. The shearers' strike of the 1890s and the coming of the oil engine virtually swept the blades off the board by 1900. The number of shearing plants now represents not so much the replacement of the hand shears, but rather, closer settlement and the building of more sheds.

In Victorian dairy farming, essentially a small scale subsistence family affair, the only new appliance appearing in the 1880s was the cream separator. Gillies of Terang made a significant step towards developing a mechanical method for the twice-daily milking with his invention in 1903 of the double-chambered teat-cup. The principal features of the modern milking machine were well established both locally and overseas, especially in New Zealand, by the 1930s. During the Second World War dairy families and the cheap labour of the preceding depression were depleted to the point where milk became scarce and milking machines essential ; with finance made available, they became common rather than exceptional : 4,400 plants were recorded in 1933, 9,000 in 1940, 15,000 in 1950, and 25,000 in 1964. The use of electricity on dairy farms has been

accompanied by the wide scale adoption of modern techniques such as refrigerated vats, bulk collecting by road tanker, and stainless steel hardware.

Fruit and vegetables

When the Chaffeys began to irrigate the citrus groves and vineyards of Mildura in the 1890s, at the same time as the Goulburn Weir watered the soft fruit orchards of the Goulburn valley, vines and fruits were picked by hand. Since then no local progress has been made with mechanising the picking of fruits and vines. In the early 1970s a grape picking machine was brought to Mildura, and a tree-shaker to the Goulburn valley, both imported for study from the U.S.A.

In comparison with the extensive farming on the broad acres of the wheat belt, the intensive farming of the metropolitan vegetable gardens has always required more labour. Nevertheless, many locally devised machines, transporters, and mechanical aids have been developed as the demand for produce has increased. Pea-viners, in effect threshers of the green pods, are standard in the harvesting of peas for freezing or canning. Although some hand sorting is still required, the larger plots of potatoes are now harvested by potato diggers ; in 1946 there were 818, and by 1971 the number had risen to 2,378.

Manufacture and mechanisation

The growth of power and machinery on the farms has been continually reflected in the growth of local industry to supply them : 16 agricultural implement factories were recorded in 1864, 44 in 1874, 50 in 1910, 60 in 1920, 80 in 1940, 125 in 1960, and 200 in 1967. Since 1900 Victorian manufacturing has contributed more than half the total value of the industry's output in Australia.

In the late 1960s and early 1970s the forced reduction of wheat growing through the imposition of quotas, the continued decline of wool prices, and the move to consolidate the smaller and less efficient dairy farms, had a depressing effect on the rate of growth in farming enterprise. This sharply reduced the demand for, and the local manufacture of, farm machinery, and the importation and assembly of tractors. Several of the smallest firms disappeared, while the largest reduced their efforts or diverted them to other areas of their business.

EARLY RURAL TRANSPORT

When Port Phillip was first settled, roads were the responsibility of the New South Wales Government, but the Public Roads Act of 1833 was not applied to the new district. Since the economy of Victoria was based on the pastoral industry, and the population was sparsely scattered, an efficient system of roads and bridges had not yet developed, and most goods were carried by bullock wagon, which was slow, costly, and damaging to freight. As a result the pastoral industry was seriously affected, especially during the winter months when roads often became impassable. In 1852, for instance, it was claimed that floods had disrupted transport so much that it took bullock wagons three months to travel 100 miles at a cost of £150 per ton. During summer it was only £10.

Some effort was made to deal with this problem, and the Parish Roads Act of 1840 authorised trusts elected by local landowners to levy rates of

up to 6d per acre and to charge tolls. Money could be raised by mortgage against rate and toll income. In 1842 a further Act established district councils with similar powers. A later Act of 1847, which was not enforced because the move for separation from New South Wales was well advanced, reverted to a system of trusts to care for " district " roads, while the central government was to undertake responsibility for arterial routes.

However, it was not until 1851 when large numbers of people and supplies moved to the gold diggings at Bendigo, Ballarat, and elsewhere that the first real effort was made by the Victorian administration to consider expenditure on the road system. In addition to highlighting the need for adequate roads, the gold discoveries attracted so many labourers to the diggings that the labour supply was greatly reduced. Also it was not unknown for carters to refuse to travel anywhere except to the goldfields ; station homesteads found it very difficult to get supplies, and in 1853 on completion of the shearing some stations had two wool clips stored in their sheds. On the other hand, the discoveries so altered the financial position of the Colony that it became possible to construct roads and bridges and even railways. The Government appointed a Select Committee to report on the state of the roads and the possible use of funds, and it was found that the roads were unsuitable for carriages and that only pack horses could be used. The Committee recommended that a central road board be established with exclusive power to deal with main roads, and that district road boards should be responsible for local roads. It also recommended that government finance be provided for main roads, and subsidies on a £1 for £1 basis for local roads. In both cases tolls were to be imposed for maintenance, and an appropriation was made by the Government of £88,000 for road construction to Bendigo. The Act of 1853 established the Central Road Board with three members who were responsible to the Colonial Secretary for policy, the Treasurer for finance, and the Surveyor-General for co-ordination with other public works. Although this divided control was unsatisfactory, excellent relations were established with the District Road Boards. In 1857 the Central Road Board was abolished and its functions were absorbed in the Department of Roads and Bridges in the newly established Board of Land and Works.

Six years later the Municipal and Local Corporations Act authorised the constitution of Shires which, with the remaining Road Districts, became corporate bodies. All roads within a Shire or Road District were placed under the control of the Council of the Shire or Board of the Road District, while roads outside these administrative areas remained the responsibility of the central government, through the Commissioner for Railways and Roads. The toll system, which had been intended to place the burden of road maintenance on the user, had proved unsatisfactory as costs of collection were high and the revenue uncertain. The cessation of tolls was authorised by the Shire and Borough statutes of 1869, but as no alternative revenues were available the tolls continued until they were abolished by an Act in 1877.

The *Local Government Act* 1874 provided municipalities with an endowment of £310,000 per annum for five years, but distribution was inequitable and the well established districts received much more than the new, more isolated ones. The endowment became a subsidy which reached

£450,000 in 1891 and by this time distribution had been improved. By 1894, however, the subsidy had been reduced to £100,000 and there it remained until the constitution of the Country Roads Board in 1913.

During the middle of the nineteenth century efforts were made to supplement the poor road system by means of railways. Short lines had been constructed in the early 1850s within Melbourne to provide public transport and for the movement of cargoes from the port to Melbourne, and with the discovery of gold, companies were formed to raise funds for railway construction to various parts of the State. The Melbourne, Mt Alexander, and Murray River Railway Company (known as the Mt Alexander Company) was established in June 1852 with the avowed object of constructing a line to the Castlemaine and Bendigo diggings and thence to the Murray River. This had the twofold purpose of connecting the diggings to Melbourne and of capturing the riverine pastoral trade. The railways, including the Mt Alexander Company, experienced great difficulty in raising funds, both in Victoria and overseas, largely because of certain limiting provisions in the legislation. Two other companies were formed at the same time, one with the object of constructing suburban railways around Melbourne and the other with a grandiose scheme to construct a line to Ballarat and thence to the Murray River at Castle Donnington (later Swan Hill). The suburban railway companies did not survive for long when costs of construction were ascertained and similarly the Ballarat company could not finance its schemes.

The Mt Alexander Company continued for some two or three years but experienced many financial difficulties. The Legislative Council, which had previously been opposed to State owned railways, then decided that the Government would purchase the Mt Alexander Company's property and interests, and that thereafter all Victorian railways would be constructed by the Government. The legislation was passed in March 1856, and the result was that Victoria established a state owned railway system.

In 1851 the Government of South Australia considered the possibility of using the Murray River for transport, even though unfavourable reports had been received earlier from Captain Charles Sturt about sea access at the Murray mouth. This was the beginning of a thriving and extensive shipping trade on the Murray River system. It grew so rapidly that by 1856, 10,000 bags of wheat were transported from South Australia to various ports on the Murray and 1,800 bags of flour were landed at Wahgunyah for overland transport to the Beechworth gold diggings. Despite the distance to be travelled from the place of production, it was cheaper, quicker, and more reliable than road transport.

By 1864 the railway via Bendigo to Echuca was completed. Echuca became a thriving port, second only to Melbourne in importance for the Colony. The pastoral industry of northern Victoria, most of southern and western New South Wales, and parts of South Australia now had quick and reliable access to a sea port for the dispatch of the biggest single primary product, wool. Despite the short season of about seven months during which the river steamers could operate, they were able to carry cargoes for 1,000 miles at £5 per ton, very much cheaper than by road transport.

The importance of the river trade increased until the 1870s when railway lines were constructed to other points along the Murray River. The first of these

lines was to Wodonga and was completed in 1873. Other lines were then built, to Yarrawonga in 1886, Cobram in 1888, and Swan Hill in 1890. New South Wales lines were completed to Albury in 1881, and Corowa in 1892. In New South Wales, other lines touching the Murrumbidgee and Darling completed the destruction of the river trade, but the early railway to Echuca had led to the large movement of population and to an adequate means of transport. It also led to settlement and population growth along the Murray River, and in particular to development in Echuca of the red gum milling and boat building industries. At Echuca alone some forty-eight river steamers and barges were constructed for use on the Murray system, and the settlement at Mildura in the 1890s was served for the most part by river transport, either from Echuca or from South Australian ports.

Ultimately the railways were to be seriously affected by the development of road transport and the use of the internal combustion engine. However, the early settlement of Victoria and the development of large areas and otherwise inaccessible places were made possible by the construction of railway lines throughout the State.

EXTENSION AND ADVISORY SERVICES

From the early days of the Colony people were conscious of the need to maintain a progressive agricultural community. In 1888 a travelling dairy demonstration promoted the establishment of butter factories and the use of advanced methods on dairy farms, and in that year David Wilson, who had made a successful shipment of butter to England from his farm at Egerton in 1881, became the Government's first dairy adviser. His lectures and demonstrations throughout the dairying districts did much to advance the efficiency of this industry, whose importance was growing with the development of refrigeration—a major factor in initiating Australia's export trade of perishable commodities. A series of demonstration cool stores in the horticultural districts was also linked with developments in refrigeration.

Early in the 1900s the first permanent head of the Department of Agriculture was appointed, and the *Journal of Agriculture* published. The Chamber of Agriculture's first convention in 1903 provided a forum for the discussion of problems between primary producers and agricultural experts. At this time, too, the use of superphosphate for wheat growing was coming into vogue. Its wide adoption during the early years of the century owed much to lectures by officers of the Department of Agriculture.

Farm competitions continued, although they lost some of their popularity in the early 1900s. However, many agricultural societies, notably that at Nhill, continued to sponsor crop and fallow and occasional farm competitions. From 1917 crop competitions again spread rapidly and led to the inauguration of the Farm Competitions Association of Victoria in 1927. District Wheat Crop Championships began in 1938 ; the Agricultural Society of Victoria co-operated by donating prizes.

Between 1924 and 1935 the Better Farming Train made a significant contribution to Victorian agriculture as it travelled throughout the State with its exhibits and lecturing teams. In a similar way, the Mobile Extension Unit visited a number of districts by road between 1954 and 1958. Some authorities, such as the Vermin and Noxious Weeds Destruction Board and the State Rivers and Water Supply Commission, now also have mobile displays.

One of Victoria's most important extension programmes began in 1931. This was the pasture improvement campaign which, subsidised by the Pasture Improvement League, stimulated a notable increase in the area under improved pasture. By that time the State Research Farm at Werribee and the Rutherglen Research Station, both established in 1912, were already influencing the State's extension activities. These stations, to be followed by a number of others throughout the State, had become focal points for regular field days which attracted large crowds to see the experiments and demonstrations and to hear the latest advice on topical problems. A more recent development during the past twenty years has been the establishment of farmer owned demonstration farms at Swan Hill, Kerang, and Maffra. There were, in addition, smaller field days at plot sites on a number of farmers' properties, especially in the cereal growing and pastoral areas.

During the 1940s soil conservation competitions began and have continued under the aegis of the Soil Conservation Authority. Since then field days on the properties of winners of the Hanslow Cup contests have drawn attention to the best management practices to control soil erosion. Since it was constituted in 1950, the Soil Conservation Authority has developed an effective decentralised extension service for advising landholders about suitable systems of land use and management to prevent soil erosion and achieve soil conservation. In addition to advice to individual landholders, it is now able by means of group area conservation projects to aid groups of landholders owning contiguous land with planning and implementing land improvement, soil conservation, and erosion control measures. Special field days have also been conducted by the Vermin and Noxious Weeds Destruction Board to instruct landholders on methods of controlling rabbits. The State Rivers and Water Supply Commission also conducts field days on special subjects such as automatic irrigation. Machinery field days have become more frequent, and advances in machinery design are displayed to large audiences. Commercial firms, especially those associated with agricultural chemicals, also conduct field days.

The extension method which was common in the early days of Victoria and has again become popular, is the use of a large demonstration plot or demonstration farm, as well as the farmer owned experimental farm, where research findings can be applied on an extensive practical scale. From time to time schools and seminars are held to show farmers new techniques and to help them with the application of new information. Some of these schools are residential; they are held at agricultural colleges or even in accommodation provided for shearers and in woolsheds. They are also held in local halls on a daily basis, or in a series of sessions over several days. During the 1950s and 1960s the Department of Agriculture established a great number of small discussion groups throughout Victoria, especially in the dairying and horticultural districts.

During the Second World War special crops such as flax and vegetables were promoted, and efforts were made to ensure that scarce commodities such as labour, fertilisers, and machinery were used most efficiently. The War Agricultural Committees, which included primary producers and officers of the Department of Agriculture, helped maintain production for home use and for the forces in the Pacific during this period. Since the formation of the Board of Agriculture which preceded the Department of Agriculture, regulatory officers have given some advice to farmers, especially in connection

with the administration of particular Acts. This work was particularly valuable during the early days of exports when quality standards had to be established and maintained. In 1948 the Department of Agriculture appointed several District Agricutural Officers as extension advisers in country districts, and their numbers have increased as more trained officers have become available. They have formed the nuclei for a number of extension groups throughout Victoria, and have included industry specialists on sheep and wool, beef, dairy husbandry, and agronomy, as well as agricultural economists ; some regulatory officers also perform advisory work. Extension specialists in soil conservation and irrigation are stationed in appropriate districts, and the Vermin and Noxious Weeds Destruction Board also has an advisory staff.

In the late 1940s and early 1950s agricultural extension throughout Australia was stimulated by funds from the Commonwealth Government for special programmes in dairying and certain other primary industries. These funds, since augmented, have been combined to serve all primary industries. During the 1950s extension methods developed with the " whole farm " approach, which emphasised the consequences of dealing with an isolated problem without due regard to the total activities of the enterprise. Recently, as the knowledge of agricultural economics has advanced and as costs of production have increased disproportionately to returns, farm management economics has been further emphasised. Consequently there has also been a strong stress on educational extension programmes to teach the reasons as well as the methods for improved farming. In this, extension officers have been assisted by the postgraduate course for the Diploma of Agricultural Extension established at the University of Melbourne in 1966.

Mass media have played a very important part in agricultural extension, because there are rarely enough specialists to provide a widespread person-to-person service. For the first half century printed media were mostly used, especially local newspapers, rural weeklies, and the *Journal of Agriculture*. Books and pamphlets were also published by the Department of Agriculture, and a series of special industry digests began in 1953. Also, all irrigation farmers receive a quarterly publication from the State Rivers and Water Supply Commission. Radio services, which began in the 1920s, have been developed by the Australian Broadcasting Commission and country commercial stations, and television services have been available since 1961. During the Second World War, when it was impossible to advise many primary producers in person, motion pictures assisted in the special food production programmes.

A further development in agricultural extension in Victoria occurred in the late 1950s with the establishment of farm clubs and private consultants. The consultants, whether servicing a farm club or their own clients, have provided an intensive personal service for primary producers on payment of a fee. Much of the advice is in relation to farm management economics. Other commercial firms have provided advisory services to their own clients in particular, and to primary producers in general.

AGRICULTURAL EDUCATION

University of Melbourne School of Agriculture

The Victorian Government provided, in the *University Act* 1904, a grant of £11,000 per annum to establish facilities for training students in mining

and in agriculture. In 1905 the University passed a statute for the creation of a Faculty of Agriculture in which students would be trained, mainly in the existing science departments. The statute became operative in 1906 and the first B.Agr.Sc. degree was conferred in 1911. During the First World War, however, few students sought places, and in 1916 closure of the School was considered and a committee of review appointed. Its report led to the passing of the *Agricultural Education Act* 1920, which authorised finance for a building and equipment for the School and provided for the employment of graduates in State Government departments.

The School building was erected in 1921 and since then extensions have been considerable. Staff numbers have increased; the School has acquired the University Field Station thirteen miles away at Mount Derrimut, a controlled environment phytotron, and a new animal house; and facilities for training undergraduate and postgraduate students have been expanded.

The agriculture course trains students in the basic sciences as they are applied to agriculture. In the second year of the course the students reside at Mount Derrimut in order to ensure contact with an agricultural environment. Facilities for this had been provided in the past at the State Research Farm, Werribee, and at Dookie Agricultural College. It provides residential quarters and facilities for teaching the second year students, and is also a centre for the research activities of the School of Agriculture. Significant advances were made with the inauguration of more advanced training, in 1951 in animal husbandry, and in 1959 in agricultural economics and rural sociology. A postgraduate course in agricultural extension was established in 1966.

In 1927 the students numbered 28, but by 1956 there were 191. The number of students seeking admission to the course rose steeply after the Second World War, and it was necessary to impose a quota on entry in 1959. The intake is now limited to seventy in the first year, so that there are about 240 undergraduates. Some forty postgraduate students work at the School. The course remains one of four years duration, providing a general training in agricultural science, but with elective subjects in the fourth year, and training in specialist fields is available at postgraduate level. By the end of 1970 the School had produced more than a thousand graduates.

La Trobe University School of Agriculture

A School of Agriculture was established at La Trobe University in 1967. First year enrolments have increased from 22 in 1968 to 58 in 1972. The course as a whole is directed towards an integrated biological approach to agriculture, with a substantial additional emphasis on economics. The core subjects of the course emphasise the relation between plants and animals and their nutritional and physical environments. Honours may be awarded at the end of the four year course on the basis of performance throughout the course.

Department of Agriculture Colleges

The Agricultural Colleges, Dookie and Longerenong, were established under the *Agricultural Colleges Act* 1884, which reserved 122,570 acres of Crown land as an endowment to finance the construction and maintenance of agricultural colleges in Victoria. Dookie Agricultural College was built on

6,048 acres and opened in 1886, and Longerenong Agricultural College was established on 2,386 acres in 1888. These Colleges were administered by a Council of Agricultural Education which was abolished in 1944, when the Colleges were transferred to the Division of Agricultural Education within the Department of Agriculture.

In 1957 the Victorian Government began a major building programme at the Colleges, reinforced by funds provided by the Commonwealth Government under various grants between 1965 and 1968. This programme increased the residential students at Dookie to 240 and at Longerenong to 131, and, in addition, provided new science laboratories, lecture theatres, and technical facilities for instruction to tertiary level.

The entrance standard for the course given at the Colleges was raised in 1949 and again in 1966, when the course reached a standard of matriculation plus two years leading to a Diploma of Agricultural Science, and the Colleges became recognised by the Commonwealth Government as colleges of advanced education. Dookie and Longerenong have awarded 2,092 Diplomas of Agriculture up to and including those awarded in the 1967 academic year. The first Diplomas of Agricultural Science were awarded in the 1968 year, and by the end of 1971 over 250 had been awarded.

From 1946 to 1949 special courses were given at Dookie to more than 2,000 ex-servicemen under the Commonwealth Reconstruction Training Scheme. Many of them received Diplomas of Agriculture, and some obtained properties under the Soldier Settlement Scheme. After 1949 short intensive courses for farmers were provided at Dookie and over 3,500 have attended.

A college with accommodation for 120 male and female students was established in 1971 at Glenormiston, where a two year course is given in farm production, management, and economics. This course has been designed to meet the needs of all types of primary producers and farm managers.

Marcus Oldham Farm Agricultural College

Founded privately near Geelong in 1961, the College specialises in farm management education for the sheep, cattle, and cropping industries. Students with previous practical experience attend the College for two years during which they complete a "sandwich" course of an eight month academic period, an eight month practical period on an approved farm, and then a second eight month academic period. In this way, 105 students complete the course every two years, although only 70 are in residence at any one time.

The College farm is used as a teaching laboratory rather than a training area for manual work. It covers 420 acres in a 21 inch rainfall area, and is commercially self-supporting from the income received from Merino sheep and Hereford cattle. Course work consists of lectures, demonstrations, and field trips, which provide the subject of extensive written reports on the farm, its management, financing, and budgeting. There are four broad subject groups in the lecture programme : plant and environmental sciences, animal science, farm management and economics, and agricultural engineering.

The entry requirements are a minimum age of 19 years, at least one year of practical experience since leaving school, and the completion of a full secondary course ; a matriculation pass is not necessary. Preference is usually given to older students with more practical experience.

Gilbert Chandler Institute of Dairy Technology

The Gilbert Chandler Institute of Dairy Technology was established under the name School of Dairy Technology and Dairy Research Laboratories on the State Research Farm of the Department of Agriculture at Werribee in 1939. Except for the period 1943 to 1947 when war-time problems necessitated a suspension of training, a two year residential course for the Certificate in Dairy Manufacture was provided from 1939 to 1966.

In 1966 and 1967 major extensions were made to buildings and the Institute received its present name. The new buildings provided modern lecture rooms and science laboratories for teaching and research. A new pilot scale dairy factory was also provided, with manufacturing facilities for butter, cheese, condensed and dried milk, and casein, and facilities for milk pasteurising and bottling. Since 1968 the Institute has provided an additional year of training which leads to the Diploma of Dairy Technology.

The Certificate course trains students in the basic technical and scientific principles underlying dairy manufacturing and dairy science. In the Diploma year, students receive co-ordinated training on a project basis in chemistry, microbiology, engineering, and processing, in addition to instruction in industry organisation, management, and marketing. All students are required to work in dairy factories during the vacations.

Most Victorian dairy factories contribute to a fund which provides scholarships for students at the Institute. The courses provide the dairy manufacturing industry with suitable training for skilled plant operatives, foremen, field officers, laboratory technologists, and production and general managers.

Burnley Horticultural College

Burnley Horticultural College, also controlled by the Department of Agriculture, was established in 1891 on 34 acres of land allocated to the Horticultural Society of Victoria in 1857. In 1911 a two year certificate course was instituted, and in 1958 this was raised to a three year diploma course in horticulture. Since 1966 the College has provided a three year diploma course in horticultural science; it also conducts short courses and practical demonstrations of fruit tree and rose tree pruning. These are attended annually by many home gardeners.

Courses at State schools

Between April 1907 and September 1912 ten district agricultural high schools were opened as dual purpose secondary schools giving special instruction in agriculture to some students and the normal high school curriculum to the remainder. The schools had small farms attached, but these became unprofitable during the depression of the early 1930s. Gradually they became normal district high schools.

Specialist training courses are given in some technical schools; in most instances the courses are concerned with sheep production and wool handling, but other subjects of rural interest have been commenced recently.

Other agricultural education

The *Royal Agricultural Society* was the successor of the Pastoral and Agricultural Society of Australia Felix (1840 to 1842) and the Port

Phillip Farmers' Society (1848 to 1867). In 1870 the National Agricultural Society was created, taking over the land and funds of the Port Phillip Farmers' Society. In 1883 the Society moved to the present Flemington site and in 1890 the Queen granted the prefix " Royal ".

The *Victorian Agricultural Societies' Association* succeeded, in 1965, the Chamber of Agriculture, a body concerned with the rural affairs of the State and formed in 1900. The Association now has 115 affiliated societies. These societies have assisted in local rural education and promoted interest in agricultural affairs among the non-rural population.

The *Victorian Young Farmers Movement,* sponsored by the Royal Agricultural Society and the Department of Agriculture, now comprises 164 clubs with 4,500 members. The movement began officially in 1947 as a senior section of the Victorian Young Farmers' Clubs Association which was disbanded in 1952. It seeks to increase knowledge of rural life by means of cultural, social, and agricultural activities. Since 1963 the Movement has published a monthly magazine called *The Victorian Young Farmer.*

LIFE ON THE LAND

About a third of Victoria's population lives in the country, either in provincial centres or " on the land ". The economic factors which have shaped their lives have had significant social implications. In the years before the discovery of gold, life on the land was rugged and primitive. There were few women ; the men often looked after their own domestic needs. Their days were spent supervising their flocks on the " runs " they leased ; this could be a hard job involving the uncertainties of Aboriginals as well as of ill-defined boundaries, and the supervision of the shepherds who were responsible for the flocks grazing on the " outstations " of the run. The home was usually a simple type of rectangular hut which provided little more than the basic necessities of life ; such leisure as they were able to enjoy in the evenings was usually derived from reading and perhaps some music. These " squatters ", as they came to be called, were comparatively young, as one would expect from the rigorous demands of this kind of life, and many had no other aim than to become rich quickly and return to their homeland.

When gold was discovered in various places after 1851 the miners lived in tents or makeshift buildings on the " diggings ", while the merchants and squatters supplied them with food and clothing, a profitable occupation, especially when supplemented by proceeds from wool. These profits eventually came to pay for the permanent homesteads which the squatters erected on their properties after they had ensured the freehold of their titles. The merchants built shops, hotels, and houses in the provincial cities, which were geographically well placed in relation to the diggings, and later became rural regional centres.

Many of those who came in search of gold soon realised that their hopes would be unfulfilled and so sought to obtain land, thereby coming into conflict with the interests of the squatters. When land was finally made available in the 1860s and 1870s in various parts of the State, the era of the small family holding began. A significant economic and social gulf developed between these smaller farmers and the older squatters whose tenure was now legally established and some of whose properties ran into thousands of acres. Life on the smaller, as on the larger, holdings was isolated (the roads, where

they existed, were poor for the most part) and the economic rewards fluctuated and did not allow for many luxuries. The chief leisure activities, when time allowed, were local sports meetings, picnic races, the annual agricultural shows, the mechanics institutes, visiting friends, family gatherings, reading local newspapers, and informal entertainments based on the home, which was usually a comfortable, if modest, building. All the family was likely to share in some work on the property. On Sundays attendance at church was common and was one activity shared by all classes of society.

Life in the homesteads, however, could be very different—in fact, leisurely and luxurious. Builders and decorators were frequently engaged from Europe to build substantial homes of classic proportions and treatment; imported furnishings could be sumptuous and enhanced by valuable *objets d'art*; and the tenor of life made smooth by domestic servants. The sons were educated at boarding schools established for this purpose from the 1850s on, and later often sent to one of the old universities in Britain, before returning to take their turn at managing the property and perhaps rendering public service on a shire council or in Parliament. The daughters would likewise go to boarding school after having had their tutors at home for their earlier education, and they later tended to marry men of a similar social background. The wealth of these families originally came from the land and was later strengthened by association with pastoral investment in other States (e.g., Queensland), mining investment (e.g., Broken Hill), and manufacturing investment in many other places.

There were, of course, countless variations between the types of social life outlined above, although they do describe the basic patterns of life on the land in the nineteenth and for a large part of the twentieth centuries. In contrast to Europe, Victoria never witnessed a yeoman class of farmer and although some large land owners did have tenants, their existence was of a less significant and more transitory nature than it was in Europe.

Drought always affected the small landowner more than the squatter. The pastoral finance companies and banks had to "carry" them through years of natural disaster and capricious overseas markets. As the original concept of the small holding (frequently of 640 acres) became popular in the western, central, and northern parts of the State in the 1860s, it did not take into account the severity of drought which first became apparent in the 1870s and was eventually to act as a spur to developing irrigation. At such times many owners were bought out by their more affluent neighbours, and the small family holding has had a less stable history because of drought, falling markets, and later, over-capitalisation than that of the squatter, the size of whose holding (in itself a substantial security to borrow against) enabled him to weather adversity.

The Government had sponsored closer settlement at various stages from the end of the last century by acquiring land from the large holdings in the Western District or opening Crown land for the purpose in other parts of the State. Most of these schemes were designed to settle ex-servicemen from the two world wars on the land, but some of the earlier ones failed because of inadequate economic planning and those begun in the 1950s were careful to heed the lessons of the past. This gave the more recent schemes a social stability lacking earlier.

The social changes so apparent in the cities were slower to appear in

the country. Here there was no boom growth to match Melbourne's at any time; prosperity in the provincial cities and towns was more closely related to that of the farmers, and the merchants who served on municipal councils were only too well aware of the connection. The general isolation of life on the land, which originally was only reduced by horse transport, became less noticeable as better roads, the motor car, the radio and the kerosene refrigerator, regional transport to school, regional services for libraries, hospitals, and ambulances, and perhaps more than any other single factor, television from 1956 onwards, were changing the social patterns of life. New domestic amenities added more comfort. The gradual electrification of the State provided the country housewife with the same domestic appliances as were available in the city, and bottled gas, available since the 1950s, extended this range of appliances. From the 1930s onwards the Council of Adult Education and the Young Farmers Movement provided more social and general educational opportunities than had been available in previous years.

However, for all this, the trend of population has been away from the country to the city. For two decades after 1945 land prices rose and the use of sophisticated farming machinery lessened the demand for manual labour, while at the same time greatly increasing rural productivity per person employed. However, the financing of this equipment in spite of special taxation concessions has been costly and eventually had to be matched by a commensurate return from the land's produce. During the 1950s and 1960s various government subsidies were one answer to this "cost-price" problem, but by the late 1960s the state of international markets, especially for wool, wheat, and dairy produce, brought this solution into question. Many smaller farmers (including small wool growers) were then faced with the possibility that the economic return on their capital was insufficient to allow them to continue on the land. One suggested solution was the restructuring of small family farms into larger units. But this would not only force farmers into the cities but also deny their children the possibility of living on the land. Quite apart from augmenting the problems of urban planning, the rural uncertainties apparent in the early 1970s questioned the economic and social assumptions behind the family holding which had been taken for granted for over one hundred years.

4

MINING

GEOLOGICAL SURVEY OF VICTORIA, 1852–1970

The Geological Survey of Victoria was born out of a need for expert geological advice following the discovery of gold in 1851. Governor La Trobe recognised that the discoveries promised a rich potential source of income, and he appealed to the Colonial Office in London to select and appoint a mineral surveyor for the Colony.

Mr Alfred R. C. Selwyn, of the Geological Survey of Great Britain, arrived in Melbourne in 1852 to start a geological survey of Victoria. With one assistant he travelled the Colony and surveyed the Loddon and Campaspe valleys, other areas between Melbourne and Cape Paterson, and part of the Yarra River basin. In 1855 he discovered the Caledonian goldfields at Warrandyte ; in 1856 the Geological Survey proper was inaugurated under his charge. There were no reliable topographical maps available so the Geological Survey's work included map-making as well as geological investigation. In the mapping programme maps were prepared of rectangular blocks measuring 6 by 9 miles. Known as quarter sheets, these were the basis of early geological surveying in Victoria.

Conflict arose because of the overlapping activities of mining surveyors under the Board of Science and geologists under the Commissioner of Lands. In 1863 a Board of Enquiry decided that mining surveyors should be put under the control of the head of the Geological Survey. Later in the same year the first geological sketch map of Victoria was issued, and a laboratory was established for analysis of minerals and rocks. The Minister of Mines took over control of the Geological Survey in 1867. Once again the problem of overlap between the functions of geologists and mining surveyors arose. A co-operative scheme was suggested whereby mining surveyors were to help with the preparation of topographical maps. The plan was approved by the Minister, but before it could be implemented the Geological Survey was disbanded in 1869. Selwyn, founder of the Survey, resigned and took up an appointment in Canada.

The Survey was revived in 1870. In three years the Ballarat, Bendigo, Ararat, and Creswick goldfields were surveyed ; the Beechworth area, the Cape Otway district, and the Grampians were mapped ; and a new geological map of Victoria was compiled on a scale of 16 miles to 1 inch. After 1873, reports on the progress of the Survey were published and in the same year the survey of south-west Gippsland was commenced. It covered 3,500 sq miles, included the Walhalla goldfield, and took four years to complete. A

survey of the Stawell goldfield commenced in 1874. With the decline of alluvial mining and the introduction of deeper reef mining, underground surveys were needed ; the Bendigo mines were selected for this type of survey in 1876. General geological investigations continued for the next ten years, and surveys were made of the Gippsland goldfields, the Clunes district, and the deep leads of the Loddon valley. The survey of the Rheola goldfields and the reconnaissance of the Mitchell River district in Gippsland were completed in 1889.

After Selwyn left the Geological Survey a number of important goldfields were surveyed under contract, but little attention was paid to stratigraphic and structural geology. In 1890 the Geological Survey was reorganised on more scientific lines, and in the early 1890s it investigated the black coal discoveries at Outtrim, Jumbunna, and Korumburra ; made surveys of the Heathcote goldfields and the Mount Wills tin deposits and goldfields ; and surveyed the Rutherglen and Chiltern deep lead goldfields. In 1896 the first palaeontologists were employed by the Survey for the study of fossils ; this had previously been carried out by the University of Melbourne.

In the late 1890s the border area of Victoria and New South Wales in the far east of the State was surveyed, and detailed surveys of the Stawell and Walhalla goldfields were made. In this period the Survey carried out general research into the stratigraphy and structural relationships of Victoria's geological formations. A study of the Tertiary strata of part of the Mornington Peninsula was completed, and in 1900 the Buchan Caves were examined and the first catalogue of Tertiary fossils was prepared. By this time the Geological Survey had obtained a broad outline of the geological structure of the Colony and contributed greatly to the knowledge of Victoria's mineral resources.

In 1901 a new mapping programme was started based on the parish plan as a unit at a scale of 40 chains to 1 inch. Palaentological research covered graptolites, Tertiary fauna, and Mesozoic flora. Petrological work was revived, but during the decade 1901–1910 the goldfields still received priority, the main areas being the Harrietville area, the Bendigo district, the Steiglitz area, the Bethanga area, and the Granya area. At the same time the Survey investigated both black and brown coal resources ; investigations in the Powlett River area resulted in the State Coal Mine opening at Wonthaggi. A survey of the Mount Buffalo area published in 1908 influenced the development of Mount Buffalo National Park as one of Victoria's most favoured tourist resorts.

The Geological Museum to house the large collection of accumulated geological specimens was completed in 1910. Between 1910 and 1920 surveys of the La Trobe valley brown coal and the Wonthaggi black coal resources advanced ; work on the Ballarat and Bendigo goldfields continued ; and a survey of the Jamieson and Macalister River areas was made. To combat the coal shortage a State Parliamentary Committee recommended close examination of brown coal deposits in the La Trobe valley, and the Mines Department re-opened the former Great Morwell brown coal open cut at Yallourn North to supply the needs of the State. Steady progress was made in all fields of activity between 1920 and 1930. The main interest was centred on the search for oil in the Lakes Entrance district and in the extension of the brown coal investigations in the La Trobe valley

where the control of brown coal mining passed to the State Electricity Commission in 1924.

The depression of the 1930s brought geological work almost to a standstill, but as conditions improved the Survey worked in the Heathcote, Castlemaine, and Bendigo districts. In 1936 investigations were made in the Kiewa valley to provide information for the State Electricity Commission's hydro-electric power scheme. The Second World War disrupted the Survey; in the immediate post-war period detailed investigations were made to find further brown coal deposits, moulding sands, concrete aggregates, limestones, clay, gold, tungsten, antimony, tin, and oil. New regional surveys supplied detailed information of the geology of most parts of Victoria including information on such individual projects as the Big Eildon Dam. A revival of interest in petroleum exploration led to a demand for current geological mapping, and to an increase in staff in the late 1940s.

A major function of the Survey is the preparation of basic geological maps of Victoria. Maps at a scale of 1 : 250,000 are being prepared to cover the whole of the State, with selected areas being mapped at scales of 1 : 63,360 (1 mile to an inch) and other suitable scales. Geologists now use modern scientific aids; aerial photographs provide accurate basic information for maps, and field parties no longer work from remote field camps but use motor vehicles to move quickly along tracks into country which was previously difficult to reach.

A large amount of drilling was required to complement the surface surveys. By the end of 1952 all the old rigs, which were slow to operate and expensive to maintain, had been replaced by new mobile drills. The increase in geological staff continued throughout the 1950s and a section of geologists was appointed to intensify groundwater exploration of the State, including the Murray, Otway, and Gippsland sedimentary basins; this is now a major function of the Geological Survey. In liaison with the Drilling Branch of the Mines Department much data has been accumulated, and from the mid-1960s this information has been progressively programmed into the Department's computer system. Since then the section has carried out hydrological and hydrochemical investigations of surface water and groundwater in existing bores. It has supervised work of drilling teams putting down many new exploration bores. Legislation providing for the exploration, conservation, and better use of Victoria's groundwater resources was passed in 1969 and is administered jointly by the Mines Department and the State Rivers and Water Supply Commission.

Gold mining, the original and for many years the mainstay of Victoria's mineral industry, has declined rapidly since the 1930s. Mining at Bendigo ended in 1953, gold dredging in central Victoria in 1957, and in 1968 the then last publicly listed mining companies, the Wattle Gully Gold Mines NL (Chewton) and the A1 Consolidated Gold (A1 Mine Settlement) finished operations, but these two mines have, since then, re-commenced working. The Victorian Mines Department continues to encourage mineral exploration throughout the State, and in the 1960s most of the mineralised areas were covered by exploration licences. The Geological Survey maintains an active interest in exploration, supplying up-to-date maps and geological

literature and advice to the limit of the present resources. In 1965 new legislation was introduced to enable large areas of private and Crown lands to be explored. Gold, tin, lead, copper, and phosphate were sought under licence provided by the legislation, and the legislation has now been extended to provide exploration licences for zinc, nickel, antimony, silver, molybdenum, zirconium, and titanium.

Industrial expansion in Victoria relies heavily on large supplies of sand, gravel, clay, and stone ; the Geological Survey has intensified the search for deposits of these materials and prepares reports on areas with economic deposits to be reserved for future extraction. Mining of black coal in Victoria virtually ended with the closing of the State Coal Mine at Wonthaggi in 1968, but the Survey has continued to explore brown coal reserves in the Lal Lal, Won Wron, Gelliondale, and Anglesea areas ; the Anglesea brown coal field found by private enterprise under geological direction from the Survey now supplies coal to generate electricity for the needs of the aluminium smelter at Geelong, in the same way as brown coal has been mined at Bacchus Marsh since 1944 for local and metropolitan needs.

Since 1954, when the first petroleum tenement was taken up offshore, the Geological Survey has provided the petroleum industry with detailed geological maps and stratigraphic and palaeontological services ; this has assisted the search in the Gippsland Basin where commercial fields of natural gas and oil are now operating.

The staff of the Survey helps with engineering geological investigations on sites for large construction projects. The Commonwealth Centre site, the proposed route of the underground railway, the Lower Yarra Crossing, and the Portland harbour works have been among the many geological investigations covered by the Survey. The basic sequence of rocks in Victoria was established early in the history of the Survey, but continued detailed mapping and biostratigraphic studies over the recent years have improved and extended the knowledge of the geology of the State.

GOLD

Discovery

The discovery of gold in Victoria was officially credited to James Esmond at Clunes, and to Louis Michel and his party at Andersons Creek, near Warrandyte, in July 1851 ; these discoveries were recorded only a few days after Victoria had been established as a separate colony. Prior to this, and following Hargraves' discovery at Ophir near Bathurst on 12 February 1851, the exodus of gold seekers to New South Wales so alarmed the business men of Melbourne that they offered a reward for the discovery of a goldfield within 200 miles of Melbourne.

The existence of gold in Victoria had been known for some time. Strzelecki had found it in his wanderings through Gippsland during 1839 and 1840, but the facts surrounding his findings were suppressed at the insistence of Governor Gipps. However, rumor was rife and in spite of official restrictions the illegal digging and selling of gold was an established fact by 1841. After the officially recognised discoveries in July 1851 the gold

fever which the authorities had feared set in. July and August marked the beginnings of a gold rush without parallel, the results of which completely altered the economy of the Colony ; instead of being a purely agricultural community, the Colony developed an economy based on mining and its ancillary industries.

In August 1851 Hiscock found gold at Buninyong, and this soon brought about the opening of the rich Ballarat diggings where gold was gathered by the pound weight from small claims, and fortunes were made by some in a few hours. In September 1851 gold was discovered near Trentham, and in October workings commenced at Spring Hill near Creswick, then at Daylesford, and at Specimen Gully near Mt Alexander. About the same time Worley discovered gold at Forest Creek, several miles south of Mt Alexander, and the Castlemaine field was opened up. The finding of these new localities prompted a rush from the Ballarat diggings where, although the field was amazingly rich, not every digger had been successful ; this constituted the pattern which was to characterise the search for gold throughout the country. In mid-October 1851 digging commenced on Bendigo Creek, and this was the start of what was to become the richest goldfield in the Colony, and at one time, in the world. By the end of the year further discoveries were made at Smythes Creek on the Broken River, on the Delatite, Mitta Mitta, Mitchell, and Tambo Rivers, at Omeo, Bendoc, and Shady Creek in Gippsland, and in the Pyrenees in the west of the State.

Men left their work ; farms lay idle ; and ships were deserted in port. In some towns not an able bodied man remained ; men streamed out over the tracks in a frantic rush for the early diggings where all believed that easy fortunes awaited them. Some men did grow rich, while others struggled in poverty ; mining was hard work and men needed good food to sustain them, but good food was scarce and dear, and only the lucky ones could keep a full larder. Flour was £20 a 200 lb bag, sugar one shilling a pound, bread five shillings a 4 lb loaf, butter six shillings a pound, and eggs one shilling each. Liquid refreshment in the form of water was free, but ale cost five shillings a bottle.

The true yields of gold from the thousands of shafts put down in the shallow alluvial goldfields will never be known, but some of the recorded yields were amazing. From one claim at Ballarat where the depth of sinking was 6 ft, Esmond and Cavanagh washed out 50 pounds weight of gold in two days, and when Lieutenant-Governor La Trobe was inspecting the diggings in October 1851 they washed out 8 lb of gold from two dishes. At Beechworth, from a 10 ft by 10 ft claim just at the rear of where the present Empire Hotel stands, a lucky digger won £15,000 worth of gold. Victoria became famous as news of this type spread, and hard on the heels of the diggers came the undesirables, and crime and vice began to spread. During 1852 new fields came to reveal their secrets. The remote mountain country of the north-east was explored, and the Ovens valley was found to be a prospector's paradise. Thousands of men moved up the valley to places such as Myrtleford, Bright, and Harrietville, and then penetrated over the Alps to the dense forest of the Omeo district ; machinery and plant were hauled and carried and set up in almost inaccessible places ; amazing

surveying and engineering feats were accomplished to construct races and tracks and to generate power to operate the puddlers and the stamp mills.

In 1853 new fields such as Stawell, McIvor (Heathcote), the Upper Goulburn valley, Buckland, Moliagul, and Rushworth were opened, and during 1854 and 1855 further large scale rushes occurred at Fiery Creek (Beaufort) and Creswick, where approximately 40,000 people gathered. During the same period other fields were opened at Ararat, Maryborough, Blackwood, Maldon, and Tarnagulla. It was much later before a close examination was made of the rugged Gippsland country which hid the fabulously rich Walhalla, and of the mountainous country to the north where more rich reefs were to be exploited at Woods Point and Gaffneys Creek.

The first full year of gold mining yielded the recorded amount of 2,286,535 oz valued then at £9,146,140, but on 1971 prices at over $70m. Population estimates showed that the two main fields were Bendigo and Forest Creek (Castlemaine) with 40,000 and 30,000 miners, respectively. Scarcity of water was a great problem, and it often caused migratory movements from one field to another. The gold output from the various fields was sold to a local bank, and transferred to Melbourne or Geelong every fortnight, sometimes, according to the quantity, by packhorse and sometimes in a carriage. All consignments went under escort, the guards being heavily armed and constantly on the alert for the bushrangers who frequently harassed them. It was customary for them to travel only by day, and to spend the nights at solid stone block-houses.

In the early days of mining the diggers had plenty of grievances, the worst being the licence fee of 30s a month. This was a heavy burden if diggings were poor, and the ruthless way in which the fees were collected did nothing to improve conditions. The "digger hunt" became common and the miner who could not produce a licence was treated as a criminal. Other grievances were the shortage of saleable land, which prevented a miner from establishing a farm, and the denial of certain political rights to the miners.

Relationships between the miners and police became very strained towards the end of 1854, and a riot occurred on 17 October ending in the burning down of the Eureka Hotel. A protest meeting against licences was held on 29 November and licences were burned. Police and soldiers were then ordered to arrest the unlicensed miners, who defiantly barricaded themselves in a stockade at Eureka under the leadership of Peter Lalor. On 3 December 1854 the militia attacked, and, after a short battle in which some men were killed and others injured, the rebels were overwhelmed. Sir Robert Nickle assumed command on behalf of the Government, restraining the police and the soldiers, and negotiating with the miners. The prisoners were later acquitted, and mining legislation and administration was reformed in favour of the miners. The Miner's Right, which replaced the Gold Licence, gave the holder the right to vote as well as the right to dig; Peter Lalor, their leader at Eureka, was elected as a Member of Parliament in 1855. As a symbol of liberty and democratic rights for every citizen, the stars of the Southern Cross (originally shown on the miner's flag at Eureka) were later incorporated in the Australian flag.

Early mining methods

During the gold rush period the gold was won almost exclusively from alluvial deposits on or quite near the surface ; a shaft would be put down through the alluvial gravels, which would then be removed and washed for their gold content. Gold washing appliances were based on gravity principles ; gold would sink to the bottom of a dish or box when the material containing it was broken down with water. Panning (washing in a dish) was the simplest method when the gold bearing wash was free. Clayey material was puddled in a large tub with water by continuously stirring to remove the clay. Eventually the gold was concentrated on the bottom of the tub where it awaited final separation. Puddling machines worked on the same principle except that they were on a larger scale and were often operated by horse power. The cradle, a refinement of the gold dish, was a box mounted on rockers with a hopper on top and inclined trays and riffles underneath. The rocking motion given to the cradle caused the water-mixed material to break down and pass over the riffles where most of the gold was caught. Larger quantities of alluvial gravel were treated by sluicing, using a long box fitted with a perforated plate as a false bottom, with cross bars or riffles to catch the gold as the gravel was washed through.

Mining techniques

The diggers soon realised that the shallow shafts did not represent the deepest level at which gold could be found. They deepened their shafts to reveal gold-bearing gravel beds of old streams and watercourses which had been buried in past ages, either by the eruption of basalt or lava or by the deposition of new layers of sand and gravel ; these became known as " deep leads ". It was impossible to determine the trend of these from surface indications, as the drainage system of the land had been altered. Typical examples were the Loddon, Daylesford, Avoca, Maryborough, Durham, Rokewood, Pitfield, Langi Logan, and the Chiltern and Rutherglen systems. They provided large quantities of gold, but were the most dangerous type of mining operation known in the State because of the instability of the ground and consequent sudden inrushes of sand and water. The handling of the large volumes of water in these buried underground watercourses was the largest single problem ; because of this the very heavy loose gravels had to be supported to sustain passage-ways to the limits of the lead or the lease area. Machinery was not as sophisticated as it is now, and the Cornish miner (or the " Cousin Jack " as he was known) introduced many simple but novel ideas, some of which were widely used. This related particularly to the method of timbering the drives in the heavy wash.

The central Victorian method of deep lead mining was to sink a shaft through the basalt down to the bottom of the lead. When the lowest level of the lead was reached, wash drives were put out at right angles to the shaft, and the whole block was cut up into sections. When the entire area of wash within the lease had been blocked out, the wash was totally removed, starting at the boundaries and working back towards the shaft, the ground being temporarily supported either by pillars of solid ground or by timber balks or " pig sties " as they were known.

The Chiltern valley method was developed by the doyen of alluvial mine managers, John Cock, whose son later became an Inspector of Mines. His method was to determine the width of the lead by boring (this also determined the values of the ground) and then to sink the main haulage shaft away to the side of the lead, and well below the deepest level, always having a sump hole of large capacity at the bottom of the shaft. The bottom level was then put out under the centre of the lead, and the wash tapped so that as much of the water as possible in the lead was drained off into the sump and pumped to the surface. When the lead had sufficiently drained, the wash drive was put out from the shaft at the lowest level of the wash and the whole area blocked out as previously.

Nearly all machinery and plant in those days was steam operated, and the old Cornish plunger pumps, with barrels up to 18 inches in diameter, successfully pumped millions of gallons from these mines. Later they were used in the much deeper quartz reef mines with similar success. The miner had to work in wet unpleasant conditions and had to use timber continuously to protect himself. The face man was a highly skilled person, and his ability to quickly place his sets, and side and back laths and face boards, earned him a reputation as one of the world's most capable miners. Unfortunately there were disasters, the one at Creswick in 1882 when thirteen lives were lost being the worst.

When shallow alluvial gold became scarce, some miners turned to the many outcrops of gold-bearing quartz, and the reefs were followed below ground either by shaft sinking or by tunnelling. Thus was born the exploitation of quartz reefs. Bendigo, which was to become world famous and which led the world in gold production and techniques for many years, saw the erection of the first " battery " in 1854. When the quartz was mined it was crushed to a very fine size to release the gold, some of which was in lumps and some of which was very fine.

The fine sand which emerged from the battery box was passed over a copper plate table where the fine particles of gold amalgamated with the mercury or quicksilver with which the plates were dressed. Some of the early crushings were amazingly rich (100 oz to the ton was not uncommon) and losses were inevitable. It was discovered, too, that as the reefs went deeper the associated minerals in the quartz, such as pyrites, pyrrhotite, and arseno-pyrite, contained gold in fine quantities. This led to the addition of gravity concentrating tables over which the sands were passed and the mineral concentrate, usually to the order of 1 to 2 per cent, was retained. It was ground until broken up finely enough to allow the gold to be amalgamated with mercury. Some of the concentrates, heavy in sulphur and arsenic, were burned in huge burners ; the gold remaining in the matrix was retorted and smelted to obtain pure gold. Where the gold in the concentrates was very fine, cyanidation was used. The chlorination (Cassell's) process, an electrolytic method of recovery, was generally used to treat the final residues from the roasting of iron pyrites. Further developments were the addition of amalgam traps at the end of the plate tables, and amalgamating barrels through which concentrates in small quantities were fed. The ball mill, introduced at a later date, proved most effective in finely grinding and separating gold from ore, and greatly increased the percentage of recovery.

Legislation

The first goldfields law of Victoria was contained in a proclamation of 15 August 1851. This introduced the gold licence, which on the payment of a monthly fee authorised the digger to stake a claim over a small area of Crown land, and to dig thereon for gold, but which did not give any protection against the trespasser who jumped or encroached on his claim. In January 1852 the first Mining Act authorised the appointment of Gold Commissioners who were empowered to inquire into disputes between miners and determine the outcome in a summary way. Their powers were extended in the following year by an Act passed " for the better management of the goldfields of the Colony of Victoria ", which also authorised two justices of the peace to award compensation for encroachment and trespass to an amount not exceeding £200, and also to hear and settle disputes between mates or partners. This method of dealing out justice was of the roughest fashion. The Gold Commissioner, whose office was subsequently filled by the chairman of the local court and later by the Warden, held his rough court where he pleased. He usually settled any disputes by visiting the claims and giving his decision on the spot, and that decision was final.

The Goldfields Act which came into operation on 1 June 1855 effected a still further reform in the mining law. This Act created the office of Wardens of the Goldfields, giving them jurisdiction to decide cases of title to claims, encroachment and trespass, forfeiture, and abandonment; right of appeal existed from their decisions to the District Courts of Mines, also first created by this Act; and from these a right of appeal lay to the Supreme Court. With the further development of mining, particularly reef mining, this Act fell short of the requirements of the goldfields, and as a result of a Royal Commission into the mining industry, the Mining Statute of 1865 came into operation on 1 January 1866. The general principles of the Goldfields Act were adhered to in this new Act but were greatly enlarged and extended. The jurisdiction of the Warden and of the Court of Mines was more clearly defined, and a new court of appeal, called the Court of the Chief Judge of Courts of Mines, to which court appeal might be had from the Court of Mines, was established. This new appellate court was abolished by the Judicature Act of 1883, and the jurisdiction given by the Mining Statute of 1865 to the Chief Judge is now vested in the Supreme Court. The many decisions and opinions of the Chief Judge of this new court and the judgments on the equity side of the Supreme Court reduced the mining law of Victoria to a firm basis, forming a solid foundation for the superstructure of mining law which has been built up on them. This applied not only to Victoria but to the other States of Australia. Sir Samuel Griffith, when Chief Justice of Queensland, said " It is a well known fact that the mining law of Australia was practically made by the decisions of Mr Justice Molesworth and the Supreme Court of Victoria ". The Mining Statute of 1865 is the foundation of all the mining laws of Australasia, and still remains embodied practically in its original form. In 1969 new legislation was introduced which abolished the Courts of Mines and transferred their jurisdiction to the County Court, and abolished Wardens Courts and transferred their jurisdiction to the Courts of Petty Sessions.

Marlin gas production platform, 11 miles offshore from the Gippsland coast.

Val Foreman

Crowded conditions on an early alluvial goldfield.
La Trobe Collection, State Library of Victoria

Forest Creek alluvial diggings, 1858.
La Trobe Collection, State Library of Victoria

VICTORIA

GOLD LICENSE.

No 87 May 2 185

The bearer S. F. Bamford

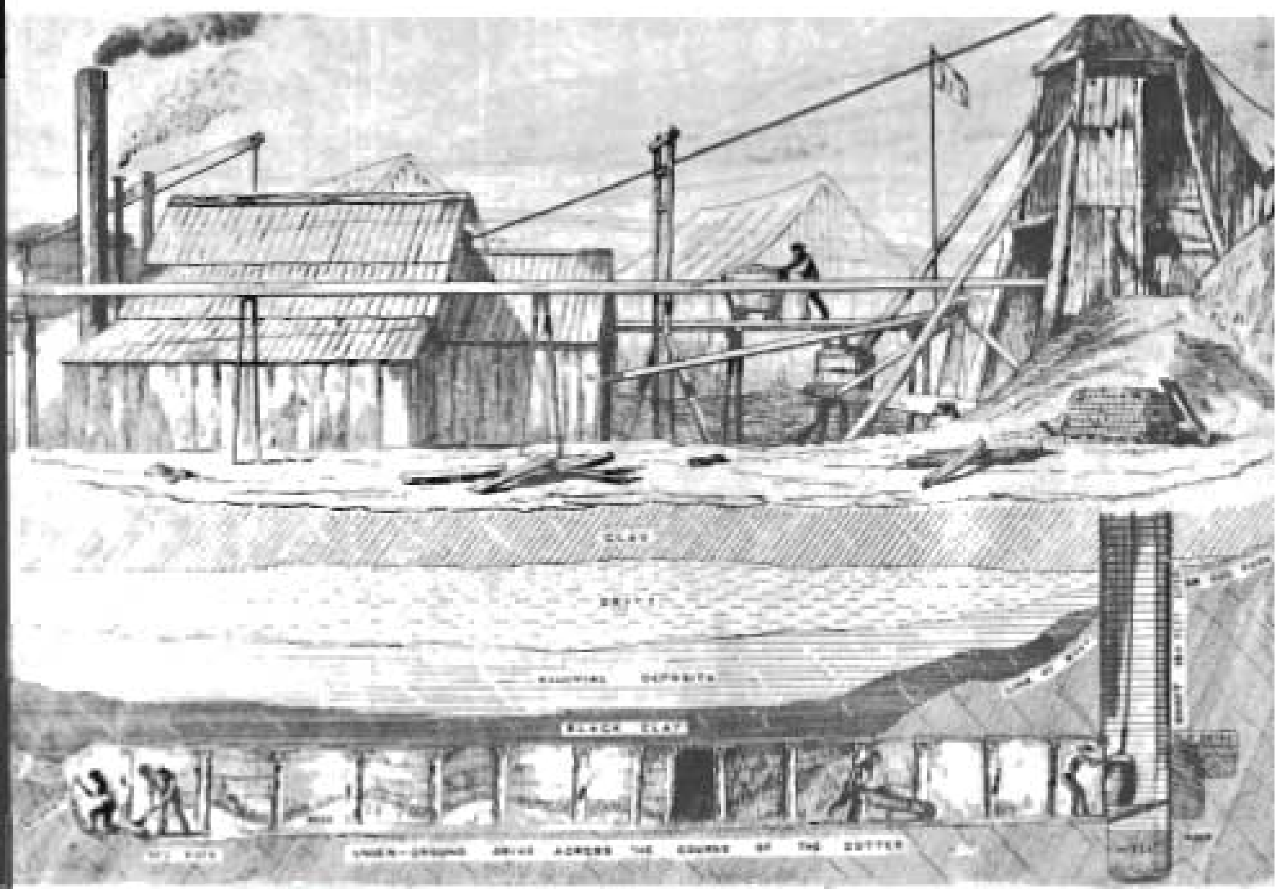
Loddon Dist

May

Commissioner

Gold licence issued for one month in the 1850s
La Trobe Collection, State Library of Victoria

Diagram of workings of a mine at Ballarat
Royal Historical Society of Victoria



Pack horses carrying mining supplies at Walhalla.
La Trobe Collection, State Library of Victoria

The "monster meeting" of miners at Mt Alexander in December 1851 to protest about a proposed increase in gold licence fees.
La Trobe Collection, State Library of Victoria

Poppet head and tailings of the Talbot alluvial mine, c. 1930s.
Mines Department

Ovens valley, scene of alluvial gold mining in the 1850s and later of dredging operations.
I. J. Nesbon

Bucket-chain dredge at the Morwell brown coal open cut
State Electricity Commission

Cape Grant quarry near Portland in the late 1930s.
Australian News and Information Bureau

The *Glomar Conception*, a drilling vessel operating in Bass Strait in 1972.

Val Foreman

Pipeline to McKay Creek power station in the Kiewa hydro-electric scheme in north-east Victoria.

State Electricity Commission

Crude oil pipeline under construction near Longford in Gippsland.
Esso (Australia) Ltd

Hazelwood power station in the La Trobe valley.
State Electricity Commission

In spite of the importance of the goldfields in the early history of Victoria, there was no Minister for Mines until 1863. The Chief Secretary carried out the administration, first through the gold commissioners and later through wardens. John Humffray, who was appointed Commissioner of Mines in November 1860, was the first member of a Government responsible for mines, and his appointment was followed a month later by that of R. Brough Smyth as the first Secretary for Mines. In 1863 John Forrester Sullivan was appointed the first Minister of Mines, taking over the existing organisations based on wardens with elected Mining Boards on the respective fields. The duties and scope of the Department as defined by the Mining Statute of 1863 included the administration of miners' rights, leases of reservoirs, business licences, mining leases, licences to search for metals and minerals other than gold, and licences to cut water races. Later Acts extended and modified the provisions according to developments in mining, prescribing conditions for mine safety, ventilation, drainage, use of machinery, labour conditions, tribute agreements, dredging, and other matters as they arose. The Department gradually acquired staff and the Geological Surveyor was transferred to it from Lands and Surveys. The Mining Boards were reconstituted in 1904 to consist of representatives of the Department and of various mining interests. They were finally abolished in 1914 when their duties devolved on the Minister.

During the life of the Department a number of related issues have brought it responsibilities for matters often only indirectly connected with mining. Under the *Residence Areas Act* 1881, the Minister of Mines in the early 1890s was responsible for the sale of land held under residence area or mining lease. Through its responsibility for the use of water on the goldfields, it undertook a number of water supply schemes other than those which were under municipal control. They were designed specifically to supply water for mining purposes, but were used for town supply and even irrigation. Forestry was another marginal interest, the Department being the responsible authority when efforts were first made during the late 1860s to foster timber production by the reservation of State forests. It again had charge of forestry from 1891 until 1907. Sludge and similar waste products of mining were a source of constant worry, and at first were dealt with by normal departmental methods. In 1904 the Sludge Abatement Board was set up to deal with the problem, and the organisation was expanded by setting up sludge abatement trusts in 1907.

Inspection of boilers, which began as part of the normal precautions for the safe working of mines, expanded gradually until all industrial boilers were under the jurisdiction of the Department. With the decline of mining and the introduction of electric power, the number of boilers in mines decreased, and eventually in 1962 the responsibility for boilers was transferred to the Department of Labour and Industry. In 1965 the Explosives Branch, until then a part of the Chief Secretary's Department, was transferred to the Mines Department. Gold buying was administered by the Treasury until 1928 when the responsibility was transferred to the Mines Department. In 1938 an Act was passed consolidating all previous enactments, defining who might buy gold in various forms, and under what conditions.

Safety and accidents

Practically all types of accidents which occur on the surface have also been encountered in underground workings, but there are hazards which are peculiar to underground mining, especially because of heavy and unstable ground, broken rock, and inflows of water and material. Dangers from noxious fumes, bad air, electricity in wet places, working in confined spaces with poor conditions underfoot, poor lighting, and exposure to falling materials are ever present. In the early years when one third of the population was directly engaged in the mining industry there was no statutory control in relation to safe working or health of the worker in the mines. A government commission reported on the need for inspectors of mines in June 1863 as it was considered that the work of the wardens and the mining registrars was fully taken up by other matters relating to claims, leases, and mining statistics. In 1866 the sum of £3,000 was voted for the payment of six inspectors, but no appointments were made. The same amount for payment again appeared in the 1867 estimates, but after the vote was brought forward it was struck off the list. Eventually the Regulations of Mines Statutes of 1873 was passed and took effect from 1 January 1874. The Mining Districts were arranged in twenty-eight divisions, and an inspector was appointed to each. Instructions issued to all inspectors differed very little from those which apply today. It was not until some years later that a Board of Examiners for mine managers was constituted, and mine manager's certificates were issued. A prerequisite for examination as a mine manager was at least five years practical experience, and a good knowledge of the regulations applying to safe working in every section of the mine, whether on the surface, underground, or in the mill.

In the six years 1863 to 1868 inclusive a total of 670 workmen were killed in the mining industry, and it is significant that three years after the appointment of the first inspectors, the accident rate had declined by one third.

Conclusion

Although New South Wales was the first Australian Colony to produce gold, Victoria soon surpassed it in importance. During the first ten years (1851 to 1861) the two colonies together produced 40 per cent of the world's gold output. Twenty and one half million ounces were exported from Victoria, of which the Bendigo field yielded more than four and one half million ounces, whilst three million ounces came from New South Wales. In the peak year, 1856, Victoria's recorded production was 3,053,744 oz of gold.

Since 1965 gold mining in Victoria has played a less prominent role, but by 1972 there was evidence of renewed activity as a result of recent movements in the price of gold.

NATURAL GAS AND CRUDE OIL

Exploration

Onshore exploration, 1921–1971

In a 1916 report published in the Records of the Geological Survey of Victoria in 1921, reference is made to the sinking of a bore " some 30 years ago to a depth of 175 ft . . . the object being to strike oil." The date of this bore would therefore be about 1886, but its precise position is not

known. The drilling of Boola Boola No. 1 oil exploration well in the Toongabbie area was commenced in October 1921 and completed in August 1925.

The first oil exploration well in the Lakes Entrance area, the Lakes Entrance Development (Lake Bunga) No. 1 well, was drilled in January 1924 and had traces of oil. This was followed within four years by the Lakes Entrance Development No. 2 well which also showed traces of oil. The government well (Colquhoun No. 1), drilled in 1928 near the bridge over the North Arm, Lakes Entrance, also found traces of oil.

Since the first crude oil was discovered at Lakes Entrance in 1924 petroleum exploration in Victoria has gone through stages of activity, largely influenced by developments in other parts of Australia. The early well sites of Lakes Entrance, selected under the guidance of the Director of the Victorian Geological Survey, were aimed primarily at establishing the stratigraphy, structure, and extent of the Lakes Entrance field. Numerous small shows of oil and dry gas were found in the basal Tertiary greensands and sands, but significant production could not be established.

Oil exploration companies grew because of indications of petroleum, but at this early stage most lacked the knowledge necessary for scientific selection of well sites or for carrying out deep drilling operations. A large number of wells was drilled throughout the State during the ensuing years. An area roughly within a three mile radius of Lakes Entrance was found to yield small quantities of oil with water. Capital raising difficulties led to an arbitrary concentration of effort in the Lakes Entrance area and this resulted in the neglect of other areas. Activity at Lakes Entrance waned in the late 1930s, but was temporarily revived during the Second World War in an attempt to obtain worthwhile production by drilling horizontal holes radially into the oil reservoir from a shaft sunk for this purpose; this project was economically unsuccessful. Production of heavy asphaltic base crude oil from wells at Lakes Entrance totalled a little over 3,000 barrels for the period 1930 to 1941. A small additional production was obtained from the Lakes Entrance Shaft from 1945 to 1950. Throughout this period small flows of gas were discharged continuously to the atmosphere.

From 1924 to 1946 a number of wells drilled by the Mines Department yielded much essential new stratigraphic data, mostly in Gippsland, providing a basis for subsequent exploration and geophysical interpretation. Immediately before and shortly after the Second World War several major oil companies carried out geological reconnaissance with a view to selecting areas for further search. These investigations failed to attract the companies concerned, but led to a revival of local interest.

By 1950 much of the Gippsland Basin had been taken up under petroleum permits and licences. Following the discovery of oil at Rough Range, Western Australia, in December 1953, activity stepped up considerably. Integrated geological and geophysical investigations were undertaken, a number of deep wells were drilled, and investigations were extended to the pre-Tertiary sedimentary section. Minor oil shows were encountered in the lower Tertiary and Mesozoic strata in wells drilled at Woodside in 1955. After 1950 the Bureau of Mineral Resources carried out regional gravity and aeromagnetic surveys which provided basic data for exploration in Gippsland, Port Phillip Bay, and south-western Victoria. Considerable stratigraphic data was also obtained

from deep water wells drilled by the Mines Department in western Victoria after November 1957. Apart from a minor lull in activity in 1958 and 1959, the tempo of company exploration has increased since 1953.

With the stimulus of a strong, but non-commercial, flow of wet gas in the Port Campbell No. 1 well late in 1959, and a show of petroliferous gas in North Seaspray No. 1 in November 1962, surface and sub-surface geological and geophysical data have been steadily built up to the stage where parts of the basins are known in reasonable detail. In keeping with overseas practice, the trend throughout the post-war period had been to increase the proportion of preliminary geological and geophysical work carried out before selecting new sites for drilling. Some difficulty was experienced in obtaining satisfactory seismic records in parts of western Victoria and Gippsland, and the extensive basalts of western Victoria caused difficulty in the interpretation of aeromagnetic records.

Onshore exploration activity involving both geophysical surveys and drilling operations continued intermittently from 1964 to 1971, but still without any commercial discovery of crude oil or natural gas being made. During these years thirty-one wells were drilled in Victoria's three onshore sedimentary basins by a number of operators including Arco, Planet, Frome–Broken Hill, Woodside, Alliance, Interstate, Pursuit, Shell, Ashburton, A.A.O., and Halliday. The total number of wells drilled from 1921 to 1971 was 173.

An important development during 1961–62 was the extension of oil search to the offshore area, with most Victorian waters to the edge of the continental shelf being covered by aeromagnetic and seismic surveys.

Offshore exploration 1960–1971 and the discovery of natural gas and crude oil

The bulk of Australia's confirmed reserves of natural gas and crude oil is located in the offshore part of the Gippsland Basin in eastern Victoria. Exploration permits covering most of the offshore area administered by Victoria have been granted to various companies by the Minister of Mines, originally under the provisions of the *Petroleum Act* 1958, and since April 1968 under the *Petroleum (Submerged Lands) Act* 1967.

In 1960 two offshore Gippsland Basin permits and an offshore Otway Basin permit were granted to The Broken Hill Proprietary Co. Ltd. In 1961 these permits were transferred to a wholly owned subsidiary of B.H.P. now known as Hematite Petroleum Proprietary Ltd. A further Otway Basin permit was taken up by Hematite in 1964. Geophysical surveys were carried out in these areas and farmout agreements were concluded with Esso Exploration and Production Australia Inc., over the Gippsland Basin in May 1964 and the Otway Basin in April 1967. These provided for carrying out further geophysical work and a drilling programme in a number of promising structures.

Using the *Glomar* III, a mobile ship-type drilling rig, the first well was spudded-in 15 miles offshore in 148 ft of water on 27 December 1964. Natural gas was discovered in February 1965 and the subsequent drilling of a step-out well confirmed that this reservoir—now known as the Barracouta field—was a commercial discovery. Another field, Marlin, about twice as large, was discovered by the Esso/B.H.P. partnership in 1966,

thus proving that adequate reserves were available to supply the Victorian market for at least thirty years.

Still using the *Glomar* III drilling ship, Esso/B.H.P. moved out into deeper waters 40 to 50 miles offshore. In April 1967 the Kingfish wildcat well was drilled and in July the rig moved about 10 miles north to explore the Halibut structure. Subsequent testing and evaluation, and in the case of Kingfish the drilling of two confirmatory step-out wells, proved the existence of two oilfields of high commercial significance. On 25 January 1968 Esso/B.H.P. announced that as a result of production tests "Kingfish field may be classified as potentially a major oilfield". In May 1968 drilling of Tuna and Snapper structures commenced. In both instances two confirmatory step-out wells were drilled. In 1970 the Snapper reservoir was declared to be a large commercial gas field, and in April 1971 Esso/B.H.P. announced that the Tuna field contained reserves of oil and gas.

Two other companies have also drilled for petroleum offshore in the Gippsland Basin. The first, Woodside Oil N.L. and its partners, with B.O.C. Australia Ltd as the operator, discovered the small Golden Beach gas reservoir in 1967. The second, Endeavour Oil N.L., drilled two holes in July 1970, but both proved to be dry. Offshore exploration in the Otway Basin by the Shell–Frome–Broken Hill group and the Esso/B.H.P. partnership between 1967 and 1970 proved unsuccessful.

All offshore exploration drilling in the two basins was suspended in July 1970. To that time forty-seven wells had been drilled in Victorian waters. Of these, sixteen were in commercial or potentially commercial reservoirs, six in reservoirs not presently commercial, nine had shows of oil or gas, and eight had no shows. A total of five mobile drilling rigs were used between 1964 and 1970, of which the *Glomar* III was by far the most successful, discovering five of the six commercial fields, all of which are located in the Gippsland Basin from 15 to 48 miles offshore in waters ranging from 148 to 255 ft in depth.

VICTORIA—INITIAL RESERVES OF GAS AND OIL IN GIPPSLAND FIELDS, 21 MAY 1971

Field	Natural gas	Crude oil	Years when field discovered and proved
	trillion cu ft (*a*)	million barrels	
Barracouta	1.8	7	1965 (gas) 1968 (oil)
Marlin	3.5	..	1966
Halibut	0.3	440	1967
Kingfish	dissolved gas in crude	1,060	1967 and 1968
Snapper	3.2	..	1968 to 1970
Tuna (*b*)	0.5	84	1968 to 1970
Golden Beach	0.2	..	1967
Total	9.5	1,591	..

Sources: 1. The Broken Hill Proprietary Co. Ltd, December 1970, for all fields except Golden Beach.
2. Woodside Oil N.L., for Golden Beach.
(*a*) Million million cubic feet.
(*b*) Announced by Esso/B.H.P., 21 May 1971.

The initial recoverable reserves of natural gas and crude oil in the six commercial fields discovered by Esso/B.H.P. in the Gippsland Basin between 1965 and 1968, and as announced by the companies, are set out in the preceding table. In addition, there are reserves of natural gas in the Golden Beach reservoir discovered by B.O.C. Australia Ltd in 1967 in an offshore tenement shared with Woodside Oil N.L. and a number of other companies.

Exploration and development legislation

When it became evident in 1965 that substantial petroleum reserves were likely to be found off the Victorian coast, the Victorian Government sent two senior officers from the Mines Department to Canada and the United States of America to investigate petroleum legislation and administration in those countries. Following that visit the Government retained a Canadian consultant, Dr Charles Hetherington, to make a report on the newly discovered petroleum resources. His submission entitled " Report on the Orderly Development of Petroleum in Victoria, Australia " was submitted to the Premier of Victoria in March 1966.

At the time when the first discoveries of oil and gas were made in Victoria's offshore waters, petroleum exploration and production were governed by the *Petroleum Act* 1958, the application of which had been extended offshore by the *Underseas Minerals Resources Act* 1963. After several years of discussion to determine their respective rights, the Commonwealth Government and all the State Governments agreed in 1967 to introduce a system of " mirror " legislation. This resulted in the passing by the Victorian Parliament in October 1967 of the *Petroleum (Submerged Lands) Act* 1967. The legislation passed by all Parliaments was practically identical and incorporates a common mining code for all offshore operations.

Under the legislation a graticule system of titles provides for all new permits and licences to consist of block areas the size of which is approximately 25 sq miles each. Exploration permits are subject to relinquishment provisions after six years and each succeeding five year period. When petroleum has been discovered a location of nine blocks is declared, the permit holder having the right to take a licence over five blocks at the standard royalty of 10 per cent of the value of petroleum at the well-head. This is shared on the basis of 4 per cent to the Commonwealth and 6 per cent to the State Government. In addition, the permit holder may elect to take a licence over the four remaining blocks by paying a negotiated royalty of between 1 and 2½ per cent on both licences, all of which is retained by the State. The new legislation also provides for the laying of undersea pipelines.

Pending finalisation of the joint Commonwealth–State offshore legislation, the Victorian Parliament early in 1967 passed interim legislation to enable the granting of production licences for the development of the Barracouta and Marlin gas fields and to lay undersea pipelines. This legislation was later repealed when the *Petroleum (Submerged Lands) Act* 1967 came into operation on 1 April 1968.

Between 1965 and 1967 other new and important legislation resulting from the discovery of natural gas was introduced by the Victorian Parliament.

First, late in 1965 the Government, reviving an earlier proposal, passed the *Fuel and Power Act* 1965 which empowered the formation of a Ministry of Fuel and Power. Under this legislation the Minister is responsible for the co-ordinated development and utilisation of all present and future sources of energy in Victoria. Second, late in 1966 the *Victorian Pipelines Commission Act* 1966 was passed enabling the formation of a Pipelines Commission to construct gaseous hydrocarbon pipelines in the State. The Commission commenced operating on 1 March 1967, and during the next four years laid the 108 mile Longford to Dandenong, 30 inch trunk line to supply natural gas to Melbourne and the 33 mile, 14 inch transmission line from Brooklyn to Corio to supply natural gas to Geelong. On 1 July 1971 the Commission ceased to operate and its functions and responsibilities were absorbed into those of the Gas and Fuel Corporation of Victoria, the State's largest gas utility. The third important item of legislation was the *Pipelines Act* 1967, which came into operation on 1 September 1967. This Act regulates the granting by the Minister for Fuel and Power of permits to own and use hydrocarbon pipelines and the issuing by the Minister of Mines of licences to construct and operate such lines. To the end of 1971, 76 permits and licences have been issued in respect to pipelines conveying natural gas, crude oil, finished petroleum products, ethane gas, and liquefied petroleum gas.

Development of the Gippsland gas and oil fields

Natural gas

Anticipating that adequate markets for natural gas would be secured, the Esso/B.H.P. partnership commenced, early in 1967, the development of the Barracouta and Marlin gasfields in accordance with the terms of tentative agreement reached between the producers and the gas utilities of providing a dual system of platforms and pipelines to ensure security of supply. At Barry Beach, in Corner Inlet about 120 miles south-east of Melbourne, a large marine terminal was established to fabricate the offshore platforms, to coat and store pipe for the necessary undersea and onshore pipelines, and to service the exploration rigs currently operating and the production platforms after they had been built. Made from Australian steel, the first of the jackets for the offshore platforms was set in position in 150 ft of water over the Barracouta field in December 1967. Within 12 months the planned ten development wells had been drilled, the undersea and onshore pipelines laid, and on 7 March 1969 natural gas commenced flowing to the treatment plant then in the course of erection at Longford, a few miles south of Sale. The second gas platform, Marlin, was erected during 1969 in 198 ft of water about 30 miles offshore, and on 21 January 1970 gas commenced flowing ashore through a 67 mile, 20 inch pipeline from the four development wells completed on this platform after the serious blow-out in December 1968.

Between 1968 and 1970 Esso/B.H.P. erected a combined gas treatment and crude oil stabilisation plant at Longford at a cost of about $51m. At this plant the heavier hydrocarbons—ethane, propane, butane, and light oils—are removed from the raw field gas to yield a dry, pipeline quality gas suitable for marketing to homes and industry. The plant also treats the crude oil from the oil fields by removing the dissolved gases and passing them to

the gas treatment facilities. The dry gas is piped to Dandenong through the trunkline built by the Victorian Pipelines Commission in 1968 at a cost of about $20m, and now operated by the Gas and Fuel Corporation.

The heavier hydrocarbons—ethane, propane, and butane extracted from gas and crude vapours—are conveyed through a 118 mile, 10 inch pipeline built by Esso/B.H.P. in 1968 and 1969 to a fractionation plant at Long Island Point near Hastings, about 40 miles south-east of Melbourne. This plant, the erection of which commenced in 1968, will have the capacity to produce one million tons a year of marketable propane and butane (L.P.G.). The initial stage of the plant was commissioned in April 1970 and was later expanded to double both output and storage capacity ; the construction of a further butane storage tank is in progress.

Crude oil

Following the discovery in 1967 of commercial quantities of crude oil in the Halibut and Kingfish fields, Esso/B.H.P. expanded the Barry Beach marine terminal and commenced the fabrication of three additional platforms from which the development wells could be drilled. The first of these, Halibut, was erected in 241 ft of water early in 1969. Development drilling of 21 wells from the twin jacket platform was completed in 1970 and on 17 March 1970 crude oil commenced flowing ashore through an 82 mile, 24/26 inch pipeline, 47 miles of which was laid offshore. Earlier, in October 1969, crude oil had commenced flowing to Longford from the Barracouta field where it had been discovered during gas development drilling in 1968. The production rate of crude from Halibut increased towards the end of 1970 to over 200,000 barrels a day with an additional 5,500 barrels a day coming from the small Barracouta field.

The two 21 well Kingfish platforms were erected during 1969 and early 1970 ; development drilling from the Kingfish A platform commenced on 31 March 1970, and from the sister Kingfish B platform on 22 October. By the end of April 1971 development drilling on the Kingfish A platform had been completed and the two pipelines linking the two Kingfish platforms to the Halibut crude oil line had been laid. On 22 April 1971 the large Kingfish field came on stream and four days later the overall production of crude from the Gippsland fields passed 300,000 barrels a day. This comprised about 60 per cent of Australia's total refinery requirements of 500,000 barrels a day.

After treatment in the stabilisation facilities at the Gippsland Gas Processing and Crude Oil Stabilisation Plant at Longford to remove the dissolved gases and produce a suitable refinery feedstock, the crude oil is conveyed through a 117 mile, 28 inch pipeline built by Esso/B.H.P. in 1969 to the eight 268,000 barrel capacity storage tanks and the shipping terminal located at Long Island Point. From there it is conveyed by tankers to refineries in Victoria, New South Wales, South Australia, Queensland, and overseas, and by pipeline to the nearby BP refinery at Crib Point.

Purchase and distribution of natural gas by Victorian utilities

The Esso/B.H.P. partnership, realising the need to establish local markets for the natural gas discovered in the Barracouta field (and later in the Marlin field), and the Gas and Fuel Corporation of Victoria, aware of the value of the discovery, commenced negotiations on 19 October 1965 for

the supply of the gas. The Corporation also represented the then three other gas utilities in Victoria—The Colonial Gas Association Ltd, The Geelong Gas Company, and The Gas Supply Co. Ltd. Since then the Corporation has purchased all the Victorian assets of The Gas Supply Co. Ltd and The Geelong Gas Co. has become a subsidiary of the Corporation.

The Gas and Fuel Corporation also engaged consultants, H. J. Gruy and Associates of the U.S.A., to make a report on the gas reserves and associated matters relating to the discoveries off the east Gippsland coast. The study confirmed the estimates made by Esso/B.H.P. Negotiations continued until 16 March 1967, when the four gas companies and Esso/B.H.P. signed a "Letter of Intent" to purchase natural gas from the latter company over a 20 year contract period, at prices to remain firm over that period ranging between a maximum of 3.2 cents a therm and a minimum of 2.58 cents a therm, depending on quantities taken. This "Letter of Intent" has since been confirmed by contracts between the buyers and the sellers.

Natural gas commenced flowing from the Esso/B.H.P. treatment plant at Longford on 16 March 1969, and was turned in from the Victorian Pipelines Commission's station at Dandenong to the Gas and Fuel Corporation's Melbourne distribution system on 31 March 1969. On 14 April 1969 Victoria's first consumer was connected at Carrum. The Corporation and The Colonial Gas Association Ltd had commenced planning in 1966 for the introduction of natural gas ; old pipelines were checked and up-graded and a number of new ones installed to form a fully integrated network. The principal distribution pipelines laid were the Corporation's 51 mile, 18 inch diameter transmission main around the eastern and northern suburbs from Dandenong to West Melbourne between 1966 and the end of 1969, and the 22 mile, 30 inch diameter transmission line from Dandenong to West Melbourne in 1969 and early 1970, thus ringing the city with a new 73 mile long pipeline. Costing about $11m, this line became fully operational in May 1970.

The combustion characteristics of natural gas vary considerably from those of manufactured gas and it was necessary to modify all gas burning appliances and equipment to burn the new fuel. Both companies embarked on a programme to convert all appliances at no cost to the consumer. The Colonial Gas Association completed converting the 170,400 appliances owned by its 78,653 customers in March 1970 at a cost of about $5.3m. On 23 December 1970 the Gas and Fuel Corporation completed its project at a cost of about $27m, having converted the 1.1 million appliances owned by its 446,000 customers. Melbourne thus became the first capital city in Australia to be wholly converted to natural gas.

Natural gas has been supplied to the Gippsland towns of Warragul, Trafalgar, Morwell, Traralgon, and Sale since November and December 1969, and the Corporation's Lurgi gas-making plant at Morwell ceased production on 26 November 1969. The West Melbourne gas works ceased production on 6 December 1970, thus ending the manufacture of gas in Melbourne. The City of Geelong, 45 miles south-west of Melbourne, commenced receiving natural gas on 15 March 1971 through the Victorian Pipelines Commission's $4m pipeline laid late in 1970 and early 1971. By the end of 1971 when

The Geelong Gas Company's 23,000 customers had their appliances converted, about 95 per cent of Victoria's 576,000 gas users were burning the new fuel. The remaining 30,000 customers will be using reformed liquefied petroleum (manufactured) gas. These will be further reduced when natural gas is supplied by the Corporation to Ballarat and Bendigo and other country centres in 1973.

To 30 June 1971, 47,101 million cu ft of natural gas had been recovered from the Barracouta and Marlin gas fields. Of this 30,905 million cu ft was distributed to Victoria's gas utilities, the balance being produced as ethane, propane, and butane, or burnt as a fuel at the treatment plants.

Distribution of crude oil and L.P.G.

The first load of Gippsland crude, comprising 105,000 barrels of Barracouta crude, left the Long Island Point liquids jetty on 24 March 1970 in the tanker *Hemiglypta* for the Petroleum Refineries (Australia) Pty Ltd refinery at Port Stanvac, South Australia. The liquids jetty built by Esso for the Victorian Public Works Department during 1968 and 1969 at a cost of $6m is 2,200 ft long, has a 356 ft berthing head, and the capacity to load both crude oil into tankers up to 100,000 tons d.w. and liquefied petroleum gas into large refrigerated carriers. In Victoria, the first deliveries of Gippsland crude to the P.R.A. refinery at Altona were made on 27 March 1970, to the BP refinery at Crib Point on 3 April 1970, and to the Shell refinery at Corio on 7 April 1970. To 30 June 1971, a total of 300 tankers had been loaded at Western Port, conveying 76,536,343 barrels of crude. In addition, 11,600,442 barrels of crude have been conveyed to the BP refinery at Crib Point through Esso/B.H.P.'s 7.2 mile, 42 inch distribution pipeline laid in early 1970, connecting the Long Island Point tank farm and the Crib Point liquids jetty to increase tanker loading capacity and to provide alternative shipping facilities. Government approval was given to W.A.G. Pipeline Pty Ltd to lay a crude oil distribution line 84.4 miles long from Long Island Point to Altona and Geelong to supply the P.R.A. and Shell refineries, respectively. This line was built during 1971 and 1972.

The first load of propane and butane, for which markets in Japan had been arranged independently by Esso/B.H.P., left Long Island Point in the *Bridgestone Maru 1* on 4th July 1970. The L.P.G. shipped from Long Island Point to various markets, principally Japan, is becoming a significant earner of foreign exchange.

Refining and marketing

The refining of crude oil to produce finished petroleum products commenced in Victoria in 1924 when Commonwealth Oil Refineries built a refinery at Laverton ; this was closed in 1955. The Vacuum Oil Company, later to become Mobil Oil Australia Ltd, brought Victoria's first large refinery on stream at Altona in 1949 and extensively enlarged it in 1954 at a cost of $40m to refine 2.1 million tons of crude oil a year. In the same year Shell commenced production at its new refinery at Corio near Geelong and built Victoria's first long distance petroleum products pipeline to Melbourne. The refinery cost $60m and has a capacity of 2.4 million tons a

year. Further expansion of the automobile industry in the 1960s, coupled with the demand for oil in other industries and for the manufacture of petrochemicals, resulted in the establishment by BP Australia Ltd of a refinery at Crib Point, costing $40m and having 2.2 million tons a year capacity, and in the expansion of the two established refineries.

Until 1969 the output of all Australian refineries had been designed for crude oil imported from the Middle East and Indonesia, and blended with small amounts of light indigenous Australian crudes from Moonie and Barrow Island. The market for refined and residual products had therefore been established to consume the percentage of petrol, kerosene, aviation fuel, distillate, fuel and furnace oils, lubrication oil, and bitumen produced from the base stock obtained from these sources. The Gippsland fields, however, produce light crudes with a high wax and low sulphur content, containing mainly fractions suitable for the production of petrol, jet fuel, and diesel oils. Therefore, some modifications to Australian refineries were required to process these different types of crude. The approximate average yield of Gippsland crudes is naphtha 35 per cent, kerosene 10 per cent, diesel oil 22 per cent, light ends 5 per cent, and residuals 28 per cent.

Between 1967 and 1970 the three refineries in Victoria undertook an expansion programme to cope with increasing market demands and at the same time convert existing equipment and install new plant to enable Gippsland crude to be processed. First, the Shell refinery undertook in 1967 and 1968 a $10m expansion programme and followed this with the installation in 1970 of a new $5m gasoline alkylation plant. The P.R.A. refinery at Altona completed late in 1970 a $26m construction programme comprising a new crude processing unit, a new naphtha reformer, a new naphtha treater, and various other work, upgrading existing refinery facilities. When the work had been completed, the Shell refinery had increased its processing capacity to 118,000 barrels a stream day (BSD) and P.R.A. to 85,000 to 95,000 BSD, while the BP refinery at Crib Point remained unchanged at 50,000 BSD. The total cost of the various expansion and conversion programmes amounted to about $50m and increased Victoria's refinery capacity to about 263,000 BSD or 38 per cent of the Australian total.

Petroleum products are distributed throughout Victoria by nine major companies through more than 5,200 retail outlets. The principal products marketed in Victoria during 1969–70 were 658,685,000 gallons of petrol, 144,086,000 gallons of light fuel oils, 100,125,000 gallons of industrial diesel fuel oils, 377,652,000 gallons of furnace oil, and 50,844,000 gallons of aviation turbine fuel and gasoline, out of a total of 1,413,989,000 gallons of products of all types or 25.5 per cent of the Australian total.

5

URBAN AND SUBURBAN DEVELOPMENT

SITING OF CITIES AND TOWNS

The possibilities for pastoral development of the hinterland of the Victorian coast were first realised largely through the activity of whalers and sealers at such places as Portland and Port Fairy, closely following the discoveries of the early navigators, Grant, Baudin, and Flinders.

Whaling, and to a lesser extent sealing, was established at Portland Bay from 1828, and by 1832 Captain William Dutton, one of the whalers, had erected a cabin there and cultivated a garden. On giving up whaling he later farmed land at Narrawong. Similarly, two men, Raby and Penny, who had a whaling station at Port Fairy in 1834 were apparently the first to reside there. In the same year Edward Henty established at Portland the first permanent homestead in Victoria, following his visits during the two previous years when he had been greatly impressed by the appearance of the country. Shortly afterwards he sowed his first cereal crop and over the next few years, while he and his three brothers consolidated their holding, settlement began. By 1840 Portland comprised one large house, six cottages, and several huts, also sheds, storerooms, stables, a dairy, a smithy, and a carpenter's shop. In that year it was surveyed by Charles James Tyers and Thomas Scott Townsend, proclaimed a township by Governor Sir George Gipps in Sydney, and held its first land sale.

Meanwhile settlement took place at Melbourne and Geelong. Stimulated by reports from Lieutenant John Murray and Captain Matthew Flinders, and particularly by the explorers Hume and Hovell, pastoralists in Van Diemen's Land (later Tasmania) and Sydney resolved to test the settlement potential of the territory around " Jillong ", the name given by the Aboriginals to the Corio Bay locality. In May 1835 John Batman, acting for the Port Phillip Association, landed at Indented Head and explored the country around the western arm of Port Phillip Bay, before moving northward to the mouth of the Yarra River, where he made his historic land deal with the tribal chiefs of the district. On 8 June he found good water six miles up the river and recorded his celebrated statement, " This will be the place for a village ". He thus confirmed an opinion recorded in February 1803 by James Flemming, a member of the Grimes expedition to Port Phillip Bay, that " the most eligible place for a settlement that I have seen is on the Freshwater River [Yarra] ". In August 1835 J. H. Lancey visited Batman's party at Indented Head in the schooner *Enterprise,* which belonged to John Pascoe Fawkner. The vessel then sailed to the Yarra and unloaded passengers and cargo.

On 21 October 1836 Captain William Lonsdale, first Police Magistrate at Port Phillip, informed Sir Richard Bourke, the Governor of New South Wales, that he had decided to locate the official township where the greatest number of persons was living. He had preferred a site at Gellibrand's Point (now Williamstown) because of its proximity to the ship anchorage, but as there was no fresh water at the Point he selected the established settlement. In March 1837 the Governor visited and commended the site of the township which he named after Viscount Melbourne, then Prime Minister of England, and approved a plan of survey prepared by Robert Hoddle, Government Surveyor.

The first settlers in the locality of Geelong were Dr Alexander Thomson, who occupied a small station near Buckleys Falls on the Barwon River, and James Anthony Cowie, David Stead, and Robert William Steiglitz, who took up land near Bell Post Hill in 1836. Other settlers soon followed. In 1837 David Fisher pitched a tent at South Geelong on the north side of the Barwon and there (to quote his own words) " built the first house in Geelong worthy of the name ". Governor Bourke after inspecting the locality in March of that year expressed the view that " If a town must be established for Geelong, it should be placed on the Barwin [*sic*] not far from Fisher's Station ". Both the Governor and Fisher were impressed by the natural beauty of the locality. In March 1838 Robert Hoddle instructed Assistant Surveyor H. W. H. Smythe to survey a township between the river and the beach " the front street to commence one hundred yards from high water mark at Corio. The main street to extend towards Mr. Fisher's house on the Burwon [*sic*] . . . ". On 26 October the township received official recognition. In the following year the first land sale was held and Captain Foster Fyans was appointed first Police Magistrate.

The founding of most of the other centres established in the first years of settlement may be attributed to five main factors. The first of these was the need of pastoralists around Melbourne and Geelong to seek fresh territory as more graziers arrived with their flocks. This, allied to the second factor, namely, that the country was ideally suited to sheep and cattle raising, was responsible for the very rapid occupation by late 1838 or early 1839 of most of the Western District and the country around Ballarat. For example, the Wedge brothers, who had been associated with Batman and Fawkner, were induced to move their stock from the Werribee River and occupy the future site of Hamilton on the Grange Burn. The third factor was the report made by Major Thomas Mitchell, Surveyor-General of New South Wales, on " Australia Felix ", the name he gave to the country which extended over a large section of western and central Victoria, and which he had explored towards the end of 1836. Mitchell's visit to the Henty brothers at Portland in the course of his journey through the Port Phillip District was directly responsible for their establishing sheep runs over several large tracts of land, both along the coast from, and to the north of, Portland. The fourth reason was linked to the third. Settlers in New South Wales, particularly in the Riverina, had experienced a long drought, and on hearing about refreshing pastures at Port Phillip, many graziers drove their stock southward. Major Mitchell's expedition had left a well defined track known as the " Major's Line " which many followed. The first were John Gardiner and his party who, in the first week of 1837, arrived at the Yarra

settlement with 300 head of cattle from the Murrumbidgee River. They then travelled east, where Gardiner erected a dwelling on the future site of Scotch College in Hawthorn, and formed a run on the creek which now bears his name. The fifth factor was the necessity to provide facilities for travellers and their stock to cross rivers and streams, which were a major hazard. Enterprising persons, therefore, erected bush inns and often operated punts at difficult or important crossing places such as on the Goulburn River at Shepparton, and so provided the nuclei of numerous townships.

These factors were, indeed, largely responsible for the foundation of Camperdown, Colac, Echuca, Hamilton, Horsham, Sale, Shepparton, Wangaratta, and Warrnambool, and have also contributed towards the development of Bairnsdale, Morwell, Swan Hill, and Traralgon. Although Ararat, Ballarat, Bendigo, Castlemaine, Maryborough, St Arnaud, and Stawell are also associated with early pastoral settlement, they owe their first permanent positions to the discovery of large deposits of alluvial gold during the early 1850s. Their survival as centres when the alluvial gold gave out may mainly be attributed to the successful transition to deep-lead and quartz mining, and to their becoming centres for the surrounding districts when the Government authorised the large scale subdivision and selection of land during the 1860s. In some cases the development of industry, especially to service mining operations, also helped. In addition to these, Victoria, excluding the suburbs of Melbourne and those of Geelong, Ballarat, and Bendigo, has a large number of other smaller centres whose foundation can usually be ascribed to one or more of the causes mentioned.

More recently brown coal mining has created the town of Yallourn, and this activity, together with the development of rich agricultural and dairying areas, has caused Moe and Traralgon, once small towns on the Melbourne–Gippsland railway, to develop into cities, and Morwell to become an urban area of a similar size. Except for Yallourn, a State Electricity Commission township, and the Morwell "urban area", which is not separately incorporated, all population centres mentioned are municipalities constituted under the Local Government Act or allied legislation.

A provincial city, also so constituted, which does not directly owe its origin to any of the factors mentioned is Mildura, situated on the Murray River near its confluence with the Darling. Settlement began through an irrigation scheme for fruit growing and agriculture originally introduced in 1887 by the brothers George and William Chaffey, and actively supported by Alfred Deakin, then Commissioner of Water Supply. After many difficulties the scheme was successfully effected, and the future of the settlement assured.

While the pioneer settlers and traders were responsible for the physical origins of most of the cities and towns, it was the early surveyors who determined their bounds, shape, and position; set out the streets and building allotments; and provided sites for public services and amenities. Foremost among the surveyors was Robert Hoddle, who personally carried out or else supervised the survey of many towns. The broad thoroughfares set out as part of the original road pattern of Melbourne, Geelong, Warrnambool, and other cities are one indication of the skill and foresight with which these surveyors did their work.

MELBOURNE

In November 1872 Anthony Trollope, after spending a year visiting the Australian colonies, wrote "Melbourne . . . is the undoubted capital, not only of Victoria, but of all Australia. It contains, together with suburbs, 206,000 souls, and of these so-called suburbs, the most populous are as much a part of Melbourne . . . as Marylebone is of London . . . There are very many cities in the world with larger populations . . . but I believe that no city has ever attained so great a size with such rapidity."

Melbourne had been both his point of arrival, direct from London, and the natural centre of his travels. Twenty years earlier, he would have found it equally convenient for intercolonial journeys, but much less significant as a town. The city which impressed him by its size and its institutions had been created by gold and immigration in barely two decades. But its location and the directions of its residential and commercial growth had all been determined earlier when merchants and tradesmen first established themselves on the lower Yarra to serve the original pastoral community of Port Phillip.

John Batman had led the way from Launceston in 1835, and within a year a government representative sent from Sydney had found some huts on the northern bank of the river, some six miles from where it entered Port Phillip Bay, and more than 25,000 sheep grazing within a radius of some thirty miles. A few months later Major Thomas Mitchell, exploring from the settled districts of New South Wales, had reached the coast many miles further west, to reveal both the extent of the grazing country south of the Murray, and a practicable land route by which to reach it. Within months would-be pastoralists were moving southwards through the Riverina, to meet those who had moved northwards across Bass Strait. The effective occupation of the Port Phillip District had begun, and on 4 March 1837 Governor Bourke arrived by ship from Sydney to regularise it and to establish its administration.

The huts and tents stood on the slopes of two ridges which ran down to the northern bank of the Yarra and offered the first firm landing beyond several miles of estuary swamps. A reef of rock across the river in line with the western ridge checked the incoming tides. Immediately below the reef, tidal swells had widened the river into a natural pool or basin where boats and smaller schooners could be berthed and turned. Permanent drinking water was available above the reef, either from the river or from nearby wells. The site met all the immediate requirements for a settlement. Robert Hoddle, the Assistant Surveyor-General, who arrived from Sydney a little ahead of Governor Bourke, had completed work on a township plan begun by his own assistant, Robert Russell, and Bourke approved it on the day of his own arrival.

The one obvious disadvantage was that larger ocean going vessels could not use the river. Feeling that the estuary anchorage might yet become the more important site, once a fresh water supply had been found for it, Bourke named it William, in honour of King William IV. The township site upstream was named Melbourne, in honour of the then Prime Minister, and the first land sales were held there on 1 June 1837. Hoddle's plan had provided four long streets each 99 ft wide, running

parallel with the river immediately alongside the pool and the reef. These streets ran from the brow of the western ridge, across a shallow gully and on to the brow of the wider eastern ridge beyond it; each was divided at 10 chain intervals into eight main blocks by shorter cross streets, running almost north and south. Half acre allotments, with various frontages, faced each east-west thoroughfare, with provision for narrow service lanes between the backs. The street immediately adjoining the river basin was named after Matthew Flinders, its focal point being the Customs House reserve; and most of the first land sales were in this vicinity. Lot prices rose spectacularly as private subdivisions and new frontages changed an intended service lane into Little Flinders Street, and merchants and importers quickly established it as the township's wholesale trading centre. By 1839 small central properties, bought two years before for £150, were changing hands at more than sixty times their original price.

Bankers and investors operated in Collins Street, one main block behind the waterfront; larger retailers were located beyond them in and between Bourke Street and Lonsdale Street, the thoroughfare which completed Hoddle's initial east-west design. Near the central gully, however, and beyond it, these streets were still little more than clearings. By far the busiest thoroughfares were those which ran north-westwards from the river, where flocks and immigrants began the long trek to the inland pastures, and drays lumbered in with bales of wool and back with stores.

William Street, so named (like Williamstown) in honour of the King, as the intended administrative centre, climbed directly along the western ridge. Because many of the allotments adjoining both it and King Street (to the west) had been reserved for government requirements, either immediate or future, its eastern neighbour, Queen Street, had immediately become the main commercial–business thoroughfare. As shipping agents established themselves around the Queen Street–Collins Street intersection, the lawyers and bankers joined them. Both William and King Streets led directly towards the highest point on the western ridge, where shipping movements observed within the bay were announced to the Melbourne community by flags and signals. A time-ball erected on the same hill served both town and shipping in place of a public clock.

The stock routes and wagon tracks which veered east around the Flagstaff Hill continued along the western ridge to where the eastern ridge converged with it, to run on and form a main route towards the northern pastures and the Murray—known then and now as the Sydney Road. The stock route to the central and western pastures ran north-westwards from the same junction. Here, where the main town and country tracks converged, flocks and stock were bought and sold; it was to remain a major saleyard area for a century, until the Royal Melbourne Hospital complex occupied the site.

Immigrants, stock, and capital came rapidly as the pastoral lands were occupied, and Melbourne's merchants, speculators, and building tradesmen shared the rough and ready prosperity of an early boom. Soaring rents encouraged professional men to move across to the so-called Eastern Hill, and in the gully which divided the Eastern Hill from the commercial centre retailers and tradesmen were soon establishing frontages along Elizabeth and Swanston Streets. Those who really prospered and sought more secluded residence, and the wage earners harassed by the fantastic climb in central township rents, looked much further east. Their houses and huts marked

the beginnings of the future suburbs of Fitzroy, Collingwood, and Richmond. But a disastrous fall in wool prices and a corresponding collapse in stock and station values had already shattered Port Phillip's initial boom. Although the Port Phillip Savings Bank had opened on 1 January 1842, a commissioner of insolvent estates had been appointed little more than a month later, and three years of hardship and depression were to be endured before wool prices rose again.

In 1842 Melbourne had been declared a municipality. Its official boundary ran three miles from east to west, the mid-point exactly one mile from the river basin and the Customs House. The eastern and western boundaries now ran directly to the river, to be extended southwards to the Bay in December 1844. Three years later both surveys and land sales had been renewed, and Melbourne had attained the status of a city. Subdivisions had filled in the main western township area to its extended northern boundary, and houses were appearing beyond Victoria Street by 1849, following land sales in North Melbourne. Albert Street, Grey Street, and Gipps Street, among others, marked the official recognition of East Melbourne. Bricks from the clayfields around the northern and eastern limits of the settlement, often brought down by a roundabout journey by dray and river boat, were beginning to replace the weatherboards; slates, brought in as ballast in returning wool ships, were beginning to appear amid the thatch and shingle.

Churches which stood out against the skyline already reflected Melbourne's early eastward growth. The foundation stone of St James', just above the north-west corner of William Street and Collins Street, was laid late in 1839. January 1841 saw the official opening of the Independent Church on the north-east corner of the Collins Street–Russell Street intersection; and between 1841 and 1845, while Scots Church rose on the north-west corner opposite, immediately above Collins Street's first steep eastern climb, the Baptists were building halfway down the same slope. St Peter's, completed in 1847, looked across Melbourne from the Eastern Hill, its tower a much more conspicuous landmark there than that of St James' in the west, and visible for many miles beyond the township.

A road from Melbourne to the beach, opposite the estuary anchorage, had been cleared and levellel as a "relief" work during the depression of the early 1840s. Here the mails and most ships' passengers were landed, and the inn established by Wilbraham Liardet, mail contractor and ferryman, was to form the nucleus of Sandridge (later Port Melbourne). A little further down the bay, the tiny village of St Kilda was attracting those who preferred seaside residence or recreation, although it was in the vicinity of the quarantine station on what is now Point Ormond. By 1845, when a wooden bridge replaced the river punt at the foot of Swanston Street, lands behind and beyond St Kilda were supplying most of Melbourne's fresh vegetables and much of its firewood. Thanks to good soil, attractive beaches, and its proximity to Melbourne, Brighton had overtaken Portland by 1846 to become the third largest township of Port Phillip, exceeded only by Melbourne and Geelong.

In November 1850, when Melbourne celebrated the announcement of the forthcoming separation of the Port Phillip District from the Colony of New South Wales, it was inconceivable that within months many would maintain that the new Colony had sought independence far too soon. In May 1851,

however, the *Sydney Morning Herald* had announced Hargraves' discovery of gold, and the first rush began to Ophir, beyond Bathurst in New South Wales ; a few weeks later more than a thousand diggers were camped there along a single creek, and in Melbourne would-be diggers were crowding coastal vessels bound for Sydney. But the unwelcome migration to the New South Wales goldfields was short-lived. Rumours of gold within Victoria itself were too persistent to be discounted, and shepherds everywhere were soon neglecting flocks to turn prospector. By September, Clunes, Buninyong, and Ballarat had all been " rushed ", to be followed by Mount Alexander and Bendigo. " The whole structure of society, and the whole machinery of government is dislocated ", Lieutenant-Governor La Trobe was lamenting in December ; Melbourne's work force had become greatly depleted ; police had deserted *en masse ;* and shipping in the bay was paralysed as crews absconded for the diggings.

In the summer of 1851–52, as would-be diggers arrived in increasing numbers from overseas, much of the city was little more than a sprawling, makeshift camp, and it was to remain so until unsuccessful miners returned to follow their regular callings and immigrant tradesmen arrived to join them. South of the Yarra a tent town, known as Canvas Town, sprang up. Tents were arranged in streets which were named, and refreshment booths bore the names of overseas hotels ; this tent town lasted until about 1864. There were almost as many tents as other dwellings, and within a few months much more corrugated iron than weatherboard. While a tiny group of surveyors strove to cope with the demands for sites, the few remaining building tradesmen had been overwhelmed.

Imported iron houses solved many immediate problems, despite their obvious discomfort in the heat. Erected from sheet iron and corrugated iron panels bolted together on iron supports and beams, they played no small part in the first swift spread of settlement beyond the far slopes of the Eastern Hill and across the ill-drained flats. By 1855 there was an iron theatre, George Coppin's so-called " Iron Pot ", in Lonsdale Street, and there had even been plans for an iron Wesleyan Church nearby.

While perforce competing with the new goldfields townships for the bricklayers, Melbourne was to attract most of the immigrant masons, stone-cutters, and architects. Iron provided the sheds, storehouses, and workshops, but the new Wesley Church was eventually built in stone. During 1858 its spire rose high above the two and three storey hotels already occupying many of the city's corner sites, and by May 1860 *The Argus* could note, with obvious pride, that "the real building of the metropolis is advancing with rapid strides ".

Amid the turmoil of traffic between the river wharves and the roads to the goldfields, sites on the western hill had soon proved inadequate to meet the administrative needs of a fast growing, self-governing colony. Victoria's government centre was to be established on the wide brow of the Eastern Hill, where the foundations of a Parliament House had been laid in 1856 and of a new Treasury nearby in 1858. In the central area, the Public Library had been started in 1853 (its foundation stone and that of the University were laid on the same day) and the new Elizabeth Street Post Office in 1859. The Treasury was a magnificent design from the recently established Public Works Office ; the Public Library, Parliament House,

and the Post Office were the outcome of architectural competitions, the latter the winner out of sixty-five entries.

The new city skyline, to be portrayed with all its incongruities and contrasts in Charles Troedel's *Melbourne album* lithographs, was probably seen most clearly from the tower of Toorak House, the vice-regal residence which had established the ridge on which it stood as Melbourne's most exclusive residential area. But the seclusion sought by the well-to-do along the carriage tracks of Toorak Road was not to remain unchallenged. As a new Prince's Bridge and improvements to St Kilda Road offered readier access from the city, speculators bought up both vacant lots and market gardens beyond the ridge and promptly subdivided them. When the first Prahran Council met early in 1856, fringe subdivisions were beginning to reduce many of the larger Toorak estates ; the market gardeners were moving out along Gardiners Creek to establish the beginnings of Malvern.

Only prompt action by La Trobe had saved the areas of open land immediately around the town which survive today as Melbourne's extensive parks and public gardens. Settlement was to spread swiftly beyond them all, across undulating country already cleared by the ever growing demand for firewood. By 1856 the municipalities of Collingwood, Richmond, Prahran, and St Kilda had been proclaimed, and part of Melbourne known as Emerald Hill (later South Melbourne), between the river and the bay, had chosen to break away and establish municipal institutions of its own. By 1861 parts of North Melbourne had followed the lead of Emerald Hill to form the municipalities of Hotham and Fitzroy. Sandridge, Footscray, Flemington, Brunswick, Kew, Hawthorn, and Brighton made up an outer ring.

Footscray and Flemington had emerged as dairying and market gardening communities along streams running down to the lower Yarra ; Brunswick's clay and rock had provided bricks and building stone ; south and east, beyond the Yarra, ridges running eastwards from the river provided firm access roads and also facilitated swift rectangular subdivisions. Replacement of punts by bridges had carried settlement beyond the river throughout the 1850s ; and it was the demand for attention to local roads generally instead of concentration on the main produce and timber tracks to Melbourne which played a significant part in the establishment of most of the separate municipalities.

In the heart of the city the inadequacies of the river wharves had become apparent almost as quickly as had those of the administrative centre on the western hill. Coastal shipping crowded the available berths ; the larger passenger vessels, competing for the immigrant trade and anxious for a quick turn-round, made no effort to navigate the lower Yarra. Sandridge built its piers to accommodate them, and as early as 1854 the Melbourne and Hobson's Bay Railway Co. was conveying passengers, mails, and cargo over the last few miles to central Flinders Street. Repair and maintenance facilities for shipping were quickly developing at Williamstown. The railway between Melbourne and the goldfields was a government line, and made its way into Spencer Street between the river swamps and the city's western hill. No less than a quarter of a century was to elapse before the two lines were connected, even for the transfer of goods wagons. Melbourne needed not only more extensive and much more sheltered and accessible wharves than Sandridge could provide, but also an effective link between its shipping

and the country railways. The ultimate answer was to be a triumph of civil engineering—the draining of the West Melbourne swamp, the excavation of extensive docks in the angle of swamp between Spencer Street and the river, the construction of the Coode Canal, and the systematic dredging and widening of the lower Yarra. Henceforward Melbourne was to enjoy the advantages of an all-weather harbour for overseas merchant shipping situated alongside its main country railway terminal and the adjoining commercial and banking district. The new Melbourne Harbor Trust included members elected by the municipalities of Melbourne, Footscray, Emerald Hill, Sandridge, and Williamstown. Effective co-operation between municipalities within the metropolitan area had been achieved.

A conference of municipal delegates had recommended a board of works in 1874, but it was not until a Royal Commission had revealed the serious lack of sanitary services in 1888 that effective planning actually began. The outcome was the Melbourne and Metropolitan Board of Works ; its initial tasks of sewerage were financed by a special London loan, and it played no small part in halving the mortality from typhoid fever and similar infections by the end of the century.

On the western hill, the Royal Mint buildings had been completed as early as 1870 ; the first portion of the Titles Office and the foundations of the Law Courts were both in evidence by 1875, and the dome of the Supreme Court Library rose above the city only two years later. The plans for the unfinished Parliament House had called for a similar dome high on the Eastern Hill; but while argument raged concerning suitable stone for first completing the main western front, the commissioners organising a building for the Melbourne International Exhibition of 1880–1881 moved swiftly and decisively. The dome of the Exhibition Building, claimed to rise higher above the city than did that of St Paul's over London, became Melbourne's dominant landmark, visible for miles across the spreading eastern suburbs.*

The exhibition of 1880 had symbolised Melbourne's coming of age as a commercial and industrial community. A second exhibition held in 1888 reflected a decade of growth and a degree of self-confidence which few cities or colonies had ever known. Within the city freehold values were rising as business expanded. Between 1881 and 1891 the population of metropolitan Melbourne rose from 283,000 to 491,000 ; and as the hotels, business premises, terraces, and villas proudly recorded the date of their erection in stucco or stone, city and suburban building became a major industry in itself. Much of it catered for the first generation of native-born Victorians. The ornate Princess Theatre of 1886, and the Grand Hotel (Hotel Windsor), completed some seven years later, survive to portray the flamboyance and culmination of the boom.

Thanks to the introduction of the hydraulic passenger lift, an experimental six storey building in Queen Street had been successful, and nine storey buildings were immediately built nearby. The Australian Building, at the corner of Flinders Lane and Elizabeth Street, was planned for twelve storeys. By 1892 the Melbourne Hydraulic Power Co. had erected a central pumping

* Fergus Hume's well known novel, *The mystery of a hansom cab*, was to make these features of the Melbourne skyline known throughout the world. As Madge Fretlby and her companion sailed down the bay they " watched Melbourne gradually fade from view. . . . They could see the great domes of the Exhibition and the Law Courts, and also [the new] Government House, with its tall tower rising from the midst of green trees ".

station, and its specially laid high pressure mains served some three hundred passenger and goods lifts throughout the city. The city skyline was changing swiftly once again.

The laying of hydraulic power mains was not the only upheaval in the streets. Three lines of tramway, operated by underground cables, had been laid from Spencer Street in the west to the eastern boundaries of Richmond and Collingwood; others ran north from Flinders Street to Brunswick and Clifton Hill; the longest crossed Princes Bridge and ran beyond Prahran to Windsor and Balaclava. After the suburban railway lines had reached Box Hill to the east and Frankston to the south, there were suburban building booms along the tramway and railway routes, and booms in subdividing in areas immediately beyond them.

South Melbourne had seen the most spectacular changes of all. Factories needed larger workshops than city rentals would permit, with readier access to the wharves and railways. Their needs, and those of many who worked in them, were partly met by the reclamation of the swampy, open land between the lower Yarra and Emerald Hill. Subdivision and occupation followed swiftly. *Victoria and its metropolis* could describe this area as "a region of hammering and din", and the Census of 1891 revealed South Melbourne as the city's most populous suburb.

The 1891 Census had also revealed surprising numbers of empty dwellings. Contractors and mortgage companies had almost completely supplanted the smaller master tradesmen, and building, especially housing, had outstripped the genuine demand. By 1892 a swift recession in the building industries was obvious to all. Suburban subdivision values weakened to the acute embarrassment of the many finance companies; the embarrassment of the latter in turn meant added strain for banks already harassed by sharp falls in Victorian wool prices. Substantial withdrawals of overseas capital followed, and a five day "bank holiday" paralysed business and administration alike in May 1893. By 1894 more than 20,000 dwellings stood vacant in the Melbourne metropolitan area. Many younger men had left for the Western Australian goldfields; many families were seeking a bare livelihood on the farmlands of Gippsland or the Mallee. Others were moving from the outer to the inner suburbs to escape rates and assessments for new streets and footpaths hitherto impatiently demanded. For the insolvent and the growing numbers of unemployed, public or voluntary charity was the only immediate relief.

Had the establishment of the Board of Works, or the negotiation of its first loans, been delayed another year, Melbourne's sewerage might have been postponed indefinitely. The main outfall sewer, begun in May 1892, was the outstanding venture of the day, and when the central city area was linked to it in February 1898 the men in the continuous employment of the Board and of its various contractors were contributing significantly to Melbourne's gradual recovery.

Melbourne had retrieved its loss of population by the end of the decade, and was to be the temporary capital of the newly established Commonwealth. The occupation of the Spring Street buildings by the Commonwealth Parliament, the establishment of the new Commonwealth Public Service, and a major share of earlier Commonwealth contracts, all contributed to the reviving economy. Preparations for the inauguration of the new Parliament by the

Duke and Duchess of York in May 1901 had stimulated prompt rebuilding after fire had ravaged buildings on the eastern corner of Flinders and Elizabeth Streets in 1898 ; effective co-operation between municipal councils had ensured the transformation of St Kilda Road into the beginnings of the subsequent spacious boulevard ; and the opening of Alexandra Avenue added dignity and charm to the city's central river frontage.

Melbourne's revival was confirmed in record sales by the Hydraulic Power Co. in 1902, and by the installation of the earliest electric lifts in 1903. But external changes were few until the steel-framed building eventually appeared in the Centreway in 1911 and the Commercial Travellers' Club in 1912. The new Public Library buildings were completed in 1913, with a large reading room spanned by a concrete roof.

Meanwhile, a Royal Commission on transport had noted in 1911 that no other city of comparable population had provided so few additional facilities for public transport during the previous twenty years. The same cable tramways served the inner suburbs ; the same railway lines ran to outer areas. Building had been resumed either in areas between the various suburban railway lines or, especially in the inner suburbs, on subdivisions of former private estates. Brick, with terracotta and then tile, had displaced stone and slate ; and the various styles along many a suburban street still reveal the successive encroachments on once extensive and secluded residential retreats.

Within the city, the railway viaduct which now brought trains from the north-western suburbs into Flinders Street had helped to make Melbourne's central station even more widely abused for the increasing discomfort and delays on its overcrowded trains. A completely new station had been built between 1905 and 1910, but it brought all too little immediate relief. Faster or more frequent suburban services were impossible until both the viaduct and the Yarra bridges could be duplicated, and longer, heavier trains were not possible until electrification had been completed in 1923. By then the Melbourne and Metropolitan Tramways Board was in operation and had prepared its plans to link all tram lines together and to begin electrification of the entire network.

Melbourne, in 1923 a metropolis of over 850,000 people, was again expanding. Caulfield was now the most populous suburb. With Sandringham, Mordialloc, Oakleigh, and Box Hill, another ring of outer suburban municipalities was developing to the south and east. The State Government had set up a Metropolitan Planning Commission in 1923, but its report was not available until 1929 on the eve of an economic depression during which more than a quarter of the work force was unemployed at one stage. And before the effects of the depression of the early 1930s could be fully overcome, Australia was at war. Six years of war saw a virtual cessation of building, the curtailment of road transport by petrol rationing, and industry transformed by defence production needs. When housing construction was eventually renewed, post-war immigration had begun to usher in Melbourne's swiftest rate of growth, and, with the family car now available to the entire community, its biggest range of problems.

Between 1947 and 1954 Melbourne's population rose from almost 1.25 million to over 1.5 million; its motor registrations almost trebled; and its industrial output had risen to more than a quarter of the Australian total. The problem of overall planning for the metropolitan area could no longer

be ignored, and the Board of Works undertook the task. The preservation of a green belt, the development of suburban business centres, and the provision of adequate highways were major objectives.

Throughout the 1960s there was no diminution in house building; it took place mostly in the outer areas, and particularly in the eastern municipalities of Waverley, Doncaster and Templestowe, Knox, and Nunawading. Partly because of the increasing time and expense involved in commuting, however, annual flat building more than trebled during the same decade, especially in the inner eastern and south-eastern suburbs of Caulfield, Malvern, Camberwell, Hawthorn, Prahran, and St Kilda. In South Melbourne, Collingwood, Fitzroy, and Carlton, the Housing Commission erected many multi-storey flat blocks as part of a slum reclamation programme.

Changes in the nature and tempo of Melbourne's continuing growth have threatened to outstrip envisaged planning. Its eastward growth, originally encouraged by good soils and pleasing undulations, is now accelerating through the attraction of the power and industrial complex of western and central Gippsland, and of the oil and natural gas potential of Bass Strait.

In 1956 height restrictions on buildings, in force for seventy years, were finally eased. Height now depends upon the proportion of a given area actually occupied. The steel frame, reinforced concrete, and glass and metal panels have swept away ornament and decoration and established the rectangular silhouette. In central Melbourne, buildings of twenty storeys or so have been rising at the rate of about one a year. Seen from a distance, such buildings soon lose their identity; the same is true of the freeways and overpasses, without which the city would be choked.

Whatever the nature, rate, or direction of Melbourne's ultimate growth may be, the former Customs House will continue to remind the observant of where and why it all began. From the eastern parapet of Kings Way it can be seen standing immediately beyond the railway viaduct which deprives the passer-by in Flinders Street of all immediate view or indication of the river. From the same vantage point the low, level reclaimed land on either side of the Yarra still reveals the outline of the former river pool. The reef has long since been removed, but underlying rock was found when foundations were sought for carrying both the Queen Street and railway bridges across the river.

The skyline cannot completely hide the slopes of the ridge adjoining the northern bank; and from Kings Way's western parapet, the masts and funnels are seen rising only a hundred yards or more downstream, immediately below the Spencer Street bridge.

A natural river anchorage above the estuary swamps, offering both dry landing and fresh water, established the site of a settlement which has become a metropolis of over two million people in a matter of five generations.

PROVINCIAL URBAN AREAS

Although groups of whale and seal fishermen had settled at various points along the Victorian coast even before 1800, there was no permanent settlement until 1834. As the number of settlements increased, their subsequent development depended upon their economic potential; the discovery of gold played an important part in the development of Ballarat

and Bendigo, while Geelong and Portland developed as ports; inland centres such as Mildura, Shepparton, Wangaratta, and Horsham became agricultural centres and the La Trobe valley region is the centre of brown coal mining.

Portland, the only deep sea port between Port Phillip Bay and Adelaide, is located less than one hour's steaming time from the main interstate and overseas shipping lanes. It serves an area of 40,000 sq miles of pasture land which supports a population of 300,000. It is the site of the original settlement in Victoria and for many years was an important port, but with the development of Melbourne and Geelong port facilities and the coming of the railway it gradually lost importance. Due to its natural advantages and its position on the shipping route, local opinion after the Second World War urged its redevelopment as a deep water port to serve western Victoria and south-eastern South Australia. This was sanctioned by Parliament in 1949. In recent years its harbour facilities have been extended and modernised and sites have been set aside for industrial development. A bulk grain terminal, a modern wool storage and selling centre, and bulk oil storage and distribution facilities have been provided; road and rail facilities are being improved, and a modern airport links the town with Melbourne.

Geelong, situated on Corio Bay, is now Victoria's largest provincial city. It was one of the first areas to be settled, and is also one of the oldest municipalities, dating back to 1849. Established early as a deep sea port, facilities developed with increasing trade. The number of wharves, for instance, rose from four in 1880 to eighteen in 1966. Silos for bulk-handling wheat and barley handle over two thirds of Victorian wheat each year. Their capacity is 4 million bushels, but this is being expanded. Industrial expansion has also assisted development. The first woollen mill in Victoria was established at Geelong, and others followed. The Ford Motor Company's Australian operations were located there and other large companies include the International Harvester Company, Alcoa, and Shell Refining. Geelong is also an important centre in the production of cement, and has many other factories producing a wide range of goods. Expansion to the north and east created new suburbs and was controlled by the first development order made under the Town and Country Planning Act. Green belts and parks were planned, and the city developed its water resources to provide for 140,000 persons. The town planners designed a scheme covering 100 sq miles, including the Cities of Geelong, Geelong West, and Newtown, and those parts of the Shires of Corio, Bellarine, Bannockburn, Barrabool, and South Barwon which border on the greater Geelong area.

Ballarat, situated 73 miles to the north-west of Melbourne, is one of Victoria's leading provincial cities. When gold was discovered in 1851, Ballarat was a small hamlet surrounded by scattered holdings. The goldfields covered more than 800 sq miles, but after alluvial mining declined Ballarat remained as a centre of a rich agricultural and pastoral area and a quartz mining industry. It is one of the finest wool growing and stock breeding districts in Australia, and wheat, oats, vegetables, and fruit are grown. Secondary industries range over metal works, engineering, food, textiles, and other consumer goods.

Bendigo, which has been known as both Castleton and Sandhurst, was one of the earliest Victorian inland towns. There is some evidence that the Bendigo valley was penetrated as early as 1838, but it was not until 1851 when gold was first discovered that the district began to develop. The gold rush continued through 1852 and 1853, and by 1870 there were 200 mines employing 5,000 men. However, the agricultural potential of the area was recognised early. The plains to the north were well suited to wheat and oats, and the climate and alluvial soils were ideal for fruit culture and grape growing. The farming community gradually expanded and diversified its activities, and extensive areas of cropping are now found to the north and west. From the pastures of the Riverina and the valleys of the Loddon and Campaspe Rivers, stock trains and road transports bring sheep and cattle to the saleyards where more than a million sheep and 50,000 cattle are handled annually. Bendigo is well situated in Victoria's network of highways and railways, and is the recognised industrial and trading centre for an extensive area. A variety of manufactured goods is produced, the production of food and textiles being the principal industries. An ordnance factory which still operates was established during the Second World War.

The site of Mildura was originally part of a pastoral run of 150,000 acres grazing 10,000 sheep. Development began in 1887, and by 1894, despite Victoria's financial problems, about 8,000 acres of horticultural and urban land had been occupied, pumping plants had been constructed along the Murray, water channels cut, business organisations established, and the population was 3,500. Its development continued in spite of economic and other difficulties. The Merbein and Red Cliffs areas were added to the original irrigation settlement in 1909–10 and 1921, respectively, and there are now approximately 35,000 acres under irrigation. There are two locks and a weir on the Murray, and a bridge, erected jointly by the Victorian and New South Wales Governments, links Mildura with Gol Gol across the river.

Shepparton is located on the Goulburn River in the rich Goulburn valley at the junction of the Midland and Goulburn Valley highways, 113 miles from Melbourne. Settlement in the Shepparton district began in 1841; the discovery of the rich Ovens goldfield in 1852 had caused a rush of miners from the central Victorian goldfields, and many settled on the river opposite the west end of the present High Street. By 1853 the Government had established a pound, several huts had been erected, and Shepparton village covered about 20 acres. The first municipal government in the district was established in 1876 when Shepparton was included in the Shire of Echuca. In 1927 the township area was severed from the Shire and constituted the Borough of Shepparton, which was proclaimed a city in 1960. The population in 1971 was about 19,000, and the city, 6,600 acres in extent, is the centre of an irrigation district. Milk and dairy products are the main industry, but fruit growing is perhaps the best known. Large quantities of various fresh fruits are grown for local and export markets, including most of Victoria's apricots, and a large fruit cannery handles most of Victoria's canned peaches and pears. The city is the focal point of a large road transport network with services at least daily to Bendigo, Benalla, Echuca, and other centres.

The pioneer settler in the vicinity of the Ovens and King Rivers was George Faithfull in 1837. Subsequently Rattray established himself as a storekeeper in a primitive slab and bark structure. He was bought out by William Henry Clarke, a young Englishman from Yass, who reached the Ovens crossing in June 1839 and is regarded as the founder of Wangaratta. Wangaratta was proclaimed a township in 1845, created a municipal district in June 1863, and proclaimed a city on 15 April 1959. By 1863 the population had grown to 1,300, and there were 187 ratepayers and 230 dwellings. The railway linking Melbourne and Wodonga was opened in 1873, and water was first supplied in 1873 by arrangement with the Railway Department, mains being laid in some streets a year later. Situated on the Hume Highway, the city is now the commercial and marketing centre for a district covering a radius of over 30 miles. Wheat, oats, maize, tobacco, broom millet, hops, and potatoes are all grown ; the cattle, sheep, fat lamb, and pig industries have been developed; and within a few miles of the city there are a number of milk processing factories. A local woollen mill produces yarn for the Australian market, and rayon fabrics are also manufactured in a factory originally intended during the Second World War for aluminium fabrication.

Horsham was named after an English town by John Monckton Darlot who first settled in the area in 1841. It is situated on the Wimmera River at the junction of the three highways traversing the area. It serves an extensive wheat growing area, being the regional centre for the Wimmera region, and has some secondary industry.

Gippsland was perhaps the most difficult area to settle and develop, as the early explorers found thick forests and rapidly flowing rivers. Communication came only through Port Albert on the coast, or across the Great Dividing Range to the north. Efforts were later made to reach Gippsland by road from Melbourne, but difficulties were caused by the great Moe swamp, which took drainage from the mountains to the north and extended for some ten miles westward to Trafalgar. Moe was the branching point for the northern goldfields of Walhalla and Tanjil in the 1860s; it grew in importance following the opening of a railway to Thorpdale in the south in 1888 and to Walhalla in 1910. Nevertheless, at the end of the last century Moe was little more than a clearing in the forest in low, marshy surroundings, and comprised a number of buildings spread along two streets. Its surrounding scenery, however, was notable with the Great Dividing Range to the north, and the Narracan Hills and Strzelecki Ranges to the south. Since 1945 it has shared in the industrial expansion caused mainly by the development of the brown coal mining industry in the valley of the La Trobe River, and this, together with the fact that it is the centre of a rich dairying and agricultural district, has been responsible for its recent growth. The population increased from 1,200 in 1947 to 16,544 in 1966. The Moe area was severed from the Narracan shire and was constituted a borough in 1955 and was proclaimed a city in 1963.

TOWN PLANNING

The first formal resolution on town planning in Victoria came from the Melbourne City Council in July 1920, and a conference was held

in the Melbourne Town Hall in October of that year with twenty-one municipalities represented. A committee was set up and in January 1921 its report recommended the appointment of a planning commission, consisting of nine members, five to be appointed from the municipalities and the remainder as technical members. In December 1922 an Act was passed to set up the advisory and honorary Metropolitan Town Planning Commission to be financed partly by all metropolitan municipalities and partly by fixed contributions from the Railways Department, Tramways Board, Harbor Trust, and the Melbourne and Metropolitan Board of Works. The Commissioners were appointed on 27 March 1923, and Alderman Stapley as the representative of the Melbourne City Council became chairman. In December 1925 the term of the Commission was extended and a tenth member to represent the Railways Commissioners was added.

The Government also called for several other reports, the most important containing proposals for removing the livestock saleyards and abattoirs from within the City of Melbourne to a new location. Another important report covered planning for the area to be served by the authorised Darling to Glen Waverley railway. These added tasks delayed the main report, and the Commission's term was extended further. Its comprehensive report completed in December 1929 outlined proposals for zoning, transportation, recreation facilities, harbour and river improvements, building regulations, conservation, etc., and also suggested legislation for implementing the metropolitan schemes.

The Commission also prevented many developments which would have conflicted with the subsequent plan, and was able to influence the adoption of many of the improvements recommended, thus saving the municipalities much expense. Legislation was postponed because of the depression of the 1930s and the Second World War, but nevertheless, individual councils and public authorities frequently acted upon the Commission's proposals, so that some effect was given to zoning and other works. Various professional bodies, especially the Town and Country Planning Association, the Royal Victorian Institute of Architects, and the Municipal Association continued to press for legislation; this was eventually enacted in December 1944. In February 1946 the Town and Country Planning Board was appointed with a full-time chairman and two part-time members. It was given administrative authority over all municipal town planning schemes, and was to report independently on planning matters to the Minister or undertake tasks allotted by him.

It soon became apparent that a major problem existed in the Melbourne metropolitan area, which comprised about forty separate municipalities, only some of which had begun to prepare planning schemes. The necessity for co-ordination between one municipality and another was evident, and the Government in 1949 introduced a major amendment to the Act, authorising the Melbourne and Metropolitan Board of Works to prepare a comprehensive plan for the metropolitan area. The metropolitan area, as then defined, comprised an area with a radius of approximately 15 miles from the General Post Office, but extended to include Ringwood, Dandenong, and Frankston. In 1950 the Board of Works, which comprised representatives from all municipalities within that area, began a series of detailed surveys to provide additional information. The Melbourne Metropolitan Planning Scheme report, together with the surveys and analysis, was published in 1954,

and in the same year the Board of Works was made responsible for implementing the scheme. Finance was provided by levying a Metropolitan Improvement Rate on properties throughout the metropolitan area.

In 1955 the first of a series of interim development orders was approved, giving the Board of Works control of land use in accordance with the proposals in the scheme while the statutory procedure towards its approval was being carried out. This involved the public exhibition of the scheme and the consideration of some four thousand objections, as a result of which a number of amendments was made. It was finally submitted to the Minister for the approval of the Governor in Council in 1959.

The Board of Works, which had been responsible for water supply, sewerage, and drainage through most of the metropolitan area for many years, was given additional responsibilities in 1956 for the design and construction of metropolitan highways, the protection and improvement of foreshores, and the establishment of metropolitan parks. These were also to be financed from the Metropolitan Improvement Rate.

The Melbourne Metropolitan Planning Scheme was under consideration by the Government between 1959 and 1965, and the Board of Works submitted two reports, in 1959 and 1961, drawing attention to changes in the rate of growth of population from that originally predicted, and indicating that increased provision for residential and industrial areas would need to be made. It also recommended substantial extensions to the metropolitan planning area as defined. As required by legislation, the Town and Country Planning Board submitted a comprehensive report on the Melbourne and Metropolitan Planning Scheme to the Minister in February 1964.

The rapid increase in registered motor vehicles in the metropolitan area was also causing concern. The Board of Works had been able to carry out a few urgently needed metropolitan highway works, such as the reconstruction of Kings Way, and the first section of the South Eastern Freeway from Batman Avenue to Burnley, but it was becoming clear that finance was insufficient and that some of the transport proposals in the scheme could prove inadequate. In 1962, therefore, the Board of Works recommended a major review of transportation requirements, and in 1963 the Government set up the Metropolitan Transportation Committee, comprising all major government and other authorities concerned, to carry out this task. Two years later the Roads (Special Projects) Act was passed to increase motor registration fees and provide finance, principally for metropolitan highways. In the same year the Melbourne Metropolitan Planning Scheme was placed on public exhibition again by the Minister for Local Government. It incorporated a number of amendments which had been made since the original exhibition, and, after consideration of the further objections, was finally approved by the Governor in Council in April 1968.

In response to a Ministerial request, both the Town and Country Planning Board and the Board of Works submitted comprehensive reports in 1967 with recommendations for the planning and administration of metropolitan Melbourne to the year 2000, when a population of 5 million persons was envisaged. In the year following the consideration of these reports the Government adopted in principle a number of the recommendations for the future growth of Melbourne, including the major principle that it should be encouraged to grow in a corridor pattern based

on the main lines of communication with green wedges of open country between. It also authorised the examination of the feasibility of establishing one or more satellite towns beyond the metropolitan area. In the same year the Town and Country Planning Act was amended giving effect to a number of changes proposed in the two reports, the main features of which were to:

1. increase the Town and Country Planning Board's membership to four by providing for a full-time deputy chairman;
2. charge the Board with the responsibilities of promoting and co-ordinating planning throughout the State, and of preparing statements of planning policy for any area;
3. establish the State Planning Council of twelve persons, comprising the heads of various government departments and authorities, with the Chairman of the Town and Country Planning Board as Chairman of the Council, as well as to define the functions of the Council, which were to co-ordinate planning by State instrumentalities and semi-government authorities of future works and developments, and to act as consultant and adviser to the Town and Country Planning Board on any statement of planning policy prepared by the Board;
4. expand the Metropolitan Planning Area administered by the Board of Works to approximately three times its previous size;
5. provide for the establishment of regional planning authorities throughout the State; and
6. establish tribunals to hear and determine planning appeals.

The amending legislation introduced a new approach to the planning process. Directives are now sent from the State Government level to regional planning authorities as guidelines for the preparation of statutory planning schemes.

In December 1971, as a result of the decisions made by the Government in 1968, the Board of Works submitted a new report "Planning Policies for the Melbourne Metropolitan Region" which defined the proposed future urban corridors and green wedges of open country and outlined long-term policies proposed to be followed. This was accompanied by placing on exhibition planning schemes amending the metropolitan scheme and giving effect to these policies over part of the long-term period. Some of the policies were quite radical and for the first time proposed that large non-urban areas be retained permanently.

By 1971 the Town and Country Planning Board had reported to the Minister on 569 principal and amending planning schemes submitted for approval. It had also, at the direction of the Minister, prepared and completed nineteen planning schemes and had twenty in the course of preparation. These latter schemes have been for areas of national or State significance. By 1969, 93 per cent of the State's population was living within areas under planning control.

REGIONAL PLANNING

Regional planning in Australia originated during the Second World War when plans were being made for post-war development, and it was found that many tasks were specifically regional with each area presenting its

own problems. It was expected that after the war the desire for direct participation in local planning would increase, and the voluntary organisation of such bodies as the Murray Valley Development League was indicative of this. In 1944, therefore, the Commonwealth and State Governments agreed to plan development and decentralisation on a regional basis. This involved the delineation of regions and a survey of their resources, mainly through the assembly of existing data; the development of each region according to State and national economic policies; and the organisation of administrative machinery, using functional departments, local government councils, and local bodies in planning schemes.

Regional planning has two main aspects which must be considered to ensure that each receives correct emphasis. First, comprehensive studies are made of existing resources, which include land with its mineral, forest, and crop products, and climate, as well as of economic and social structures. Second, the interests, knowledge, and experience of the residents must be considered, so that the relevant government organisations will act on the basis that each region's problems are rightly understood.

Each State has found it necessary to adopt its own approach based largely on geographical conditions and economic development. In April 1944 the Government of Victoria appointed a State Regional Boundaries Committee, consisting of senior executive officers of State departments and instrumentalities, to inquire into physical, economic, and human resources, and to make a broad survey of the whole State. The regions recommended were : Central Highlands, Corangamite, East Gippsland, West Gippsland, Glenelg, Goulburn, Loddon, Mallee, Upper Goulburn, Upper Murray, and the Wimmera, for which Resource Surveys have been published, and Barwon and Port Phillip, for which Surveys are not yet available.

The Victorian Government established the Central Planning Authority in 1946 to arrange conventions of municipal councils within each region for the purpose of constituting regional committees; to advise and assist these committees in making surveys and investigations into regional resources; to co-ordinate their work; to disseminate information about planning; and to consider and report to the Government on recommendations made by these committees as well as by the Decentralisation of Industries Committee, the Town and Country Planning Board, and the State Development Committee. The secretariat for the Authority was originally established in the Premier's Department, but is now incorporated in the Department of State Development. In August 1972 the Department of State Development and Decentralization was established.

Regional committees were set up for all regions except Port Phillip, and the Central Planning Authority defined their functions. These were to advise on potential development of resources ; to provide a common ground for discussion between local administrators and interested parties on problems and the methods of co-ordinating public services ; and to advise on outstanding problems such as soil deficiencies, transport difficulties, housing shortages, etc., which required attention from executive authorities.

The regional committees, having completed initial surveys, re-examined developmental problems, and reported upon such matters as land use and primary production, water resources, the potential development of the tourist industry, and on opportunities for industrial development. As a result the

Government has accepted various proposals. These have included the necessity for water storage works on Fyans Creek to serve the Wimmera–Mallee area; the partial reorganisation of educational facilities throughout the State; the development of Wyperfeld National Park as a tourist resort; the development of pastoral and agricultural areas within the Big Desert; the improvement of wildlife preservation methods; the increase in primary production areas in eastern Gippsland; the establishment of the Latrobe Valley Development Advisory Committee to co-ordinate government programmes for the development of its brown coal resources; and the improvement of road and rail communications for handling stores and materials from Victoria to the Snowy Mountains Scheme via Corryong.

6

HOUSING, BUILDING, AND SERVICES

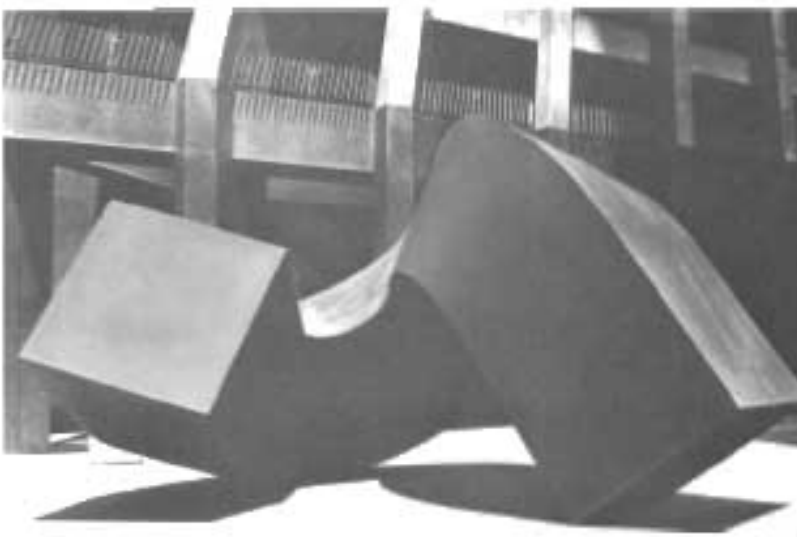
STYLE AND ARCHITECTURE

The years between 1837 and 1840 were the early years of settlement and consequently the amount of substantial building was slight. These were times of uncertainty and improvisation. Materials were not readily available and houses were imported, in a number of cases in prefabricated form. For example, Captain Lonsdale on his appointment in 1836 brought a pre-cut timber house with him from Sydney. This notable house is now stored in parts by the National Trust in Melbourne and is an early example of the weatherboard building which was later to become one of the most common building types. La Trobe, the first Lieutenant Governor, also imported a house which had been prefabricated in panel form in England. This house has now been moved from its original site in Jolimont and re-assembled in the Domain, close to Government House. Many buildings were constructed from iron parts imported in packages for the gold rush immigrants, and even one of the first Melbourne theatres, George Coppin's celebrated Olympic, was a prefabricated iron structure imported from England and known as the Iron Pot.

The construction of permanent buildings had started and St James' Cathedral was begun by 1839. Designed by Robert Russell, it was considered important enough to be built in stone, and it stands as one of the very few brown sandstone structures among the very much more common bluestone buildings. The plan is most straightforward, rectangular and of simple regency classical design, easily executed by the semi-skilled labour then available. It was built at first on a site near the corner of William and Collins Streets, but was moved in 1914 to its present site in King Street, opposite the Flagstaff Gardens. Other churches built at this time were frequently of simple gothic design, with pointed arches to doors and windowheads, and the knowledge of craftsmanship needed was usually of a fairly elementary nature. In Melbourne, although there have been additions to the St Francis' Church of 1841, much of the original fabric of Samuel Jackson's design still remains. St Peter's, Eastern Hill, begun in 1846 by the architect Charles Laing, survives in excellent condition. Of special note, however, is Christ Church, Geelong, designed by the Sydney architect Edmund Blacket and begun in 1845. This church is built of local sandstone, easily worked and pleasant in colour, but very frequently most unreliable in weathering with the result that the front face of the tower has recently been rendered in cement. Many old buildings today are experiencing problems with this stone.

Three views of the A.M.P. Tower and St James Building, one of Melbourne's newest multi-storey structures, showing the elevation, shopping arcade, and *Awakening*, a steel sculpture by Clement Meadmore.

Australian Mutual Provident Society



The Cathedral Church of St James (now known as St James Old Cathedral) on its original site at the corner of William and Little Collins Streets, *c.* 1880.

La Trobe Collection, State Library of Victoria

The Royal Arcade façade, Bourke Street, *c.* 1869.

La Trobe Collection, State Library of Victoria

The General Post Office, Melbourne, which is also shown in the photograph below.

Postmaster-General's Department

The central city area of Melbourne, c. 1870, looking to the north-west.

La Trobe Collection, State Library of Victoria

Collins Street, showing the Baptist, Scots, and Independent Churches, in 1971.
Commonwealth Bureau of Census and Statistics

The Long Room of the old Customs House, redecorated in 1970.
Department of Works

An interior view of the eastern end of St Patrick's Cathedral, Melbourne.

John Kelly

The former Royal Mint, now used for performing civil marriages.

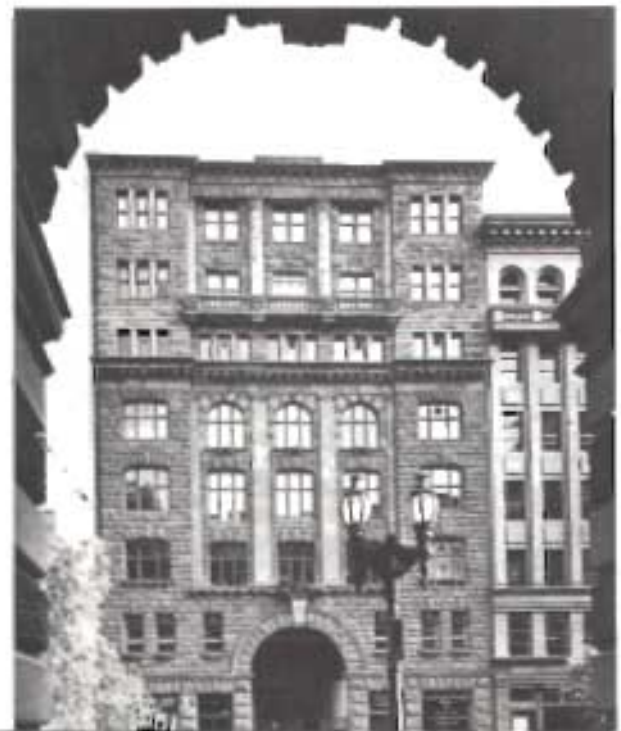
Postmaster-General's Department

Part of Collins Street in 1937, looking east past Swanston Street, prior to modern building developments.

Bank of New South Wales

351 Collins Street (the old Union Bank building), demolished in 1966 to make way for the multi-storey Stock Exchange and A.N.Z. Bank building.

Australia & New Zealand Banking Group Ltd



Collins House, 360 Collins Street, which has housed the headquarters of many leading Australian mining, manufacturing, and finance companies.

Allan Studios

The old Eastern Market building, the site of the present Southern Cross Hotel.

La Trobe Collection, State Library of Victoria

Menzies Hotel, c. 1870, of which Anthony Trollope was "bound to say that I never put myself up at a better inn in any part of the world."

La Trobe Collection, State Library of Victoria

BP House at the corner of Albert and St Kilda Roads, a development south of the central city area.

BP Australia Ltd

State offices in Macarthur Street. The fountain in the foreground was the work of William Stanford, a prisoner in the 1860s.

Social Welfare Department

Climatic conditions exert a strong influence on building forms and the early settlers usually preferred the southerly aspect, sheltered from the sun. Windows were few and deep, set in facades of good, simple lines ; and shady gardens, noted for the variety of trees and plants, were an essential part of the early house. The spreading verandah ensured adequate shade to the northern aspect and frequently encircled the house completely—very much a special characteristic of the early buildings of Victoria. The early verandahs had wooden posts, often with fretted decorative brackets, but later, largely as the result of the establishment of a substantial iron casting industry, cast iron posts and decorative components replaced the older wooden ones. Balustrade panels, gates, lamps, finials, weather vanes, and on the heavy structural side, components for bridgeworks, were the products of the iron foundries. The early houses of the city were often two storey terraces, sometimes extending for considerable lengths—one might say the Victorian version of the terraces of Bath, Brighton, and Cheltenham. Sweeps of terraces, making a total architectural environment of townscapes rather than the medley of totally unrelated buildings side by side, were the supreme legacy of the regency town style, soon to be lost in the Victorian liking for variety, a taste encouraged by the cheapness and diversity of the new machine made components. Varied and elaborate pediments and parapets decorated with urns and statuettes in all manner of shapes and attitudes became the preferred Victorian skyline. Stucco was the favourite wall finish, sometimes with incised decorations, until a later phase introduced multicoloured brickwork in a variety of patterns—a much less effective background for the cast iron decoration.

Population increased during the gold rushes, particularly inland, and although the mining settlements were, in the beginning, canvas with the most primitive facilities, the Victorian towns were noteworthy for the number of substantial buildings constructed. For example, before 1860 timber buildings were gradually being replaced by stone and brick structures, and Ballarat in particular is an example of a new settlement which became a city of notable public buildings in a generation. The government buildings were designed by the official architect in Melbourne and were often of brick, stuccoed and painted, although there are, of course, many outstanding examples of those buildings constructed in stone. Many of the gold towns were built or re-adjusted to a government plan which provided wide roads on the gridiron pattern, although in some cases the crooked, unplanned roads of the first settlements proved too costly to straighten. In Ballarat, for instance, the wide road from Melbourne is separated from the equally wide main street of the city by a length of narrow, curving road which existed before the plan came into being. Other towns which increased in importance during the gold rush days included Geelong, a port for the Ballarat fields, as well as Bendigo, the great gold city, and Castlemaine and Maldon. Splendid bluestone homesteads were replacing the early dwellings on the now increasingly prosperous station runs of the Western District, and many fine buildings were being built in Melbourne, among these being the Customs House, the Treasury, Parliament House, the Royal Mint, and the Exhibition, that vast domed building complex to house the Melbourne International Exhibition of 1880–1881.

Between 1860 and 1890 Victorian prosperity attracted architects from England and from the other States. It is interesting to observe here that frequently rigid symmetry was forsaken for the occult balance which led to the much favoured asymmetrical Victorian villa with the drawing room extended beyond the line of the front verandah in the form of a three sided " bow ". Many large mansions, the homes of the merchants of the boom period, sprang up throughout Melbourne and the fast developing ring of outer suburbs. A representative example of the late 1890s style is Illawarra in Toorak, a lavish house now the property of the National Trust of Australia (Victoria).

Melbourne is renowned for her fine Victorian churches. St Patrick's Cathedral, the principal church of the Catholic archdiocese, was designed by the celebrated architect, William Wardell. The church was begun in 1860 and was built in two stages, first the nave, then the transepts and sanctuary with all the superb geometry of the traditional French form of radiating chapels, the whole one harmonious design in bluestone with freestone detail. The three beautiful spires, of world distinction, were added very much later and completed in 1939. St Paul's Anglican Cathedral was begun later than St Patrick's, to the designs of the popular English church architect of the day, William Butterfield. This man had a predilection for the cathedrals of the Rhine, and Sienese banded ornaments with multi-coloured materials used in prolific combination. St Paul's stands as one of the greatest examples of Butterfield's work. However, the Rhenish octagonal central tower and spire of his design was never built. This cathedral was completed in 1891 except for the spires which were added during the 1930s to the competition designs of John Barr of Sydney. Joseph Reed, who supervised the construction of St Paul's, was the architect of many of Melbourne's greatest buildings. He designed Wesley Church, the brick Independent Church, the fine Collins Street Baptist Church with its noble classic portico, and the Gothic Scots Church.

The general situation of affluence, buoyancy, and confidence produced many commercial buildings in the city. Joseph Reed designed the Public Library, the Town Hall, the Exhibition Building, the Trades Hall, and many others, all in the high Renaissance style with Victorian detail. Three storey buildings had been built before the gold rush, but by 1890 buildings of twelve storeys were to be found in Melbourne, such as the Australian Building in Elizabeth Street. The hydraulic lift made this building feasible, but as it required a shaft below ground reaching to a depth about equal to the height of the building an upper limit was set. Higher buildings came with the advent of the framed structure, either in concrete or steel, and with electrical traction for lifts.

During the early 1890s the boom showed signs of collapse and by 1893 a severe depression plunged many into ruin or serious financial loss. The population of the city dropped sharply. Whole streets of new houses were never occupied and many were later demolished for the value of their materials ; few new houses were built in the wake of this depression. Those which were built showed an unusual style known unaccountably as " Queen Anne ". Its origins are uncertain, but the typical house had a roof form of greatly varied shape and broken outline in terracotta tiles of bright orange, with little spires, attics, and ornaments in the form of scrolls, and in the more lavish cases, fearsome basilisks and dragons. Much of the wooden decoration

and many of the beaten copper fireplace hoods showed *art nouveau* influence. Cast iron decoration had by now generally given way to wavy wooden fretwork, with internal screens and curvaceous aspidistra stands.

During this period two notable architects dominated the Melbourne scene. Harold Desbrowe Annear produced very original work. In his planning, the normal central passage was forsaken and instead the rooms were grouped compactly. Materials were used in their simplest forms, and window details much simplified ; window openings were carefully related to plain white stucco walls, with token decoration occasionally applied. Walter Burley Griffin came to Australia from Chicago and from a partnership with the celebrated Frank Lloyd Wright. His win in the Canberra Competition brought Griffin here, and he was to become a leader in the Australian architectural world. His splendid Newman College in the University of Melbourne is both geometrically ingenious and romantic, and his superb ceiling of repeating facets of plaster cubes in the Capitol Theatre gives a startling and beautiful effect when lit. Although the theatre has been remodelled out of all recognition the ceiling has been retained.

A slight revival of building took place after the end of the First World War and small suburban houses said to have had their origins in a popular Californian style were the norm for the fast spreading suburbs. Each had a tiled roof and a small front verandah with stocky roughcast brick piers. This type was challenged in supremacy only by the so-called Spanish Mission style, with white stucco walls, rounded window and door openings, pantile or cordoba tile roofs, grilles, and roofed chimneys. Just before the start of the Second World War a few houses influenced by Annear appeared among the more stereotyped suburban type with its curved windows, cream bricks, and jazz age chimneys. In Melbourne, designers of commercial buildings were faced with the strange dilemma of the requirement for a full blown classical front, replete with tall columns which never reached the ground and apparently became supported by a sweep of glass necessary to display the goods of the shop tenants.

At the conclusion of the Second World War an acute shortage of building materials brought on a wave of austerity building, particularly in the housing field. The houses of the post-war suburbs were frequently constructed of timber and for the most part displayed a remarkable insensitivity in design and grossness in detailing. However, the tide began to turn, and during the 1950s and 1960s spectacular progress was made in structural techniques and building product design. The Myer Music Bowl in Melbourne, for example, consists of a web work of steel cables so arranged to cross that a roof of thin plywood panels sheeted in aluminium could be laid upon the web. This suspended roof covers a deep escarpment containing tiered seats, and a sound amplification system serves the audience seated on the lawns of the Domain beyond. The Olympic Swimming Pool displays structural innovations also, as does the new National Gallery, the first completed part of the Arts Centre, which was opened in 1968. This building, surrounded by a moat, extends in one large flank of bluestone, uninterrupted except for the central entrance archway. Wide galleries and the Great Hall, with its rich stained glass ceiling, enclose three courtyards. At the city end of the site a group of underground theatres will be constructed, and the design of the centre incorporates a slender spire over 400 ft high.

Recent housing developments have taken place in a wide sweep of suburbs particularly to the north and east. The preferred form of dwelling has been one house to one parcel of land, the usual impact of this development being softened by individual gardens. Modified terraces of linked houses forming landscaped group layouts are now becoming popular and indeed these are being marketed as complete units for sale, the better ones and individual houses being designed by architects retained by the merchant building firms.

The usual form of modern city buildings at first consisted of a high simple block, designed to be seen on all sides, not merely on the street front. Curtain wall construction, that is, a light wall of glass, plain or coloured, literally hung like a curtain on the frame of the building, was popular here for a short period only. This form was soon to prove unsatisfactory in the Melbourne climate, mainly because of the very heavy demands it made on the heating and air-conditioning plant. The present scheme reveals the skyline of a city of towers as height limits are relaxed. Buildings of 500 ft high and over can be expected in greater numbers, the forms often with much less glass displaying a greater appreciation of the climatic conditions than was shown in the first towers. Retail trading has expanded greatly and vast shopping centre complexes with pedestrian malls are replacing the older shopping streets and arcades of the city and becoming the large community centres of the suburbs.

The rapid growth of industry has been reflected in considerable building investments. Heavy industrial undertakings have constructed large plants mainly to the west of Melbourne and at Western Port. Generating stations in the La Trobe valley are meeting the increased power demands, and the natural gas network is likely to assume a large share of the power market. The container shipping system has substantially re-oriented freight handling methods, and a large and impressive container terminal has been established at Swanson Dock in the port of Melbourne.

The development of freeways and direct traffic routes has been carried out progressively as funds have become available. A systematic upgrading of country road standards has taken place, and in Melbourne the South Eastern and Tullamarine Freeways are noteworthy both in the way they handle large volumes of traffic and in their strong simple flowing forms which relate favourably to the landscape. The design of the Lower Yarra Crossing provides for a fast route to the west which should accelerate development in the western suburbs. The new Eastern Freeway will handle the growing volume of traffic from the expanding area of suburbs reaching to the north-east. Pressing needs for the expansion of railway services, particularly on the electrical suburban lines around Melbourne, have required additional track-work along established lines, which in turn has called for the widening of cuttings, the renewal of overbridges and the provision of new bridges. Among these, those at Heyington over the Yarra River and at Mordialloc over the Nepean Highway are examples of the clean, simple lines of modern straight-forward functional steel structures. A firm policy for the progressive elimination of level crossings has led to the construction of road overpasses, particularly where State highways cross the trunk railways.

In the early years, the large hospitals were either in the heart of the city or close to it, although the Alfred Hospital in Commercial Road,

Prahran, was considered to be bordering almost on the bush. This hospital, designed by Webb as the result of a competition, afforded a fine example of the early pavilion type. Laid out in a series of blocks connected by lengthy wings its design recalled in some ways the layout of a vast palace. It was built in the Tudor style very much the vogue for institutional buildings of the day, and the last sections of the old building were only demolished fairly recently to make way for the new structures, a renewal programme which commenced in earnest during the 1930s. As in the case of the Alfred and Prince Henry's, some of the major hospitals have been rebuilt on their original sites, or as in the case of the Royal Melbourne, rebuilt on new sites close to the city. When finished in 1940, the Royal Melbourne was one of the foremost hospital designs in the world and enjoyed wide acclaim. Several large, well equipped suburban hospitals have also been constructed, and country areas are served by a planned system of base and ancillary hospitals, together with a comprehensive ambulance system.

The increased demand for professional and technical skills is reflected in the building of new universities and colleges and in the rapid expansion of existing ones. La Trobe University illustrates the way in which careful overall planning and rigid control of forms and materials combined with imaginative landscaping can achieve a harmony rare in building layouts of this type. A heavy programme of school building has been undertaken by both State and private institutions to provide the teaching facilities required by the many and varied disciplines, particularly at the higher levels. Experimental layouts and investigations into new school building forms, with deliberate attention to landscape and the selection of appropriate sites within the town planning requirements, promise to yield some fresh and stimulating designs for school buildings.

BUILDING AND CONSTRUCTION

Early settlement, 1834 to 1851

The period 1834 to 1843 extends from the first permanent settlement in the Port Phillip District until the pastoral recession, and was the time during which all but the most barren and impenetrable land was taken up by squatters. Labour was short, but as there was, relatively, considerable capital, the importation of whole timber buildings was an economic proposition for settlers near the ports. In fact, Superintendent La Trobe imported his own residence for erection at Jolimont.

At the same time a local building industry developed, stimulated by one condition on which the first land was sold, namely, that a permanent building worth at least £50 be erected on each allotment within twelve months. Between 1837 and 1838 the number of houses in the Melbourne area rose from 36 to about 300. Bricks were made by government employees in 1836, and commercially in 1837; bluestone and freestone were both quarried in 1839, the first used mainly for foundations; local lime was burnt in 1839; two sawmills operated by 1840 and another was built in 1841; and in 1842 Robert Langlands and Thomas Fulton, who later had separate firms, opened their foundry.

The inland settler had to be content with the primitive hut, the building which was to become characteristic of the period. The early examples at Melbourne, and subsequently near Warrnambool and Port Fairy, were of

turf sods cut straight from the ground ; further inland, bark or tarpaulins were often used over a crude framework of saplings, but the methods which were to gain general acceptance were the vertical and horizontal slab construction, both of which had been widely used in the Sydney area. Slabs were planks of some 10 inches by 2 inches in cross-section split with wedges from logs of stringybark or ironbark and held by varying means in a timber frame—vertically in the cruder, and horizontally in the more sophisticated buildings. If the roof was of reed thatch, obtainable in some of the coastal areas, or of bark tied down with greenhide, then the whole building could be erected without the use of expensive nails, but for the split stringybark shingles, or the similar but longer palings, hand wrought or patent nails were required.

When economic conditions improved after the recession of the early 1840s, building developed on a sounder basis. Many bush huts were replaced by more substantial but still unpretentious dwellings, and more noteworthy developments occurred in the city. Materials did not change substantially, but it became increasingly apparent that the local freestone was irregular in quality and unable to resist weathering. Bluestone came into use wherever its sombre colour was acceptable, and elsewhere stucco was used in a belated importation of the regency style. However, brick and weatherboard remained the more common materials ; roofs were almost exclusively made of shingles.

The combined effect of new immigrants and the economic recession resulted in many jerrybuilt shanties on minutely subdivided allotments in the Newtown (Fitzroy) area, but during the period of economic recovery many more substantial dwellings were erected and there were some developments which were to be significant in the gold and post-gold periods. Many building workers became self-employed, or employer and employee according to the work they obtained; many owned small cottages which they let for profit; and by 1850 the larger scale speculation which had been apparent in Sydney ten years earlier had reached Port Phillip and caused a minor boom in more elaborate one and two storey terrace housing.

Following legislation in New South Wales in 1847 five building societies had been formed in Melbourne before 1850, thus enabling many artisans to build substantial houses. After becoming a municipality in 1842 Melbourne experienced financial difficulties, but the Melbourne Building Act in 1849 imposed, on both the city and Fitzroy, controls aimed mainly at minimising the risk of fire. The importation of prefabricated buildings which had ceased during the recession rose rapidly to £28,777 in value in 1852 before the dramatic expansion during the gold rushes. Sawn timber, too, was increasingly imported from Van Diemen's Land at less than the local prices; their low earnings caused sawyers and splitters to strike in 1850.

Galvanised iron was first used in Melbourne in 1850, and in the form of roofs, verandahs, and rainwater tanks it was to become particularly characteristic of the Australian colonies. In 1852 four local businessmen went to America and purchased a new type of steam-powered brickmaking machine which, though not in full operation until 1856, was the first in Australia and produced bricks of a high standard.

Discovery of gold, 1851 to 1860

This period can be regarded in two parts : the first, after separation from

New South Wales when the early alluvial rushes took place and before the minor recession of 1854 ; the second, when deep alluvial sinking and quartz mining increased and speculation continued until the severe but temporary collapse in this industry in 1860. During the first period almost all major building contracts and industries such as sawmilling were suspended as workers left for the goldfields ; the provisions of the Melbourne Building Act were set aside in July 1852 and land was sold in North, South, and East Melbourne for building wooden houses for the immigrants, many of whom were occupying tents in South Melbourne's "Canvas Town".

Jerrybuilding again occurred at this time and there were to be many subsequent complaints of the uninhabitable cottages erected in these years and of bricks which washed away. England, Singapore, the United States, and even the neighbouring Australian colonies had established an active prefabrication industry for the Californian gold rush, and by 1853 were able to send to Victoria £111,380 worth of iron and £246,371 of timber houses. The building industry, along with other industries, began to recover late in 1853 ; by the time of the modest exhibition of 1854 there were said to be 192 factories in the Colony, though some comprised no more than a single sausage machine. Imports of prefabricated houses virtually ceased, not only because local conditions returned to normal but also because British efforts were diverted to the Crimean War and because, shortly afterwards, the price of iron doubled.

The successful agitation for the eight hour day in 1856 was mainly confined in its origins and its immediate effects to the building trades, for these were almost the only ones working near capacity. Wages fell steadily until about 1859 ; many artisans were not prepared to accept the rates offered and preferred to live by piece work which was in fact much less remunerative. Prices for joinery, in particular, were undercut by imports from America of doors, windows, mouldings, and sawn and plain boards; many other trades were similarly placed. However, the gold period established many manufacturing establishments which have survived to the present day.

Expansion from 1860 to 1890

The prosperity of the succeeding decades was due largely to the recovery in quartz mining, protective tariffs, and the expansion of agriculture under the Land Acts of the 1860s and early 1870s. During the 1860s the number of brickyards increased from 53 to 328, sawmills from 51 to 141, and limeworks from 7 to 36.

Many of the selectors of the 1860s erected primitive dwellings resembling those built by the squatter thirty years previously, consisting of bark or slabs, and, more commonly than in the early years, of stone, pisé, cob, or adobe. The governing factor now was lack of capital rather than the insecurity of tenure and the shortage of labour and materials which had affected the squatters. For all this increase in hut building, the total proportion of temporary dwellings fell from 28 per cent to 6 per cent. This was mainly attributable to the disappearance of tents from the goldfields, which frequently had been timber framed structures and were now converted to cottages by the addition of weatherboards. In the gold towns particularly, and in Victoria generally, owner building, with direct control of those who would normally be sub-contractors, was common in the 1860s ;

it gave way gradually to contract work and then in the 1880s to speculative building on a large scale. Prosperity was reflected in the growth of the Melbourne suburbs. The most distinctive local characteristic was the ubiquity of cast iron ornament, locally made from about 1860 and distinguished from its English equivalent by its greater density of pattern, its ornateness, its modelling, and occasionally by the representation of native flora and fauna.

The position occupied by stucco was undermined by the arrival of the polychrome brick movement only fifteen years after its appearance in England in about 1850. However, it was not until the 1880s that it became normal in suburban housing. Good bricks were more generally available, and could be burnt more cheaply after the introduction in 1870 of the Hoffman Kiln (invented twelve years previously), though not at first without some loss of quality. Roofing materials were generally slate and corrugated iron, according to the importance of the building, though shingles remained popular in country areas; attempts in 1860 to market terracotta roofing tiles were unsuccessful.

By 1881 huts and tents had virtually disappeared and the average number of persons per room had dropped from 1.5 in 1857 to 1.08, the lowest figure for any Australian colony at the time. Building societies had been housing workers in substantial dwellings while providing a sound use of capital for investors; they financed two thirds of new residential development between 1874 and 1890. Prosperity turned to boom from 1887 to 1889. By 1891 there were 0.9 persons per room but 80,000 of these rooms were vacant, due largely to high rents at a time when the boom began to show signs of uncertainty.

The expansion of the railway system, which earlier came to be almost wholly under government control, and the introduction of cable trams in 1885 imparted new value to land along the routes and contributed to irresponsible speculation in suburban lots, although much of the building on the outermost subdivisions had to be postponed until the more restrained decades which followed. In the higher income group many large houses were built, so that by the 1890s there were 1,200 with more than twenty rooms. The most significant innovation in construction was the first appearance of the cavity wall. From 1886 the more advanced buildings were adopting imported Marseilles tiles, and the outward characteristics were the floridity and lavishness of ornament in cast iron and stucco, and the extremes of polychrome brickwork. A great increase in height was made possible in office blocks by the use of iron frame construction and the introduction of the hydraulic passenger lift in 1885.

In 1888–1889, when it was the scene of the Centennial International Exhibition, Melbourne was at a high peak indeed.

Depression and recovery, 1891 to 1918

In the early 1890s Victoria experienced a depression which removed many of the building societies, especially those of dubious financial stability; many home buyers lost their savings, and the number of dwellings which were owned or were being purchased by their occupiers decreased sharply. During the decade the increase in brick and stone houses was only one sixth, and in weatherboard houses one tenth, of that of the 1880s, and much

of this increase was probably confined to the mining towns which expanded as a result of the increase in the relative value of gold. Speculative building ceased, and building of terrace houses virtually ceased. In the recovery, when it came, the cavity wall became widely accepted. It had been developed in England in the early nineteenth century and had become quite well-known in America before it reached Australia. The two leaves of brick were united across a two inch cavity by crimped wire or cast iron ties which strengthened the wall without allowing the passage of water. The most characteristic change in style was the extensive use of red face brickwork. This was relieved by austere bands of stucco and sinuous strips of mild steel (replacing the former cast iron) as building tended towards the crude local version of *art nouveau*. Alternatively, buildings tending towards the picturesque local interpretation of the " Queen Anne " revival were relieved by turned, carved, and fretted woodwork in the verandahs and gables, ornamental castings in terracotta, and dominating everything, a hipped, gabled, turretted, and generally irregular roof of bright orange Marseilles tiles.

Internally, the most notable features were the Wunderlich pressed metal ornamental ceiling, and electric lighting. Though it was restricted to major centres until the establishment of the State Electricity Commission in 1919, electric lighting effectively began with the opening of the first power house in the 1890s.

Between 1919 and 1939

Changes in building materials between the wars were influenced by fashion as well as by technical developments, availability of materials, or even the extreme variations in the economic situation. The rustic influence of the Englishman C. F. A. Voysey had already begun to show itself before the First World War in the appearance of roughcast and pebbledash surfaces and diamond patterned leaded light windows. When in the 1920s the Californian bungalow, an essentially timber style, succeeded the " Queen Anne ", these features continued to be seen ; moreover, local preference often converted the style to brickwork, sometimes softening the effect by using overburnt clinkers. Essentially the bungalow style demanded massive stained beams and boarding externally, the occasional real or imitation shingle-hung wall, and a much lower roof pitch than was used in the " Queen Anne "; internally, beams were also favoured, together with a wall lining of stained timber or, as a compromise, wide timber cover straps over plasterboard. Spanish Mission, the less important style which followed, demanded heavily textured stucco or render together with cordoba tiles and barley-sugar columns, but by the time of the Second World War plain face brickwork had again become popular.

Some significant technical developments did occur ; fibrous plaster sheets had been developed in their present form in New Zealand in 1910 (after prior use for a long time in France and Britain) and came into common use after the First World War ; concrete roofing tiles on the Marseilles pattern were locally made in 1920 ; and the kiln drying of timber was perfected in the late 1920s by the local discovery of a reconditioning process. Melbourne's waterborne sewerage system was begun in 1892, and the first stage of the scheme was completed in 1920.

During the period of prosperity after the First World War the gold towns had declined once more, and many timber buildings were removed for use elsewhere. The cost of the average brick house had almost doubled to £1,800 compared with £1,000 in 1914; moreover, some municipal councils began to stipulate areas in which only brick houses could be built. The depression of the 1930s was a severe check; the cost of the average brick house fell to £1,000 in this period; semi-detached houses became common; and before 1939 corrugated asbestos-cement sheets became frequent for roofing—a tendency later checked by the post-war shortage of asbestos. In the late 1930s large-scale residential development also took place for the first time. The Victorian Housing Commission was established as a slum reclamation authority in March 1938; its operations commenced with an estate of 412 dwellings at Fishermens Bend but were suspended by the Second World War.

Post-war period, 1945 to 1951

The war was followed by an acute shortage of materials and skilled labour and a great demand for housing, for which the arrears in 1943 were about 18,500 dwellings; a number of schemes was advanced for prefabricating dwellings, in many cases using steel. The Beaufort Division of the Department of Munitions in Melbourne developed a house using pressed steel sections as floor joists and roof trusses, and framed wall panels clad in spot welded galvanised sheets, but the scheme did not proceed. While such schemes did not become significant the pressed steel components of certain firms have now come into general use.

The Victorian Housing Commission had erected its first concrete house at Fishermens Bend in 1939, and in about 1943 it took over the Fowler construction plant to develop, in its concrete house project, one of the most enduring of such schemes; 2,000 houses for rental had been built by 1945. Timber houses for use in the country were made in two halves to be joined on the site; some prefabricated dwellings were imported; and some hundreds of suburban dwellings were built for the Commission. The Commonwealth Munitions Plant at Holmesglen was taken over in 1946 for the production of concrete houses, and from 1945 to 1956 about 26,000 houses were built under a financial arrangement with the Commonwealth Government, almost entirely on a rental basis.

Because of the shortage of building materials, the Government set a maximum area of 1,250 sq ft for new houses, raised in 1949 to 1,400 sq ft, while the average height of ceilings fell to below 9 ft. The cost of the average five roomed brick house nevertheless rose from £1,200 in 1939 to £1,700 in 1945, £2,500 in 1950, and £3,000 in 1951. The uncertainty of supplies and labour favoured cost-plus rather than lump sum contracts, and in the domestic field one third of new houses were being owner built by 1951. The time taken to construct a house had increased from four months in 1939 to between eight months and two years in 1951.

Unlike other States, Victoria turned overwhelmingly to brick veneer construction, a method which had been used before the war, and in fact known in America in the late nineteenth century; by 1951 brick veneer was twice as common as brick construction, and timber was twice as common as both together. Concrete blocks, cement tiles, various substitute

boardings, and steel windows all came into common use ; built-in cupboards became the norm ; briquettes and gas came to augment electricity in hot water services; separate shower compartments became common; and the size of windows increased.

Developments from 1952 to 1971

By 1952 materials were more plentiful, and from 1952 to 1962 between 18,000 and 23,000 new houses were commenced each year, with a slight decline in 1956 and a more severe one during 1961 resulting from governmental restrictions on credit. After 1961 there was a similar reduction in flat construction until 1964 when the numbers completed rose very rapidly until 1969–70 when 13,992 flats were completed. In the following year there was another reduction in flat construction.

The cost of suburban sites now became higher in relation to that of dwellings, often being one third or more of the total cost in the inner areas. Speculative building increased and several developers marketed large subdivisions, one unsuccessful attempt aspiring to the status of a satellite town ; these activities were partially damped by the credit restrictions of 1961. A change of policy by the Victorian Housing Commission in 1956 favoured the sale rather than letting of its dwellings, and by the early 1960s it began to erect multi-storey blocks of flats in the inner suburbs, constructed, in the main, by the efficient precasting technique which achieved tolerances of one sixteenth of an inch. Later in the decade private builders marketed one storey villa units which were able to use valuable land for a better financial return. These units were usually built in well regarded suburbs not too far from the city.

Multi-storey office blocks were again built in the 1950s, and Gilbert Court in Collins Street, and subsequently ICI House, were among the best known pioneers of the revolutionary " curtain wall ", a lightweight non-structural skin of metal and glass. Galvanised sheet steel in long lengths became available, and a variety of new decking and cladding profiles began to supersede corrugated iron, while pressed steel purlins and girts, and standardised open web trusses became widely used in industrial building.

In the 1960s several developments in concrete took place with an increasing use of reinforced concrete rather than steel frames in multi-storey work. These included flat plate construction, lift slab, precast flooring units, pre-tensioning of floor units, slabs, and beams, post-tensioning of major beams and even some slabs, and slip form construction. This latter was used in flats at South Melbourne by the Housing Commission, in the service cores of some private blocks, and in a major motel off St Kilda Road. Fireproofing of steelwork was achieved in various lightweight and other concrete and plaster products, and in latter years precast concrete cladding and load-bearing units have become more widely used.

Sheet glass, formerly imported from New South Wales and elsewhere, has been locally manufactured since 1962 ; the lightweight gang-nailed roof truss at close centres began to compete with the traditional rafter construction in housing ; critical path programming by computer was used in some major projects ; and the more economical " universal sections " began to

replace the traditional rolled steel joists in 1968. The average speed of construction of buildings increased, and the tower crane came into wide use.

By the 1960s the " package dealer ", who avoids competitive tendering by offering his own design and price to the client, became common, first in industrial work and then, with increasing architectural sophistication, in private housing. Some major companies were able to use similar methods for residential housing without sacrificing quality ; they employed architects, and yet could erect their buildings, with variations to suit the purchaser, at a considerably lower cost than would have been possible otherwise. In the field of flat construction the availability of stratum titles in later years has encouraged an increasing proportion of " own-your-own " units, and in these, higher standards of space allocation and finish have generally applied.

One development of importance in this period was the introduction of tertiary education for builders for the first time in Victoria. The University of Melbourne instituted a four year course covering many aspects of building construction and construction management, and in 1971 established a chair in building.

HOUSING COMMISSION

The Housing Commission was established in March 1938, under the *Housing Act* 1937, after the presentation to Parliament of the report of a Board of Inquiry appointed in 1936 to investigate housing conditions in the State. It was constituted to improve existing housing conditions and to provide adequate and suitable housing accommodation for persons of limited means. At that stage it did not have authority to embark on housing schemes. Authority to carry out the objectives for which the Commission was constituted was contained in the *Slum Reclamation and Housing Act* 1938 which established the Commission as a slum reclamation authority.

Although clearance of the slum areas was urgent, it was first necessary to acquire land and build dwellings to house the occupants of houses in these areas. The first area acquired for this purpose was at Fishermens Bend, Port Melbourne, where 412 homes were built on about 57 acres. Funds were obtained from loans made available by the Treasury and from the sale of debentures. In November 1940 the Commission recommended declaration of its first reclamation area. In line with the building industry in general, the activities of the Commission were restricted by the demands made upon resources by the Second World War, and from the commencement of building in 1939 until June 1945 only 2,022 dwellings were constructed. At the end of the war came new and more pressing problems—the housing of ex-servicemen returning to civilian life, and overcoming the arrears in house construction. Temporarily slum reclamation had to be deferred, and it was not until 1952 that the Commission recommended declaration of its second reclamation area.

From time to time the objectives of the Commission have been amended, and at present they are to let or sell houses to eligible persons, to improve housing conditions and reclaim slums, to give advice to the public with respect to finance for the purchase or construction of homes, and to prepare

and implement urban renewal proposals. In 1944 the number of part-time members of the Commission was increased from three to four. In 1955, and again in 1970, it was reconstituted, and since 1970 has comprised five full-time members.

Commonwealth–State Housing Agreements

In 1945 the Commonwealth combined with the State in a Housing Agreement whereby the Commonwealth provided loan funds which enabled the Commission to build about 26,000 rental houses over a period of ten years. This was essentially a scheme to provide rental houses, although towards the end of this ten year period provision was made for the sale of houses to tenants. The dwellings, built in spite of serious labour and material shortages, were mostly in the form of single unit houses on country estates and on large suburban estates at Jordanville, Heidelberg, and Maidstone. Early in 1946 the Commission acquired the Commonwealth Munitions plant at Holmesglen and began the mass production of components for concrete houses. Prefabricated timber houses produced by Victorian suppliers and prefabricated units imported from overseas were erected in some Melbourne suburbs and in country areas, notably Geelong and the La Trobe valley.

With the ratification of the 1956 Commonwealth and State Housing Agreement, which had been extended for succesive periods of five years and was current to June 1971, the emphasis shifted from Commission owned rental housing to home ownership by the individual occupier. For two years, 20 per cent of funds available under the Agreement was allocated to co-operative societies for providing finance for home builders, and for subsequent years the allocation was fixed at 30 per cent. For houses built with the funds remaining to the Commission, it was decided that 50 per cent was to be available for purchase by eligible persons and 50 per cent for rental. There was also a campaign to sell houses to tenants. As a result of adopting this policy of home ownership by individuals, of 69,688 units erected by the Commission to June 1971, a total of 31,451 had been sold. Most were sold on terms with deposits of $200 and with payments spread over periods up to a maximum of 45 years.

The Commission allocates about 45 per cent of each year's construction to provincial estates.

High density housing

The 1956 Agreement contained a provision that dwellings built with Housing Agreement funds could comprise flats in areas of high density population, thus enabling the Commission to return to its original task of clearing and re-developing slum areas. The State Treasury provided funds for acquiring such areas and the cost of re-development was met from Agreement funds. Additional funds to finance the cost of acquisitions have been provided in latter years from Commission funds, from donations by municipalities, and from the sales of reclaimed areas.

Originally only walk-up flats in blocks comprising two, three, or four floors were constructed, but in 1962 the first high-rise (16 storey) block was completed at South Melbourne. This block and a further 20 storey block at North Melbourne erected in 1963 were constructed by contractors to the Commission. The Commission, with the experience gained in

constructing flats with components manufactured at the Concrete House Factory at Holmesglen, was convinced that it was physically and economically feasible to erect high-rise blocks of flats on the same principle, and the first of these, constructed by a contractor with components from the Concrete House Factory, was completed at Flemington in 1964. With one exception, all high-rise blocks of 12 and 20 storeys built in concrete since 1964 have been erected by the concrete house project's own work force with the assistance of specialist sub-contractors. The emphasis on building in the metropolitan area has been largely upon the redevelopment of reclaimed areas with high-rise blocks. In 1969 a 30 storey block containing 299 flats was built. The production by the factory of components for concrete houses ceased in 1965–66, since when only those components required for the erection of flats have been produced.

Other developments

The provision of adequate housing for elderly persons at a rental within their economic capacity has always presented a problem. In 1955–56 the Commission began to produce at the Concrete House Factory one and two room flatettes designed to be erected in groups and later adapted to be erected in two or three storey walk-up blocks. In May 1966 the first 12 storey block providing accommodation for 200 lone persons was completed. This block is centrally heated and serviced with high-speed elevators and each flatette is provided with reticulated hot water. Five further blocks each of 12 storeys and providing similar accommodation have been completed since May 1966. Municipal councils which maintain surrounding garden areas and return to the Commission one half of the rates paid on the units have co-operated with the Commission and donated the land on which most of the elderly person units have been erected. Since 1956 a total of 3,162 lone person units and 1,310 pensioner couple units have been erected.

Conclusion

From a modest beginning in 1938–39 when only forty-four units were available for tenancy, the Commission had grown by June 1971 to be the biggest landlord in the State, having 38,295 units let with rentals for 1970–71 at $21m. Loan liability of the Commission at that date was $457m, and assets were $557m.

A major task of the Commission in the years ahead appears to be centred upon the acquisition, clearance, and re-development of known areas of decadent housing and areas which will require to be re-developed if the inner area of metropolitan Melbourne is to be capable of absorbing the anticipated future growth in population. In 1970 the role of the Housing Commission as a slum reclamation authority was widened by its establishment as an urban renewal authority. The legislation empowers the Commission to deal with all aspects of renewal—conservation, rehabilitation, and redevelopment—in collaboration with planning authorities, local councils, and the public generally.

LOCAL GOVERNMENT SERVICES

After the establishment of the first settlement in Australia in 1788, Governor Phillip had attempted to lay out townships which could be self-

supporting to some degree, and to divide the country into counties and parishes as it was surveyed. By a New South Wales Act of 1840 local landholders could elect " trustees " to take charge of " parish " roads and raise revenue by tolls and rates. District councils were incorporated in 1842 with wide responsibilities for roads, streets, public buildings, education, and some administration of police and justice. They were not very effective as they lacked sources of revenue, and an attempt to introduce them to the Port Phillip District failed. Melbourne and Geelong, incorporated as towns in 1842 and 1849, respectively, were the only places capable of effective local government. After Victoria had been separated from New South Wales in 1851 and had gained greatly increased population from the gold rushes, local government became more practicable. By an Act of 1853 district road boards could be established on petition from inhabitants. They worked in conjunction with the Central Road Board which attended to main roads, but were hampered by lack of funds as they had no borrowing powers and had to rely on revenue from tolls and rates only.

Melbourne and Geelong Councils were the first to be granted borrowing powers, when Acts of 1854 authorised them to borrow £500,000 and £200,000, respectively. In the same year the incorporation of municipal institutions was authorised for areas of up to 9 sq miles with a certain number of inhabitants. Some municipalities were established under this Act on petitions from local inhabitants, and councils were elected by ratepayers. Authority and responsibility for education, police, local administration of justice, and the provision of cemeteries had been assumed by the State, but the councils had wide, if somewhat ill-defined, powers in local affairs. Municipalities were granted borrowing powers and were able to carry out work of local importance.

By 1863 population in many rural areas was sufficiently large to justify the establishment of further municipal institutions; a new Act provided that road districts could be granted the status of shires if their revenue exceeded £1,000 a year, and that new shires could be established on petition from local inhabitants. Among other matters they had power to issue liquor and slaughtering licences, and they were given some administrative responsibilities previously exercised by the Clerks of Petty Sessions. The law relating to local government was amended from time to time as the population of Victoria increased. Municipalities as they are known today were introduced by the Shire Statute of 1869 and the *Local Government Act* 1874.

One of the principal functions of municipalities has always been the making and maintenance of roads and bridges. Main roads have been the responsibility successively of the Central Road Board, the Public Works Department, and the Country Roads Board, which have usually done all the work necessary, but at times have made grants to municipalities for this purpose. Financing the construction and maintenance of local roads was left entirely to local authorities, who also constructed private streets, laid out on privately owned land, at the expense of abutting owners. In new subdivisions, however, the subdividers must construct roads, footpaths, and drainage facilities.

Other main responsibilities have been to provide drainage, sewers, water supply, and health services, and to set up and administer building and health standards. With certain exceptions every council has had vested in it responsibility for all public sewers and drains within its municipal district.

The exceptions to this rule are sewers and drains vested in any other municipality, in the Melbourne and Metropolitan Board of Works, or in sewerage authorities operating in extra-metropolitan areas. In addition, councils are responsible for the collection and disposal of garbage. Municipalities on the sea coast were given the additional responsibility for care and management of wharves, piers, and jetties. As technical developments occurred local authorities acquired the power to build tramways, to issue licences for traction engines, and to make regulations relating to their use.

Over the years many of these responsibilities have been assumed by other bodies, some under the direct control of the central government, and others still retained by various local authorities. Harbour boards were introduced when municipalities combined to develop some of the smaller ports ; as ports became busier they tended to be placed under the control of separate harbour trusts. The passing of the Water Act of 1890 relieved most municipalities of their original responsibilities for water supply and only thirty still retain this function. Waterworks trusts, local organisations operating under the general supervision of the State Rivers and Water Supply Commission (until 1905 the Water Supply Department), cater for the needs of about 150 country local government areas, while about one quarter of the country population is served directly by the Commission. Usually central authorities have carried out the main work of building dams and reservoirs, and local organisations that of the actual reticulation to the consumer. In a similar manner local authorities have been formed to provide sewerage facilities in country areas. In the Melbourne area special problems relating to water supply, sewerage, and drainage led to the establishment of the Melbourne and Metropolitan Board of Works in the 1890s. The members of the Board are municipal councillors nominated by councils in the metropolitan area. In recent years its responsibilities have been extended to include town planning and the construction of main metropolitan traffic routes.

Tramways in Melbourne and suburbs were first built during the 1880s, but municipalities, being unable to undertake this work, authorised private companies to build and operate them. Borrowing powers for the building of such tramways were also delegated to the private companies. Melbourne tramway companies failed successively, leaving tramway services to be operated by municipalities operating through tramways trusts, which were taken over successively in about 1920 by the Melbourne and Metropolitan Tramways Board.

For some time after 1880 local government authorities provided gas and electricity supplies in various districts, and private companies supplied these services in other places. Municipal gas plants were sold one by one and during the last two decades most privately owned gas works have been taken over by the Gas and Fuel Corporation, a public authority formed in 1950 by the merger of the Metropolitan and Brighton Gas Companies. Similarly, most municipally owned and operated electric supply undertakings have been acquired by the State Electricity Commission, although a number of municipalities still buy power in bulk and distribute it to users.

Local authorities were chiefly responsible for maintaining pure food, sanitary, and health standards until the establishment of the Board of Health. Although the Board, now the Health Department, has the main responsibility,

it frequently acts through the municipalities which are its local agents. This work is often co-ordinated with the introduction and administration of building standards, including construction, ventilation, drainage and sewerage, and the collection and disposal of rubbish.

Early this century the licensing of public houses was made the responsibility of the Licences Reduction Board, which finally became the Liquor Control Commission, and licensing of motor vehicles became the responsibility of the police. Many present-day problems were not foreseen in earlier years. This is particularly so with traffic difficulties. For example, in many parts of Melbourne and in some provincial cities of Victoria, there are well laid out and spacious roads leading into much smaller streets which are the main arteries of the cities ; this situation is one which is being avoided in newer areas by means of planning schemes. The increasing use of motor vehicles, and the expansion of local shopping areas with supermarkets and multiple shopping centres, have caused parking problems in many municipalities. Some councils have assisted businesses by installing meters and providing off-street parking facilities, while regulations now require planners to provide parking facilities when development plans are being considered.

Some of the powers available to municipalities have rarely been used or are falling into disuse. The power to prepare housing schemes for persons of small means has rarely been exercised, and this function is now considered to be one of the principal responsibilities of the Housing Commission which was established in 1938 and which works closely with municipalities. Since 1944 councils have had the power to prepare plans to regulate the use of land in their municipal districts, and may join with other councils in a combined scheme. When a plan is to be prepared, a council may make an interim development order to control the use of land in the planning area until the scheme is in force. The Town and Country Planning Board makes reports and recommendations to the Minister for Local Government on planning schemes and planning matters generally. In 1949 the Melbourne and Metropolitan Board of Works, at the request of the Government, began to prepare a planning scheme for the whole metropolitan area. In 1955 the Board was made the permanent metropolitan planning authority and in 1968 its planning scheme was completed, received approval, and became operative. Subsequently, the Board delegated to councils in the planning area certain of its powers and responsibilities in relation to the scheme.

The provision and maintenance of parks, gardens, recreation reserves, libraries, and museums has been another aspect of local government services. Most local authorities have provided good sporting facilities, and Melbourne and its suburbs have been well served with ovals, tennis courts, and other arenas, while many councils outside the Melbourne metropolitan area have also established parks and gardens. Swimming pools are also being provided by an increasing number of councils. Municipal libraries have been expanded; the present method adopted by many councils is the use of a main central library, in conjunction with a mobile unit which tours the municipality on a regular schedule. In some instances where a council is unable to finance a mobile service on its own, two or more municipalities operate it jointly. Some municipalities have museums and art galleries.

Infant welfare centres have been an important part of local government services for many years. Pre-school centres are also provided in many

municipalities, and some have established home help services to look after children, prepare meals, and do household work when a domestic emergency arises. Immunisation against sickness is regularly arranged and advice is available from qualified personnel who have suitable facilities and equipment; these services are run in co-operation with the Department of Health. Older people are being provided for by special centres or club rooms, where meals and other amenities are provided, as well as by the "meals-on-wheels" schemes which bring hot meals to the sick and elderly in their own homes. In most cases these operate with the help of voluntary organisations. Some places have now appointed full-time social workers to advise and assist in relieving distress or solving personal problems.

MELBOURNE AND METROPOLITAN BOARD OF WORKS

Water

For 22 years after its foundation, Melbourne drew its domestic water supply directly from the Yarra River in the precincts of the town. Very soon the spread of settlement and the growth of population made this procedure hazardous to public health. In 1853 work began on Yan Yean Reservoir, which, with a capacity of 6,649 million gallons, provided Melbourne's first piped water supply. It is still in service. The Commissioners of Sewers and Water Supply were responsible for the Yan Yean supply until 1860, when the Government took direct control to ensure safe and reliable supplies. As Melbourne developed and more water became necessary, catchments were set aside in the mountains east of the city.

When the Melbourne and Metropolitan Board of Works assumed control on 1 July 1891 the established supplies comprised the storage reservoir at Yan Yean with headworks in the Plenty Ranges, a diversion weir on the Watts River as the first stage of the Maroondah scheme, the Toorourrong and six metropolitan service reservoirs, and 1,130 miles of aqueducts, supply mains, and reticulation pipes. The total cost had been £3.4m and a population of 490,896 was consuming about 50 gallons a head per day from 104 sq miles of forested catchments. At that time the water supply was also being extended. Supply to the high and expanding eastern suburbs had already become inadequate, and the Government, therefore, began the construction of a direct main of 20.5 miles between Yan Yean and Surrey Hills. It was, however, regarded as only a temporary measure, and development within the next twenty years made a new source of supply necessary.

In 1911 work began on the O'Shannassy scheme, the first large water supply work to be undertaken by the Board. In the first stage a weir was constructed on the O'Shannassy River with an aqueduct linking it to Surrey Hills. It was completed in 1914, just in time to avert a serious water shortage after the drought which made further water storages essential. Preliminary construction began on the Maroondah Reservoir, the Board's first storage reservoir, in 1917, and work was completed in 1927.

The O'Shannassy Reservoir was completed a year later. Owing to the steep fall of the O'Shannassy valley, a large storage extending back into the mountains was impracticable, but the reservoir was necessary as a regulating device for holding back "flashettes", the torrents which follow heavy rain, and releasing them in a steady, controlled flow. The main storage for

O'Shannassy water is the Silvan Reservoir, built in the Dandenong Ranges between 1926 and 1932.

By far the largest of the Board's reservoirs is the Upper Yarra, which had been envisaged as a source as early as 1888. A preliminary survey for possible reservoir sites in its catchment had been made in 1908, and in 1919 eight possible dam sites were investigated. However, in 1929 the Board proposed a single large dam downstream from McVeigh's, rather than the series of small ones previously proposed. Before the construction of the large dam, upper Yarra water had been utilised by tapping the river about two miles upstream from McVeigh's, and diverting some of its flow via the O'Shannassy aqueduct to Silvan.

The site of the proposed Upper Yarra Dam was tentatively determined in 1940, and immediately after the war the site was confirmed. Work began on the conduit to convey water from the new dam to Silvan and was still under way when construction of the dam itself began. The completion of the dam in 1957 brought the total capacity of Melbourne's storages to 65,452 million gallons, about ten times that existing in 1891.

Since 1891 Melbourne's population has more than quadrupled, the total annual consumption of water has increased more than eightfold, and the present daily per capita consumption is almost twice as high as in 1891. Thus the Board has had to pursue a continuous, and at times urgent, pipe laying programme, which has necessitated the building of forty-seven service reservoirs and fifteen elevated tanks throughout the metropolitan area to ensure an equitable supply pressure in all districts. Since 1956 a record mileage of large mains with diameters ranging from 84 inches down to 46 inches has been laid ; a large pipeline has been constructed between Silvan and Preston to permit the vast resources of the Upper Yarra scheme to augment the low level supply from Yan Yean and Maroondah ; and the Yarra–Silvan 68 inch diameter conduit has been duplicated. As pipe laying is very expensive, methods of extending pipe life are being studied. Particular attention has been given to mild steel pipes, now used exclusively for large mains. The Board adopted these in 1910 as they were much lighter and cheaper than cast iron pipes of comparable size, but unfortunately they have also been more susceptible to electrolytic and soil corrosion. Research to overcome this weakness has largely been successful.

The Upper Yarra Dam was completed in 1957, and although the dam tripled the amount of water impounded for Melbourne's supply, the Board's engineers were already planning new sources. The Yarra and its tributaries had virtually been exhausted as a source of unpolluted water, but the population was increasing, and supplies would have to precede expected demand. In 1962 the Board adopted a report recommending water supply augmentation works for a population of 5 million, which was a reasonable expectation by the year 2000; the Parliamentary Public Works Committee submitted its final report on this scheme in August 1967. The unprecedented drought in 1967–68, which resulted in the imposition of the most severe water restrictions Melbourne had yet experienced, emphasised the necessity of extending the available catchment areas and of providing more storages to regulate the flow.

Major works were being undertaken by 1969 to secure an adequate high quality water supply for the future ; the storage capacity of major reservoirs

will be doubled on the completion of the Greenvale Reservoir and Cardinia Creek Reservoir ; work was begun on the 12 mile long Yarra–Thomson tunnel, as the first stage of the diversion of the upper Thomson River to the Melbourne system; and four tributaries of the Yarra River above Warburton had been diverted to existing supply aqueducts. Emergency works constructed during 1967–68 permitted further catchment diversion, and the additional trunk mains became necessary to ensure that the extra water collected was available to consumers. These included an 84 inch main from Upper Yarra to Silvan and an 84 inch–68 inch from Silvan to Cardinia Reservoir (including a $1\frac{1}{2}$ mile tunnel through the ridge at Emerald) to prevent waste of water from the catchments when the occasional high flows occur during a dry period, and two new large capacity feeder mains to improve supply to the north-west and south-east portions of the system. Further service reservoirs and reticulation works will be provided as required for newly developed areas.

Water sources and purity must be protected, and the Board prevents contamination in catchment areas by prohibiting public access. Action also has to be taken against bushfires which may pollute supplies and affect their constancy. The fires of 1939 indicated the urgent need for maximum fire prevention and control, and since then the Board has built up an efficient radio-controlled fire fighting organisation. Steel lookout towers have been erected at strategic points in all watersheds, while several hundreds of miles of access roads have been built to facilitate fire fighting. To replace the forest cover in areas denuded by past fires, the Board has carried out reforestation with indigenous trees for many years.

Hydrology, the study of water in its various states as found above, on, or below the earth's surface, is of great interest to the Board of Works, whose main interests are concerned with the rainfall or input to catchments and the resulting streamflow or run-off. Knowledge of both aspects enables the Board's engineers to design storage dams, flood control structures, river and creek improvements, and adequate bridge waterway requirements to meet the expanding demand for them. Long-term records of rainfall and run-off for many catchments ensure that the extremes of the climate are adequately sampled. To effect this the Board has installed and equipped, and now operates, some eightly-five rainfall stations and fifty stream gauging stations. Others are operated by the State Rivers and Water Supply Commission and the Commonwealth Bureau of Meteorology. The Board also has specific hydrological experiments in progress, at Coranderrk for forest hydrology, and on experimental catchments for urban drainage.

Sewerage

A Royal Commission appointed in 1889 to inquire into sanitation recommended that an organisation be established to provide a sewerage system and to operate the existing government controlled water supply. It also suggested that the English sanitation engineer, James Mansergh, be brought to Victoria, and in 1890 he recommended that sewerage farms be established at Mordialloc and Werribee, on either side of Port Phillip Bay.

The Melbourne and Metropolitan Board of Works was constituted on 1 July 1891, but by this time Melbourne was on the threshold of an economic depression. Although its population was almost half a million, it appeared

that future development would be slower than previously expected, and the scheme which had originally been formulated during a boom period was therefore amended. The new plan provided for a system of gravity sewers converging at Spotswood, where a pumping station would raise the sewage and transfer it into an outfall sewer along which it would gravitate to a treatment farm at Werribee, 16 miles away. Work began on 19 May 1892, and five years later the first tenement was connected. Various improvements have since been made. Many automatic pumping stations now serve low lying areas which could not be connected gravitationally with the main system, and biological treatment plants have been established at Braeside, Altona, Heatherton, and Lower Plenty. At first the Werribee Farm comprised 8,847 acres of barren, windswept plain, but by 1950 it covered about 26,000 acres of land brought under production ; originally, sewerage purification was by land filtration, but this has been supplemented by grass filtration during the winter, and oxidation ponds have recently been used. However, the scheme was approaching the limit of its capacity, and the Board, therefore, launched its amplification scheme in 1958, the first stage of which provided for a new pumping station at Brooklyn of about twice the capacity of the original at Spotswood. It was opened in 1964. The main outfall sewer was also enlarged, and sewerage facilities now reach St Albans in the west, Campbellfield in the north, Ringwood in the east, and Waverley in the south-east. The second stage of the scheme was the South-Eastern Sewerage System on which construction began in 1964. It includes a large modern plant employing the activated sludge purification process to produce a colourless, odourless reconditioned water of high standard for discharge into Bass Strait near Boag Rocks through a 35 mile long outfall. The purification plant, with a capacity of 64 million gallons per day (mgd) mean dry weather flow, is a major part of the $170m South-Eastern Sewerage System and will begin operating in 1973. It will treat an average of 20 mgd of sewage by 1973 and 51 mgd by 1974. The plant, landscaped into the surrounding countryside, will be set in a 1,400 acre site, will use electric power generated on the site from by-product gas, and initially will be able to serve a population of about 900,000.

The South-Eastern Sewerage System will substantially relieve the Werribee Farm System, which deals with 97 per cent of Melbourne's wastewater, and when completed will provide a main sewer collecting system for the rapidly developing eastern and south-eastern suburbs as well as relieving a number of the existing main sewers. The purification plant is capable of progressive enlargement as these suburban areas develop.

Highways, foreshores, parks, and drainage

The Melbourne and Metropolitan Board of Works Act, as amended in 1956, extended the Board's authority to permit the construction and maintenance of metropolitan highways and bridges, the improvement and protection of foreshores, and the establishment of major parks. A Metropolitan Improvement Rate of up to 4d in the £ (in 1970 it was 1.4c in the $) was authorised to finance these functions and commitments under the Town and Country Planning Act. The Board is only responsible for highways and bridges approved and declared by the Governor in Council. A comprehensive roadworks programme providing largely for the construction of new facilities

was formulated, and although the lack of financial resources restricted plans, several important works were carried out. These included an eight-lane highway, Kings Way, and the construction of the first stage of the South Eastern Freeway at a cost of $4m, as part of a system linking city and suburbs.

In 1965 additional finances came from an increase in vehicle registration fees under the Roads (Special Projects) Act, and were matched with those from the Metropolitan Improvement Rate on a three for one basis, and in 1970–71 further funds became available to the Board under the provisions of the *Commonwealth Aid Roads Act* 1969. By 1972 the annual budget from all sources had risen to approximately $22m. Among the major projects included in the expanded programme were the Flemington to Coburg section of the Tullamarine Freeway linking the city to Melbourne Airport, the second section of the South Eastern Freeway, the St Kilda Road Underpass south of the city, and the Eastern Freeway from Collingwood to Bulleen which allowed for a future railway along its median.

In 1956 the Board took over responsibility for foreshore protection from the Public Works Department. There were then 49 miles of bay coastline within the metropolitan area, but the extension of the Metropolitan Planning Area in 1968 increased this to 60 miles within eleven municipalities. Financial limitations in the Metropolitan Improvement Rate have restricted the Board's operations to protective measures, but more than $1.6m had been spent by June 1971. Most works have been conventional seawalls of cemented stone, but more recently a new type of sloping wall of packed rock has been used successfully. In 1958 a rock mole was begun at Elwood, and was used later by the St Kilda City Council to establish a marina, 40 acres being reclaimed for recreation. The Board investigates new methods for the protection of foreshores and the preservation or restoration of beaches, and is represented on the Consultative Committee for the Port Phillip Authority which was established in 1966.

The 1954 Metropolitan Planning Scheme reserved public open space on the basis of 7.5 acres per 1,000 persons in the metropolitan area. It set aside areas for sports grounds, parks, and playgrounds, and planned for a series of major metropolitan parks to be established, mainly along rivers and streams or on the periphery of the urban area. In 1956 the Board was given powers to develop these parks but activities have mainly been concerned with preventing private development in the various areas. By April 1971 a total of some 2,450 acres had been acquired at a cost of about $10.3m.

When the Board was created in 1891 it was given control of the Yarra River and other public watercourses in the metropolis with regard only to commerce and recreation. The responsibility for stormwater drainage was left with the local councils which were often unable to carry out the necessary flood control works. Disputes concerning drains crossing municipal boundaries had often resulted in no works being carried out, standards of flood protection where provided had varied widely, and construction had often been poor. In 1923 legislation constituted the Board a drainage authority in addition to its other functions; it became responsible for all metropolitan rivers and watercourses and major drains, in all about 720 miles in length. Until the end of the Second World War

the Board had constructed 73 miles of stormwater drains, but post-war development demanded facilities which strained the Board's resources. Besides providing drains in newly developed areas, the Board had to maintain miles of drains built by councils before 1923 and since transferred to it. In addition to making substantial improvement works on the larger rivers and watercourses, it has constructed about 275 miles of stormwater drains. In recent years the Board has also built nineteen flood control dams (retarding basins) of up to about 1,600 acre ft capacity on several watercourses to restrict the rate of flow along their lower reaches. Expenditure on drainage and river improvement has increased greatly since the Second World War. In the 22 years between 1923 and 1945 total expenditure was $3.6m ; it rose steeply over the next 25 years to $37.6m.

In recent years industrial expansion, the mounting population, and the increase in unsewered housing have caused much pollution of rivers and drains. The Board is endeavouring to control this pollution by increased enforcement of its by-laws and by requiring the provision of sewerage facilities at the time of sub-division ; this enables it to provide outlet mains in these areas and to provide facilities in previously developed areas.

COUNTRY TOWN WATER SUPPLIES

Outside the metropolitan area, domestic and industrial supplies are available in all but very small country townships. In June 1971 417 towns had reticulated supplies serving a population of over 980,000, that is, 80 per cent of the population outside Melbourne. Supplies to 150 of these towns, serving a population of about 295,000, are managed directly by the State Rivers and Water Supply Commission. The remaining 267 town supplies are managed by local water authorities especially constituted for the purpose.

During the gold rush of the 1850s many people migrated to areas without adequate water supply ; there were then no specially constituted water supply authorities and as the mining population was too unsettled to accept responsibility, the Government constructed reservoirs where needs were most pressing. By 1865 twenty-four reservoirs had been constructed by the Mines Department, the predecessor of the Water Supply Department which was succeeded in 1905 by the State Rivers and Water Supply Commission. The earliest reticulated supply was probably a reservoir and 12 miles of mains initiated in 1859 by the Bendigo Waterworks Company. The *Bendigo Waterworks Act* 1871 provided for these works to be transferred to the City of Sandhurst (Bendigo). The Coliban Scheme, initiated in 1862, augmented the supply to Bendigo and supplied the mining centre at Castlemaine, and later a number of other townships in the area. This system is now administered by the Commission.

In 1860 two private Acts of Parliament authorised the construction of waterworks for mining and other purposes at Beechworth and in the Ovens River area. Funds for works under these Acts were borrowed privately and without any government assistance. The Beechworth supply is still operated by a local governing body under the Water Act, but the other works have since been abandoned or absorbed into other supply systems. Ballarat was first supplied in 1862

from Kirk's Reservoir which was constructed originally for mining purposes. The original local committee controlling this system was replaced in 1872 by the Ballarat and Ballarat East Water Commissioners, reconstituted as the Ballarat Water Commissioners in 1880. Geelong was first supplied in 1865 by the Government from two reservoirs on Stony Creek ; these works were transferred in 1908 to the Geelong Waterworks and Sewerage Trust.

Legislation as early as 1872 provided municipal corporations with government loans, and many waterworks of permanent value were constructed. The first comprehensive legislation for the supply of water to country districts, the *Water Conservation Act* 1881, provided for waterworks trusts to construct and manage supply works throughout the State. More detailed provisions to control supplies in urban areas were added in 1884. The *Water Act* 1905 constituted the State Rivers and Water Supply Commission which became the principal rural water supply authority in the State and was responsible for the construction and management of many town water supplies. This and subsequent Water Acts have retained provision for the constitution of local water authorities to supply specific towns or areas.

State Rivers and Water Supply Commission

The supplies for the 150 towns managed directly by the Commission fall into two main categories : those forming part of the large main urban supply systems, and those located in irrigation or waterworks districts and operated as independent urban systems.

The main urban supply systems are the Mornington Peninsula System, the Bellarine Peninsula System, the Otway System, and the Coliban System. All these were principally constructed for the supply of towns only, although the Coliban System also provides substantial irrigation supplies in the Bendigo–Castlemaine area. Town supplies in association with the Commission's irrigation and rural water supply activities are those within the Goulburn–Campaspe–Loddon Irrigation System, the Wimmera–Mallee Domestic and Stock Supply System, and towns supplied direct from the Murray River. Three towns, Eildon, Heyfield, and Wonthaggi, are supplied independently of the Commission's larger water supply systems. The total capital expenditure up to June 1971 on town water supplies administered by the Commission amounted to $59.8m.

Mornington Peninsula System

The Mornington Peninsula Water Supply System was initiated at Commonwealth request to supply the naval base on Western Port. The scheme, begun in 1917, provided for the diversion of the headwaters of the Bunyip River through about 35 miles of channel to a reservoir at Beaconsfield from where the water was to be conveyed by pipeline to the various parts of the Peninsula. However, war-time difficulties in obtaining materials made progress slow. A supply was initially obtained from Toomuc Creek, and the channel to the Bunyip River headworks was not completed until 1925. The naval base received a supply in October 1919, but it was not until 1921, following completion of the Frankston and Mornington Reservoirs, that supplies were available to Mornington, Frankston, Seaford, Carrum, Chelsea, and Edithvale. Lysterfield Reservoir, which has its own catchment, was constructed in 1929, and the

system as originally designed was completed in 1942. Since then the system has been greatly expanded to serve the growing residential and industrial requirements of the Mornington Peninsula. Devilbend Reservoir (3,212 million gallons) was constructed in 1964 to hold in reserve the surplus winter flows of the Tarago and Bunyip Rivers, and in 1968 the security of supply was further increased by the construction of Tarago Reservoir with a capacity of 5,600 million gallons. Supplies to Dandenong, Springvale, Noble Park, and Chelsea were originally part of the Mornington Peninsula System, but these areas have now been transferred to the Melbourne and Metropolitan Board of Works supply system.

The system now has eight main reservoirs with a combined capacity of 10,700 million gallons, and fifty-two service basins and tanks with a combined capacity of 140 million gallons. In June 1971 it supplied 54,000 services and a permanent population of about 125,000 persons; this is greatly increased by holiday makers during the summer.

Bellarine Peninsula System

A scheme to supply seaside towns on the Bellarine Peninsula from the headwaters of the Barwon River in the Otway Ranges was begun in 1927. This scheme, also needed to meet a major part of the water requirements for the urban area of Geelong, was completed in 1934. During 1954–55 the control and development of the system's headworks were transferred to the Geelong Waterworks and Sewerage Trust, which has since supplied the Commission in bulk for distribution to the other towns of the Peninsula. By June 1971 the Commission supplied some 10,800 services requiring 700 million gallons annually in towns, other than Geelong, of the Bellarine Peninsula, which then had a permanent population of about 15,000, supplemented in summer by holiday makers. In addition, Geelong's population has grown to 119,000, with a normal demand on the system of approximately 5,500 million gallons per annum.

Otway System

Through the Otway System the Commission provides reticulated water supplies to Terang, Cobden, Allansford, and Simpson; it also supplies water in bulk to Warrnambool and Camperdown. This system was begun in 1935 and completed in 1938. The headworks comprise three diversion weirs on Arkins Creek and tributaries near the top of the Otway Ranges. From here water is conveyed through 70 miles of pipeline to Warrnambool, and on the way fills storages at Camperdown, Ewen Hill, and Tank Hill (total capacity 285 million gallons). Services supplied by the Commission in Terang, Cobden, Allansford, and Simpson number about 3,000, for a population of about 9,000. In addition, the annual bulk supply to Warrnambool and Camperdown (combined population 22,000) is nearly 600 million gallons.

Since 1958 the supply capacity of the system has been almost doubled by means of pumping water from the Gellibrand River and by the installation of booster pumps along the main pipeline. The South Otway pipeline at present being constructed from the Gellibrand River to Allansford will increase supplies still further.

Coliban System

As mentioned above, this system was initiated by the Victorian Water Supply Department in 1862 to bring water from the central highlands at Malmsbury to Sandhurst (now Bendigo) and other gold mining towns. The system now includes 384 miles of channels and 424 miles of pipelines supplying water to Bendigo, Eaglehawk, Castlemaine, Maldon, and eighteen smaller townships. The main storages of this system are the Upper Coliban, Lauriston, and Malmsbury reservoirs with a total capacity of 15,200 million gallons ; all are located on the Coliban River. Supplies are augmented by pumping from Lake Eppalock on the Campaspe River, 16 miles east of Bendigo.

Other towns

The Wimmera–Mallee Domestic and Stock Water Supply System, with headworks in the Grampians and a channel system extending northwards to Ouyen and Manangatang, primarily supplies 19,500 farm storages over 11,000 sq miles of good agricultural and grazing land. The headworks comprise twelve storages, the earliest having been built at Wartook in 1887 ; the most recent, Bellfield Reservoir on Fyans Creek, was completed in 1966. Rocklands Reservoir on the Glenelg River was completed in 1953 and has a capacity of 272,000 acre ft. This reservoir has the largest storage capacity in the system. The distribution works involve 6,600 miles of Commission channels and 4,000 miles of farmers' channels, the longest distance over which water is delivered exceeding 300 channel miles. As well as rural farm supplies the system provides water for fifty-two towns with reticulated supplies, and serves a population of about 16,000. The Commission manages the reticulation in thirty-eight of these towns, and local storages at sixty railway stations are also supplied. The major towns supplied are Horsham, Warracknabeal, and Charlton (local authorities), and Birchip, Hopetoun, Rainbow, Sea Lake, and Ouyen.

The widespread Goulburn–Campaspe–Loddon Irrigation System in the northern part of the State provides supplies for a number of towns. Distribution in the larger towns is usually managed by local authorities, but the Commission directly controls the reticulation in twelve of these, supplying over 3,000 persons. Another ten urban centres with a population of about 8,000 persons obtain water direct from the Murray River, and have their water supplies managed by the Commission. In larger towns such as Mildura and Swan Hill, which are supplied direct from the river, the works are managed by local water authorities.

Three townships, Eildon, Heyfield, and Wonthaggi, are supplied directly by the Commission. The total population of these towns is about 8,000.

Local authorities

In June 1970 there were 267 country towns throughout Victoria supplied by local water authorities, nearly all of which were constituted under the provisions of the Water Act. The total population supplied by these authorities is approximately 686,000. Local water authorities are independent responsible bodies, but as the Government usually provides a substantial degree of financial assistance, all their operations and proposals are subject to general review by the State Rivers and Water Supply Commission. Local water authorities, under the direction of their honorary commissioners, have

built town water supply works costing $96m (up to June 1970), of which some $14.6m is borne directly or indirectly by the Government. Of the total cost, $86m has been spent since 1945, and during 1969–70 expenditure on new works was $6.8m.

Where an existing town supply has been installed and operated by the Water Commission, it is always prepared to transfer the works and management to a local authority, if practicable. This has occurred in Bacchus Marsh, Werribee, Cohuna, and Camperdown.

Special authorities

Several local water authorities operate under special Acts. The area served by the Mildura Urban Water Trust, constituted under the Mildura Irrigation and Water Trust Act, was originally part of the Chaffey irrigation settlement, dating back to 1887. The town area was proclaimed an Urban District of the First Mildura Irrigation District in 1909. The present Trust was created in 1921 by an amendment to the Act.

The Geelong Waterworks and Sewerage Trust was constituted as the Geelong Municipal Waterworks Trust in 1908 by the *Geelong Municipal Water Act* 1907 to take over that town's water supply works, the initial stages of which had been constructed by the Water Supply Department in 1865. This Trust has never received any financial assistance from the Government and bears the full cost of the works serving the population of over 110,000 in the Geelong urban area. In 1968 the West Moorabool Water Board was constituted by statute to construct and manage a dam of 13,100 million gallons capacity at Bungal on the West Moorabool River. The purpose of this dam is to augment supplies to Ballarat and Geelong ; the estimated cost was $4.75m.

The Latrobe Valley Water and Sewerage Board was constituted in 1954 under the Latrobe Valley Act to construct and manage the supply of water in bulk to towns and industries; it is not the function of this Board, however, to manage reticulation works to the town's consumers.

ELECTRICITY, BROWN COAL, AND GAS

During the early years of settlement in Victoria firewood was the principal fuel used, supplemented by black coal imported from Scotland and New South Wales ; whale and seal oil were used for lighting. During the 1850s the gas industry was established, followed by the erection of some small electricity generating plants in the 1870s. Gradually coal, gas, and electricity replaced firewood which, however, remained an important form of energy until the end of the century. Kerosene for lighting and power was first imported into the Colony in 1861 and the first of the modern oil companies set up an office in Melbourne in 1895. Brown coal had been discovered in the 1850s but technology had not advanced sufficiently to utilise this source of energy until the 1920s.

In common with world trends, the patterns of energy underwent vast changes during the present century until today petroleum products, electricity, and brown coal constitute Victoria's principal forms of energy. Black coal and firewood are now rarely used, manufactured gas plays only a minor role, and the lack of suitable catchments restricts the development of hydro power stations. The development of the vast brown coal deposits in the La Trobe

valley to generate electricity played a very significant part in the development of Victoria between the two world wars, and this activity has been greatly expanded since 1945 until today the generation of electricity is a major industry with power lines stretching to every part of the State. The discovery of indigenous crude oil and natural gas in the late 1960s is setting the pattern for the future development of energy, and these combined with the utilisation of the State's vast deposits of brown coal for electricity generation will ensure that Victoria's energy requirements can be adequately catered for until the end of the century.

Electricity and brown coal

Early history

The first application of electricity in Victoria was the telegraph installed between Melbourne and Williamstown in 1854, mainly to transmit information of shipping movements. It was another fifteen years before electric light became available to Victoria. Then, to celebrate the visit of the Duke of Edinburgh in 1869, " revolving electric lights " were displayed on a number of Melbourne buildings and vantage points. In the 1870s small generating plants were built in the central areas of Melbourne, supplying very small areas in their immediate neighbourhoods. A football match was played under lights on the Melbourne Cricket Ground in 1879, and the theatres used the new light. In 1880 the first electric lighting company in Victoria was formed ; others soon followed. To celebrate Queen Victoria's Jubilee in 1887 the General Post Office in Elizabeth Street had a display of 350 lamps ; a year later, to mark the centenary of the settlement of Australia, the Exhibition Building was lit by the then enormous number of 4,040 lamps.

Electricity, which at that time could not yet be transmitted for long distances, was still limited to the vicinity of the place of generation. However, in 1891 electricity was transmitted for more than a hundred miles in Germany. The problem had been solved, and in Victoria electricity now began to compete seriously with gas which had been lighting Melbourne streets and houses since the late 1850s. Electric light companies moved out of their city premises into the suburbs, especially along the riverside where there was room to expand as well as an ample water supply. In 1894 the Melbourne City Council began to operate a new power house in Spencer Street and lit most of the main city streets with electricity. The use of electricity for purposes other than lighting developed ; there were electric kettles, electric ventilating fans in hotels, and motors driven by electric power.

In Victoria there were few restrictions during the early years of electricity. Anyone could set up a generating plant to supply others ; with permission from the local municipal authorities to erect power poles he could transmit energy to any customers he could find, in competition with any existing undertaking. This state of affairs was wasteful, costly, and inefficient, and could be dangerous, and in 1896 the Victorian Parliament passed an Electric Light and Power Act, which ensured that no one could set up an undertaking to supply others without permission granted by an Order in Council, no new Order could be issued without the consent of the municipality in whose territory an undertaking would operate, and municipalities were also given the right to buy out existing undertakings at valuation after thirty years. This meant that suppliers, having survived the expensive and often unprofitable years of establishing an electricity supply, faced the risk that municipali-

ties would acquire their businesses when they had reached their fruitful periods. This prospect led to rationalisation, mergers, and takeovers until, in the first decade of the twentieth century, only one municipal undertaking (Melbourne City Council) and two private ones (Melbourne Electric Supply Co. and North Melbourne Electric Tramways and Lighting Co.) remained in the metropolitan area.

The use of electricity grew rapidly. The engines which turned the dynamos used black coal from New South Wales as fuel, but its price rose constantly and its supply was subject to frequent interruptions caused by stoppages in the mining and maritime industries. It had been known since 1857 that Victoria possessed brown coal, and by 1876 it had been found in thirty-two places, the most impressive fields being in the La Trobe valley. In 1887 a company began to win brown coal at what is now known as Yallourn North. In 1888 the Victorian Government offered a fixed minimum price for Victorian brown coal, and a new company took over the open cut at Yallourn North.

The great maritime strike of 1890 restricted black coal supplies and revived interest in Victoria's own fuel. Brown coal was tested for steam-raising and gas making; some was sent to Germany where it was made into briquettes of satisfactory quality. The Government offered £5,000 for the first 100,000 briquettes produced in the Colony, and the Morwell mining company set up a primitive plant. Nevertheless, despite the uncertainty of supply, black coal was so efficient by comparison with brown coal that its use continued. The Morwell company ceased operations in 1899, after a bushfire had destroyed its plant.

After 1900 the demand for electricity rose rapidly in Victoria. Between 1905 and 1915 the number of electric motors increased from 1,050 (3,250 hp) to 5,800 (40,000 hp). Difficulties with black coal supply continued, and in 1909 the Government opened its own black coal mine at Wonthaggi. The field, however, was not extensive, and the quality was not as good as that of New South Wales coal. The Victorian Government in 1907 brought out Charles Hesterman Merz, an English expert, to investigate and report on the electrification of the Melbourne suburban railways. Merz was the first to propose seriously that a power house be established in the La Trobe valley, using brown coal for fuel, and that the power be transmitted to Melbourne. This would also reduce the State's dependence on New South Wales black coal. In 1912 the Government decided to electrify the suburban rail system, but war delayed the project. The war also increased the general demand for power, but made more difficult the task of establishing the means to satisfy that demand. However, it did not prevent strikes, and because of these Victoria again suffered from lack of coal supplies in 1916. The abandoned open cut at Yallourn North was re-opened and some brown coal won for both factory and home use, but industrialists and householders did not greet this fuel with much enthusiasm. Until 1917 sporadic efforts in various places had won 120,000 tons from Victoria's known resources of thousands of millions of tons of brown coal. By 1977 the State Electricity Commission of Victoria expects to be winning about 90,000 tons a day.

Establishment of the State Electricity Commission

War-time strikes and shortages of fuel again raised demands that Victoria's vast deposits of brown coal be used to generate electricity. In

1917 the State Government took the first step towards making Victoria independent of imported coal. It appointed a Brown Coal Advisory Committee, comprising experts on electricity generation and supply under the chairmanship of the State Director of the Geological Survey, Dr Hyman Herman, who had been engaged since 1913 on a government programme of boring to prove deposits. This committee reported within fifteen weeks, recommending that a brown coal mining and electricity complex be established at what is now called Yallourn, in the La Trobe valley, and that the power generated be transmitted to the city. The coal was believed to contain 45 to 50 per cent moisture. Nowhere except in central Europe had high-moisture-content brown coal been the successful basis of an electricity undertaking. The committee recommended that a body of electricity commissioners be appointed to control the scheme. Nothing was done for a year, but the Government passed legislation at the end of 1918, and on 7 March 1919 three commissioners began work. They obtained information and material from occupied Germany, and in November 1919 endorsed the recommendation of the Brown Coal Advisory Committee.

In 1920 Sir John Monash, a distinguished civil engineer and soldier, was appointed general manager; at the beginning of 1921 he became full-time chairman of a body with extended powers and a new name—the State Electricity Commission of Victoria (S.E.C.)

On 5 February 1921 work commenced on the power house site. Work had already begun on a new open cut, for the quantity of coal available in the old open cut was insufficient for an undertaking of this magnitude. Winning the coal was the first and major concern, and, although the machinery available was necessarily makeshift until specially adapted machinery could be obtained, there were no great technical difficulties. Overburden averaged only 33 ft over a seam which averaged 174 ft in depth. The nature of the coal, however, was to cause considerable trouble ; bores had not disclosed any appreciable difference between coal in the old and new cuts, but it was discovered and confirmed beyond doubt during 1921 that the new-cut coal averaged 65 per cent moisture. Contracts had already been let for steam-raising plant based on a much lower moisture content; to call new tenders would have delayed power generation, which might have been unwise and economically disastrous. S.E.C. engineers successfully adapted the plant to burn the high moisture content coal efficiently, and so avoided a delay in production.

Meanwhile, until Yallourn came into operation, it was necessary to ease the power position in Melbourne, where existing private and municipal undertakings were reaching the limits of their capacity. The S.E.C. had proceeded with a power house known as Newport B, with a 30 megawatt (MW) capacity, and this began operation in 1923. Its production was supplemented by excess energy available from the railways power house, Newport A, and the Commission was able to supply 250 million kilowatt hours (kWh) in 1923 and 367 million in 1924.

By the middle of 1922 the open cut area at the coal face was only one acre (the area of La Trobe valley open cuts exceeded 2,000 acres in 1970). By 30 June 1924 more than one million cubic yards of overburden had been removed and 130,000 tons of coal won. Just before the end of June 1924 the first power flowed over the 132,000 volt lines which had been erected to link

the power house to Melbourne. By the end of 1924 four 12.5 MW units were in production at Yallourn, and another was in operation by the end of 1925. Parallel with this operation the S.E.C. had established a briquetting factory and this was producing by the end of 1924. In the next five years S.E.C. generation jumped to 625 million kWh per year as the Yallourn units, supplemented by a modest contribution from the Commission's new hydro station based on the mountain streams of the Rubicon–Royston area, brought power to Melbourne over lines extending over 110 miles. By 1929 the system was serving almost the whole of the Melbourne metropolitan area, 141 country centres, and hundreds of farms, through 1,500 miles of high-voltage transmission lines; Yallourn had become a self-contained town of 400 houses. In 1930 the S.E.C. acquired the Melbourne Electric Supply Company, the only surviving private undertaking in Melbourne; it had acquired the North Melbourne Electric Tramways and Lighting Co. in 1922. The number of customers served by the S.E.C., which had been only fifty in 1922 and 7,000 in 1923, rose to 179,000. When Sir John Monash died in October 1931, the S.E.C. had won more than nine million tons of coal and was producing 643 million kWh a year.

Yallourn B power station, which was to add 100 MW to Yallourn's capacity, was completed in 1938 ; the next steps included a large hydro-electric scheme at Kiewa in the north-east of the State, which would provide another 92.5 MW (this was increased twenty years later to 183.6 MW). The Second World War interfered with the course of this project, and also with a planned doubling of the 30 MW output at Newport B.

War-time fuel shortages caused the Victorian Government in 1943 to adopt a policy of brown coal development designed to make the State more independent of outside supplies. This envisaged expanding briquette production to two million tons a year, or nearly five times that of 1943. The war caused a very large increase in demand for electricity, but war-time shortages made it impossible to install new plant to meet the demand ; by working plant to the limit with no reserves for emergencies, wartime needs were met without rationing. In 1937 the S.E.C. generated 1,000 million kWh; this increased by 75 per cent during the war.

The scarcity of labour, materials, and fuel continued after the war; demand, instead of tapering off, continued to increase ; and rationing had to be introduced. With the aid of rationing, the S.E.C. was able to surmount difficulties in the post-war years when financial problems were added to material and labour shortages. Rationing remained until 1952 although restrictions on connecting hot water off-peak systems continued until 1961. In 1949, its thirtieth year, the Commission had an installed generating capacity of 577 MW and coal production exceeded 6 million tons a year. The Commission planned to increase its generating capacity to 956 MW within ten years, to set up a large briquetting project, and to expand Kiewa ; it also considered large extensions to Yallourn. The 1951 recession delayed many of its expansion plans; nevertheless, by 1952 the S.E.C. had installed a further capacity of 165 MW since the war, and electricity generated had risen from 1,747 million to 2,902 million kWh a year. In the next three years demand rose so rapidly that the annual production exceeded 4,250 million kWh. The number of consumers supplied by the S.E.C., which was 311,000 when the war ended, rose to 532,000 in 1955, while average consumption per

domestic consumer more than doubled and consumption per commercial consumer increased by over 50 per cent.

In 1955 the S.E.C. entered upon its most remarkable period of expansion. Between 1955 and 1971 energy generated (including that from the Snowy scheme which first supplied power in 1959) more than trebled, the number of consumers almost doubled, and the average consumption per consumer rose sharply. Rural connections, fewer than 5,000 in 1931, rose to more than 73,000. The S.E.C. not only met these swiftly increasing demands but built up a reserve capacity; this had not existed in the post-war decade. Installed capacity, including the Snowy allocation, passed 3,500 MW, more than three times that of 1955. Generating capacity at the Yallourn stations was doubled. The Hazelwood project was completed in 1971 and at full capacity of 1,600 MW became, for a time, Australia's largest power station. The generating plant attached to the Morwell briquetting project was completed with a capacity of 170 MW. Hydro stations at Kiewa, Eildon, Rubicon, and Cairn Curran have been expanded to bring their total capacity to some 320 MW. Power became available from the Snowy scheme in 1959 and rose to 628 MW in 1971. In 1955 the total generating capacity available to the S.E.C. was 939 MW. This had risen by 1971 to 3,531 MW, and was well ahead of maximum demand. Work had begun on Yallourn "W", which will have two units each of 350 MW. In June 1971 an announcement was made that a new peak load power station using natural gas as a fuel would be erected at Newport. Expected to cost about $145m, the station will have two 500 MW generators, the largest so far in the State. The first unit is expected to come into service in 1976 and the second in 1978.

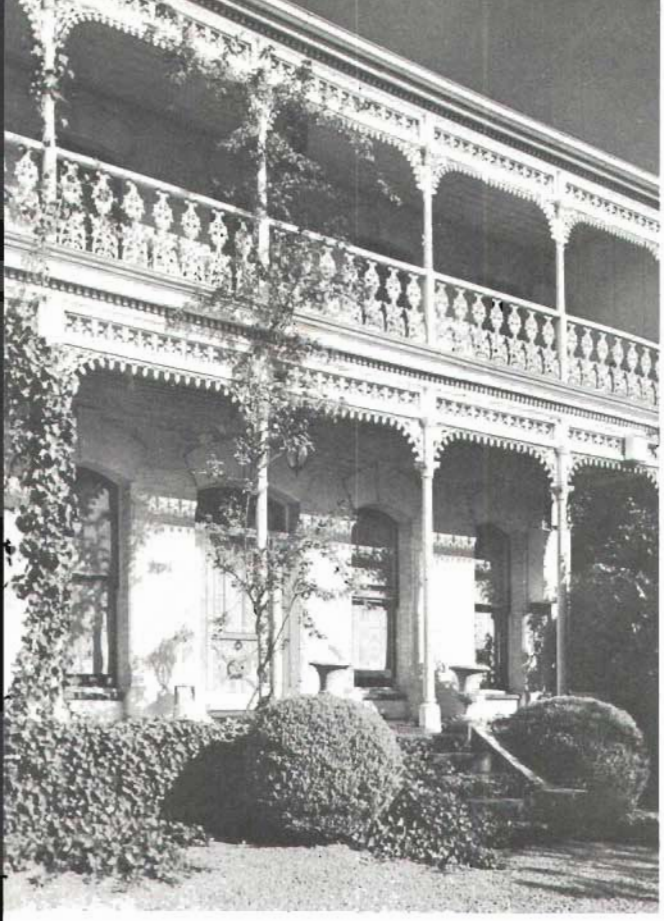
Annual brown coal production, mainly for electricity generation, rose from over 8.7 million tons in 1955 to 21.5 million tons in 1971 and the briquetting industry, unique in Australia, achieved very great growth in its early years. From a first year production at Yallourn of only 36,000 tons, plant capacity was progressively raised until it reached 655,000 tons in 1960, when the Morwell project, with a capacity more than double that of Yallourn, came into operation. The combined annual production of briquettes from the S.E.C.'s factories in 1971 exceeded 1.36 million tons. The impact of natural gas and competition from fuel oil, however, make it likely that present installed production capacity will be sufficient to meet future demand. The Yallourn briquette works closed late in 1971, and all future briquetting operations will be carried out at Morwell.

During the late 1960s Alcoa Australia Ltd erected a 150 MW generating station at Anglesea, about 80 miles south-west of Melbourne, to produce electricity for use at its aluminium smelting and semi-fabrication plant at Point Henry, Geelong. Opened in 1969 the power station uses about one million tons of brown coal a year mined by open cut methods from its 115 million ton Anglesea field.

Gas industry

History

Gas first appeared in Melbourne on 23 July 1849 when William Overton illuminated his two shops in Collins Street with gas produced by carbonisation of coal in a retort constructed by George South, a blacksmith of Fitzroy. The reception given to Overton's venture led him to take steps towards the establishment of a gas company. In this enterprise he gained support and



Ornamental ironwork on verandahs was a feature of many buildings from about 1860.
Dr E. Graeme Robertson

An ornate cast iron gateway belonging to a large St Kilda house built in 1870.
Dr E. Graeme Robertson

The roughly constructed slab shed has been a feature of many farms.
M. B. Lewis

A basic rural dwelling in a planned settlement area
La Trobe Collection, State Library of Victoria

The factory in Bristol, England, which prefabricated many houses for erection in Victoria in the 1850s.

La Trobe Collection, State Library of Victoria

Canvas Town, south of Princes Bridge, in the 1850s—temporary abode for many gold seekers.

La Trobe Collection, State Library of Victoria

The Mansion, Harwood Park, near Winchelsea, was built in 1869 and is an example of the many substantial homesteads erected about that time in western Victoria.

Melbourne Harbor Trust

The sitting room of the Lindsay home at Creswick, as reconstructed by the Ballarat Fine Arts Society.

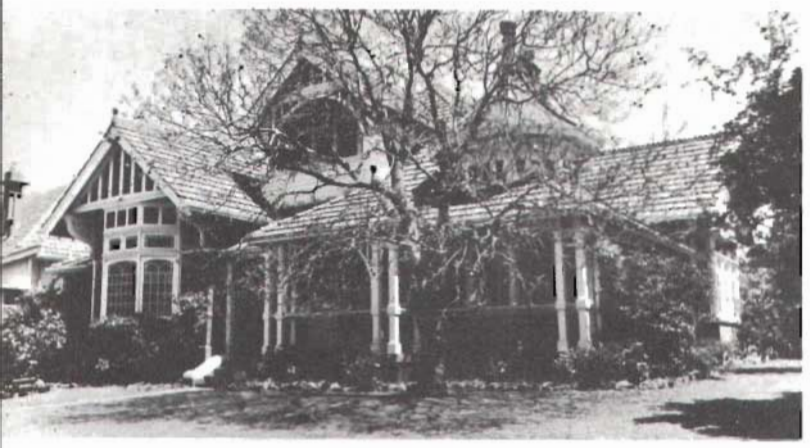
Ballarat Art Gallery

Advertisement of the Abbott estate subdivision at Sandringham in 1886
La Trobe Collection, State Library of Victoria

Illawarra, Toorak, an extravagant boom period home built in 1890-1891
Dr E. Graeme Robertson

Glenfern, St Kilda, an example of the Gothic revival style.

Commonwealth Bureau of Census and Statistics



The Queen Anne style villa, developed after the depression of the 1890s.

The Age

The Californian bungalow, very popular in the 1920s.

Commonwealth Bureau of Census and Statistics

The Spanish Mission style house was also popular between the wars.

Commonwealth Bureau of Census and Statistics

Langs, Toorak, a block of flats designed by Walter Burley Griffin, *c.* 1920.

Commonwealth Bureau of Census and Statistics

A triple fronted brick veneer house, typical of many built in the 1950s and 1960s.

Commonwealth Bureau of Census and Statistics

A block of flats in Carlton erected in the late 1960s.

Commonwealth Bureau of Census and Statistics

Newly built houses on a recently subdivided estate in the developing Doncaster–Templestowe area.

Commonwealth Bureau of Census and Statistics

Belgrave Terrace, a well preserved row of houses in South Melbourne.
Gordon De Lisle

A high-rise block of low rental flats under construction, using pre-cast components.
Housing Commission

a public meeting was called in 1850 to consider the establishment of a company for the purpose of supplying the city with gas. An Act of Incorporation was sought from the first Legislative Council of Victoria, but it was not until later that the City of Melbourne Gas and Coke Company Act was passed. The first gas works was erected on a marshy flat between Collins Street and Little Flinders Street West, and from this site gas was first supplied to a portion of the town. The site for another works was subsequently secured on the Yarra Bank at West Melbourne, and in September 1854 the foundation stone of the Melbourne Gas Works was laid. The works, using hand stoked horizontal retorts and coal imported from Scotland, was opened on 3 January 1856.

In the succeeding four years legislation was passed to establish gas supply companies in Ballarat, Geelong, Castlemaine, and Bendigo. In Ballarat gas became available from July 1858, and ten years later was being supplied to some 1,200 consumers. The company was purchased by The Gas Supply Company Limited in 1956. Geelong first acquired a gas supply in May 1860; from that date The Geelong Gas Company provided for the gas requirements of the 23,000 consumers in the Geelong area until natural gas was introduced by the Gas and Fuel Corporation in 1971. Castlemaine received its gas supply from a company incorporated in 1859; the Gas and Fuel Corporation purchased the company in 1956, as it did The Bendigo Gas Company, which had been the supplier for Bendigo since March 1860. Between 1860 and 1890 several gas undertakings were constructed by local municipal authorities in other large towns in the State.

The second gas undertaking in the Melbourne area, the Collingwood, Fitzroy and District Gas and Coke Company was formed in 1860 and an Act of incorporation was passed. A third undertaking, the South Melbourne Gas Company, was incorporated by Act of Parliament in 1872. No limits to the area of supply had been set by Parliament for the City of Melbourne Gas and Coke Company, but the subsequent Acts relating to the Collingwood, Fitzroy and District Gas and Coke Company, and the South Melbourne Gas Company, were specific on this point. However, Parliament did not grant monopoly rights and the areas of the three companies overlapped. This led to the directors of the three companies negotiating for an amalgamation; in 1877 an agreement merging the three companies was ratified, and in 1878 the *Metropolitan Gas Company's Act* 1878 came into operation. This Act authorised the Metropolitan Gas Company to supply gas within a circle of radius of 8 miles from the Melbourne General Post Office, but excluded the municipal districts of Brighton, Footscray, and Williamstown where other gas works were operating. The Metropolitan Gas Company continued to function as a separate entity until the end of 1950 when it was incorporated into the newly formed Gas and Fuel Corporation of Victoria.

The first Brighton Gas Company Limited was formed in 1877 and before the end of the year it had commenced supplying the first gas lights in the district. In 1887 the Company merged with the Central Brighton and Moorabbin Gas Company Limited, which had been established in 1885, to form the second Brighton Gas Company Limited. The Company continued to function as a separate entity supplying gas in the Brighton–Moorabbin–Chelsea area until the end of 1950, when it was acquired by the Gas and Fuel Corporation of Victoria.

The Colonial Gas Association Limited was incorporated in England in 1888. The first works acquired or established by the Association were at Benalla, Maldon, Seymour, Shepparton, Wangaratta, and Warragul. At the time, Maldon was a prosperous mining town of some 3,000 people and the Maldon undertaking was the most important of the first six undertakings in which the Association acquired an interest. The Association's Box Hill Works was erected in 1890 when Box Hill was still separated from Hawthorn, Kew, and Camberwell by a large expanse of open country.

The Association subsequently acquired a number of undertakings in the eastern and western suburbs of Melbourne, progressively consolidating its position as a significant contributor to the Melbourne metropolitan gas supply system. The Oakleigh Gas Company Limited and the Footscray Gas and Coke Company Limited were both acquired in 1914, the Frankston District Gas and Electric Company Limited in 1923, and the Williamstown Gas Company's undertaking in 1924. During 1926 the small undertaking of the Dandenong Shire Gas and Coke Company Limited was purchased.

At the same time as the Association was consolidating its position in the Melbourne metropolitan area, it continued to expand in the country areas of the State. The Bairnsdale Gas Company Limited was acquired during 1901 and the Horsham United Gas Company Limited in 1913. The Colonial Gas Association now operates gas undertakings in Victoria whilst its holding company (Colonial Gas Holdings Limited) owns and operates undertakings in New South Wales and South Australia.

The Gas Supply Company Limited was incorporated in Victoria in 1926 and at that time operated gas works at Warracknabeal, Ararat, Stawell, and Bacchus Marsh. Between 1926 and 1958 The Gas Supply Company Limited acquired, either from local government or from private ownership, other country undertakings at Ballarat, Colac, Hamilton, Portland, Queenscliff, Sale, and Warrnambool. In 1946 the Company supplied gas to Wodonga by high pressure gas pipeline from Albury, N.S.W. This was discontinued in 1964 when tempered liquid petroleum facilities were installed at Wodonga. In 1953 high pressure gas was supplied to Point Lonsdale from Queenscliff. In 1963 Bitumen and Oil Refineries (Australia) Limited (Boral) acquired the share capital of The Gas Supply Company. In 1970 this company sold its assets in Victoria to the Gas and Fuel Corporation.

The Gas and Fuel Corporation of Victoria is a public authority of the State. It came into being by Act of Parliament in 1950, its formation being a merger of interests of the The Metropolitan Gas Company, The Brighton Gas Company, and the State Government. The Corporation is the largest gas undertaking in the Commonwealth and its duties include encouraging and promoting the use of gas, and advising the Government of means to secure a safe, economical, and effective supply of gas in Victoria. The Corporation has acquired the gas undertakings in Bendigo, Castlemaine, Dandenong, Frankston, Kyneton, Maryborough, Mordialloc, Traralgon, Warragul, and Sale, and has extended its system to supply gas to Maffra, Morwell, and Trafalgar.

The present gas industry in Victoria provides a reticulated gas service for the Melbourne metropolitan area and to some twenty-six communities in country areas throughout the State. Gas undertakings are operated by three companies, the Gas and Fuel Corporation of Victoria, the Colonial

Gas Association Limited, and The Geelong Gas Company. The Gas and Fuel Corporation supplies 84 per cent of all gas sold in the State, The Colonial Gas Association 13 per cent, and The Geelong Gas Company 3 per cent. Eighty per cent of all gas sold is consumed in the Melbourne metropolitan area.

Manufacture

For over seventy years the technical development of the gas industry in Victoria was modelled on English practice with some modifications to suit local conditions. Gas was produced by the carbonisation of bituminous coal in a process similar to that originally developed by Murdoch, and developments were primarily associated with the improvement of retort design and the introduction of mechanical handling. In the early years of the industry the hand-stoked horizontal retort with direct fired furnace was used in all works. As output increased, the larger works introduced stoking machinery. Inclined retorts first made their appearance early in this century and these were followed by vertical retorts of the intermittent type. The introduction of continuous vertical retorts between 1916 and 1922 was a major development which set the pattern of gas making in the State for many years. In 1929 automatic water gas plants were introduced to balance coke production and increase the yield of gaseous products per ton of coal. These processes continued to provide the bulk of the gas produced in Victoria until the 1950s.

Victoria has no reserves of coking coal suitable for gas making. In the early 1930s investigation of the possible use of large reserves of brown coal in the La Trobe valley for town gas production began in the laboratories of the Metropolitan Gas Company. This work led in 1956 to the commissioning of the Gas and Fuel Corporation's Lurgi Pressure Gasification Plant at Morwell, the first plant of its type constructed outside eastern Europe for town gas production from brown coal briquettes. In the post-war years changes in the policies of the petroleum industry led to large quantities of relatively low cost liquid petroleum products and refinery tail gases becoming available to the industry as raw materials. The Gas and Fuel Corporation purchased large quantities of these gases of variable quality, and production methods were varied to enable these to be mixed with coal gas and water gas from existing equipment to produce a blended town gas with constant combustion characteristics. In 1961 The Geelong Gas Company installed an Onia-Gegi catalytic reforming plant specifically designed to produce town gas from refinery tail gases and in the following year a similar plant was commissioned by the Gas and Fuel Corporation. In the same year the Corporation commissioned its refrigerated liquefied petroleum gas storage plant at Derrimut. In country areas, the availability of liquefied petroleum gas led to the progressive closing down of coal-gas plants and the introduction of tempered liquefied petroleum gas plants in their stead.

Between 1945 and 1968 the gas industry in Victoria expanded considerably. The number of customers (represented by meters) increased from 349,698 to 553,106, but more importantly, gas manufacture rose from 53,613,000 therms to 141,144,000. During these years feedstock patterns changed. In 1945, 607,233 tons of black coal were used in the manufacture of town gas. By 1955 this had increased to 676,045 tons but by 1968 had

decreased to 183,756 tons. The use of brown coal and briquettes by the Gas and Fuel Corporation commenced in 1955, reached a peak of 207,114 tons in 1968, and following the introduction of natural gas had ceased completely by the end of 1969. Gas-making oil and refinery gases were used by the Gas and Fuel Corporation, commencing in the early 1950s, and had assumed significant proportions by 1968, comprising over one third of all feedstocks used. By 1971 only liquefied petroleum gas and a small quantity of black coal were being used as feedstocks in gas-making plants in country areas. Various gas-making plants closed down between 1969 and 1971. The Lurgi plant at Morwell closed in November 1969, Highett in August 1969, Box Hill in October 1969, Footscray in March 1970, and West Melbourne in December 1970. The last of Victoria's large plants, the one at Geelong, closed in August 1971.

Distribution and utilisation

In the early years of the industry gas was generally distributed at pressures of the order of 4 to 8 inches water gauge. Medium pressure distribution (5–20 psig) was first introduced by the Brighton Gas Company in 1913, but its use was not widespread until the 1920s. The first high pressure gas distribution system (20–65 psig) was introduced by The Gas Supply Company at Wodonga in 1946. Since this time there has been a considerable expansion in high pressure direct distribution, enabling the industry to provide gas where supply would otherwise have been uneconomic.

Major production changes necessitated major changes in gas distribution techniques. In 1956 Australia's first high pressure gas transmission pipeline, the 80 mile, 18 inch diameter pipeline from Morwell to Dandenong, was completed by the Gas and Fuel Corporation. This pipeline was designed for pressures up to 500 psig. At the same time high pressure gas distribution trunk mains, operating at pressures of 100–150 psig, were laid in the metropolitan area. With the advent of natural gas, transmission pipelines designed to operate at pressures up to 1,000 psig and distribution trunk mains designed to operate at pressures up to 400 psig have been constructed. Initial distribution systems had been constructed using cast or wrought iron mains. From the 1920s increasing use was made of steel mains and services, and initial test areas using plastic distribution pipework have been installed in several locations in recent years.

Distribution of dry gas was first carried out by the Metropolitan Gas Company, which commissioned the State's first gas dehydration plant at its West Melbourne works in 1933. Due to the construction of further gas dehydration plants, associated with the use of new gas making processes and finally the introduction of natural gas, dry gas constitutes the major proportion of gas now distributed in Victoria.

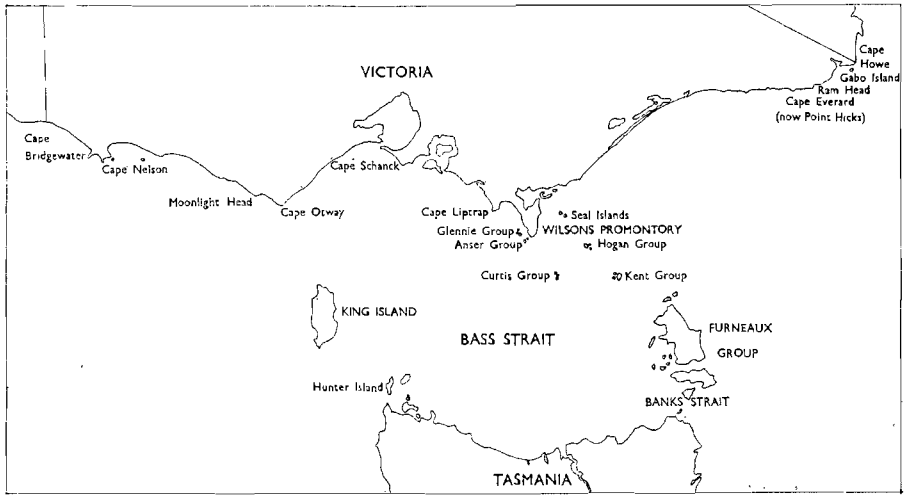
In the early days of the industry the gas produced was used almost exclusively for lighting. Gas cooking began to develop in the 1880s, and gas radiators, the forerunners of modern gas heating systems, were first sold in Melbourne in the 1870s. Modern automatic gas appliances are now available to meet the needs of the domestic and commercial cooking, water heating, and spaceheating markets, and a wide range of specialised gas fired equipment is also used in industry. The introduction in 1969, and the distribution of natural gas, which now comprises about 95 per cent of the gas reticulated in Victoria, is described on pages 164 to 170.

7

TRANSPORT AND COMMUNICATIONS

NAVIGATION ON THE VICTORIAN COAST

When permanent settlements were founded in the Port Phillip District in 1834 and 1835, charts of the adjacent waters, based on information recorded by naval ships during the preceding forty years, were available. In 1836 H.M.S. *Rattlesnake* examined the channels inside Port Phillip, buoying the West Channel and completing three charts, and on several occasions from 1837 to 1843 H.M.S. *Beagle* was surveying in Bass Strait. During 1839, of the 195 ships which arrived in the District, nine ocean going craft with an average tonnage of 436 came from Great Britain. The masters of such ships made a practice of verifying their calculated position by steering for and identifying some salient feature on the coast. In Bass Strait such features, though few, are



Salient navigational features of Bass Strait. *J. K. Crone*

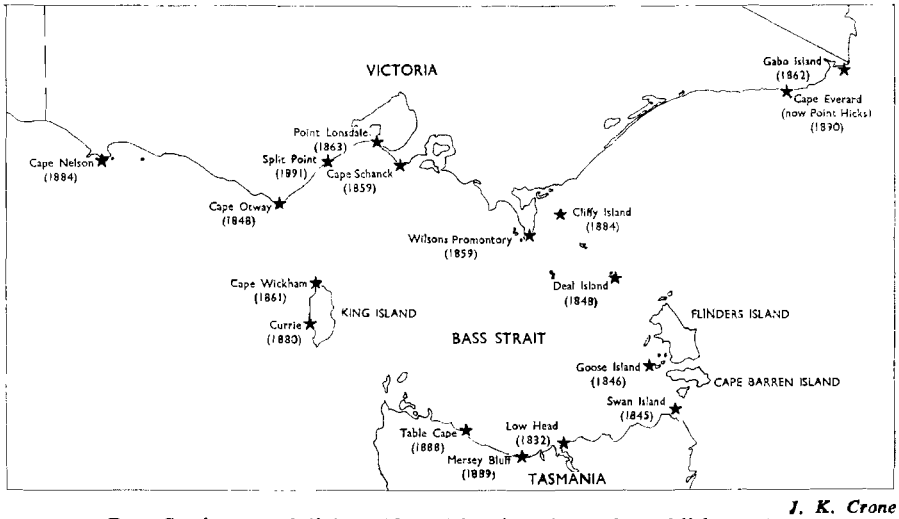
well placed, but lighthouses were desirable for identification. In 1840 a primitive lighthouse was erected on Point Gellibrand at Williamstown; two years later another was established on Shortlands Bluff at Queenscliff, to lead ships between Port Phillip Heads. In 1845 a committee appointed by the Legislative Council recommended that lights should be placed on King Island, Cape Otway, the Kent Group, and Cape Howe; in 1848 lights were established on Cape Otway and on Deal Island; and in 1853 a temporary

light was set up on Gabo Island. In the same year R. L. J. Ellery, stationed at Williamstown, commenced determining accurate local mean time. A time ball dropped daily from a flagstaff on Point Gellibrand enabled ships' chronometers to be checked. Subsequently the time ball was erected on a disused lighthouse tower and continued to operate for more than sixty years. In 1857 a second observatory was opened on Flagstaff Hill in Melbourne, to analyse weather reports from land stations and data of ocean currents and winds extracted from ships' logbooks, and to determine the components of the earth's magnetic field. Magnetic data for Melbourne were published in 1860, meteorological and nautical data in 1864, and the results of a magnetic survey of the Colony followed in 1869. In 1863 the two observatories were closed and their work transferred to the new Domain Observatory in Melbourne. Meanwhile, the survey of Bass Strait had been continued by H.M.S. *Herald* in 1853 and 1857.

The discovery of gold in 1851 caused a remarkable increase in the number of ships entering Victoria from overseas ; in particular those from Great Britain increased sixfold between 1851 and 1853. In 1855 arrivals declined sharply, though the population continued to increase. The development of the Western District, initially through Portland, was extended by the proclamation of ports of entry and clearance at Port Fairy in 1850 and Warrnambool in 1854. In 1860, besides numerous schooners and brigs, two auxiliary steamships were maintaining a twice weekly service to and from Melbourne ; in 1870 two steamers of 300 tons were in that trade, and in 1871 S.S. *Dandenong,* 1,000 tons, initiated a weekly service. Similarly, Port Albert, founded in 1841 and proclaimed a port of entry and clearance in 1850, was the outlet for the whole of Gippsland, and later became the port supplying the gold miners at Walhalla. More steamers were traversing Bass Strait, and their masters were ceasing to maintain a cautious distance off shore and were setting courses as direct as possible from point to point. Closer navigation demanded additional lighthouses and more detailed charts. In 1862 New South Wales established a permanent light on Gabo Island. Following recommendations by intercolonial committees in 1853 and 1873, additional seaward lights were established by Victoria on Wilsons Promontory and Cape Schanck in 1859, Point Lonsdale in 1863, Cape Nelson and Cliffy Island in 1884, Cape Everard* in 1890, and Split Point in 1891, and by Tasmania on King Island at Cape Wickham in 1861 and Currie in 1880, as well as two on the Tasmanian coast. Meanwhile, a survey of the coast and inshore waters was begun in 1865 by the *Victoria* and *Pharos* and continued annually until 1872 when the entire Victorian coast had been surveyed. Thereafter *Victoria* surveyed the offshore waters in Bass Strait, the coast of King Island, and Banks Strait until 1878 when the survey of Victorian waters was terminated. During 1886 and 1887 H.M.S. *Myrmidon* surveyed the waters from Cape Liptrap to the Hogan Isles; thereafter no major survey was made in Victorian waters until the 1950s.

When the Colony of Victoria was proclaimed in 1851 the need for marine legislation was urgent. The *Steam Navigation Act* 1853 created the Steam Navigation Board, instituted the survey of ships, the examination of officers,

* Renamed Point Hicks in April 1970 on the occasion of the bi-centenary of the landfall of Captain Cook.



J. K. Crone

Bass Strait coastal lights, 1892 (showing date of establishment).

the granting of certificates, and the enforcement of steering and sailing rules; the *Ports, Harbors, and Shipping Act* 1854 created the Pilot Board; the *Passengers, Harbors, and Navigation Act* 1865 consolidated these two Acts and introduced many provisions agreed to at the 1863 Intercolonial Conference ; and by the *Marine Act* 1890 the Steam Navigation Board and Pilot Board were abolished and their functions transferred to the Marine Board of Victoria. With the proclamation of the Commonwealth *Navigation Act* 1912, much of the jurisdiction conferred by the Marine Act, particularly that relating to overseas and interstate ships, passed to the Commonwealth.

Following an investigation of the adequacy of all seaward lights throughout the Commonwealth, unattended acetylene-operated lights were established in 1913 on Citadel Island in the Glennie Group and on Cape Liptrap. In 1915 the Commonwealth assumed responsibility for all seaward lights ; conversion to unattended acetylene lighting was effected at Cape Wickham (King Island) in 1918, and at Split Point in 1919 ; electric illumination was provided at Cape Nelson in 1933, Gabo Island in 1935, Deal Island in 1937, Cape Schanck in 1940, Cape Wickham in 1946, and Cape Everard in 1964; and in 1965 an unattended electrically operated light was established on Hogan Island.

The use of wireless telegraphy for ship to shore communication in Bass Strait began in 1912 when the first coast radio station was opened in Melbourne. By the end of 1916 additional stations had been opened at Mount Gambier, Flinders Island, and King Island. In 1921 all ships over 1,600 tons and all passenger ships, registered in Australia and engaged in the foreign and interstate trade, were required to carry a radio and an operator ; in addition to receiving and transmitting distress messages such ships were thereby able to receive weather forecasts, danger messages, and time signals. In 1923 the establishment of radio telephone broadcasting stations and the issue of licences for broadcast receivers enabled small ships not carrying radio operators to receive similar messages. The radio time signals proved

more accurate and convenient than the Williamstown time ball signals, and the latter were discontinued some years later.

Between 1920 and 1946 the development of the gyro-compass and gyro-pilot, electric log, direction-finding apparatus (D/F), echo sounder, and radar made possible greater precision in navigation. From 1938 to 1941 radio beacons were established at Cape Otway, Cape Wickham, and Cape Schanck to enable ships fitted with D/F to plot their positions when in the north-western part of Bass Strait in fog or out of sight of land. In 1964 a radio beacon was established on Gabo Island. But the existing charts lacked the detail needed to take advantage of the precision of the new equipment. In the winter of 1948 H.M.A.S. *Warrego* surveyed Western Port and its approaches. During the summers from 1953 to 1955 H.M.A.S. *Warrego* and H.M.A.S. *Barcoo* surveyed the waters from Moonlight Head to Wilsons Promontory and from Cape Everard to Cape Howe, and studied the tidal streams and currents. In the summer of 1961 H.M.A.S. *Bass* surveyed the waters from Cape Bridgewater to Warrnambool and the approaches to Portland. During the spring of 1970 H.M.A.S. *Moresby* was surveying off Wilsons Promontory. In the period 1956 to 1969 the R.A.N. Hydrographic Branch published four new charts based on the surveys, and two provisional charts of the waters west of Moonlight Head which had not been adequately surveyed.

COASTAL SHIPPING

Following the arrival of Henty in the schooner *Thistle* at Portland in 1834 and Batman and Fawkner in the schooners *Rebecca* and *Enterprise* at Melbourne in 1835, settlers quickly reached these areas and, in the absence of roads, sea transport was essential in and between the settlements. Steamships were few, and coastal transport consisted of increasing numbers of small sailing vessels—schooners, ketches, and cutters. In Port Phillip Bay the schooner *Lapwing* in 1838 left Melbourne every tenth day for Geelong, and two years later eight more small sailing craft were in the Melbourne–Geelong service.

Despite the rapid growth and spread of speedier land transport in the next hundred years, the size of Port Phillip Bay for many decades encouraged the regular use of ships more than along other coastal areas of the State ; this may also have been partly because of the relative cheapness of water transport. Several shipping companies carried on passenger and general cargo traffic with Geelong until 1938 when the *Edina,* built in 1854 and first used for transport duty in the Crimean War, retired because of economic conditions. In 1883 the *Edina* provided the cheapest trip in the Melbourne–Geelong trade, with the fare at 1s saloon and 6d steerage each way. Its best known captain, W. C. Forbes, commanded it for 40 years from 1880 to 1920 and claimed to have made 12,000 trips in it to Geelong. Other well-known steamers in this trade were the *Aphrasia, Vesta, Express, Despatch, Alert, Excelsior* and the larger excursion steamers, *Courier* and *Coogee,* both of which were withdrawn from service in 1927 when the Geelong bay trade began to decline.

Other Port Phillip seaside resorts (Queenscliff, Portsea, Sorrento, Dromana, and Mornington) were served first by small tugs and later by screw and paddle steamers. Amongst these in early days were the *Mystery, Williams, Golden Crown,* and *Lonsdale.* In 1886 came the first of the three

larger paddle steamers specially built for the excursion trade, the *Ozone,* followed by the *Hygeia* in 1890 and in 1910 by the largest, the *Weeroona* of 1,412 tons, which carried hundreds of passengers. These three popular steamers catered for " trips down the Bay " until 1939 ; during the Second World War the *Weeroona* was used as a convalescent ship in New Guinea, and after the war was broken up in Sydney. A " mosquito fleet " of dozens of picturesque light draught schooners and ketches plied around the Bay during the second half of the nineteenth century, and even until the 1920s. Later equipped with crude oil engines, they brought she-oak and tea-tree firewood from Mornington, Dromana, and Rye, lime from Sorrento and Portsea, and shell grit from Portarlington and around Corio Bay for the glass bottle works at Newport. One such small craft was the topsail schooner *Aquila,* which freighted wool from Geelong to Williamstown.

Along the western coast of Victoria small sailing ships and steamers carrying general cargo and passengers traded regularly from early years to Warrnambool, Belfast (Port Fairy), and Portland. Stephen Henty had the *Edina* and Howard Smith and Co. had the *Derwent* on this run for some years, but most of this fleet was owned by the Belfast and Koroit Steam Navigation Co. which carried Western District produce for the Melbourne market. From 1849 onwards many schooners and ketches had called at other smaller ports, particularly at Lorne from where timber splitters in the Otway forest shipped some wood to Melbourne and Geelong for the building industry. Much other minor coastal trading was carried on in different settlements at varying times ; for example, a schooner traded in ochre at Point Addis near Anglesea during the First World War. Ships whose names became well known along this coast were *Western* (which mainly carried dairy produce), *Cape Otway, Julia Percy, Nelson,* and *Dawn* (which carried dairy produce, pigs, and sheep). The best-known of this fleet was the *Casino* of 425 tons which called at Port Campbell when weather and tides permitted, and also called regularly at Apollo Bay, where it was at times the only link with the outside world, carrying wool, meat, butter, and other essential items ; it was in this bay in 1932 (on the fiftieth year of its running on the Victorian coast) that it foundered in a gale with the loss of more than half its crew. At this time railway and motor vehicle competition was becoming too much for the coastal trade, and within two years the remaining steamers on this run were withdrawn.

Coastal shipping to the east of Melbourne centred mainly on the Gippsland lakes, particularly after the new entrance to the lakes had been opened in 1890 enabling steamers to enter these inland waterways. Before that time schooners and ketches had been the principal means of transport, transferring their cargoes from Melbourne to the small steamers which plied inside the lakes and on the Mitchell and Tambo Rivers. The last five of the twelve passenger steamers which traded on the lakes survived from 1880 until the 1930s, when motor transport forced the end of the lake and river traffic ; gradually these steamers were broken up or used as barges. Two of the five, the *Omeo* and the *Dargo,* ran from Sale to Lakes Entrance ; two others, the *J.C.D.* and the *Gippsland,* plied between Bairnsdale and Lakes Entrance. These four steamers carried large cargoes of fish for railing from Bairnsdale and Sale to the Melbourne fish market. The fifth steamer, *Tanjil 2,* ran from Bairnsdale to Bruthen on the Tambo River, carrying Melbourne cargoes

transferred from the *Despatch* for the gold mines in the Tambo valley, and returning to the *Despatch* with quartz from the mines, maize, wool, hops, and other produce to Melbourne. The *Tanjil 2* also ran a small seasonal trade to Marlo, carrying maize from the rich Snowy River flats. The *Despatch* was the best-known east Victorian coaster from the 1870s until 1911 when it sank without loss of life after striking the pier at Lakes Entrance. Other ports of call on this coast were Waratah Bay where ships picked up lime, and Port Albert where goods and materials were landed for the gold mines at Walhalla.

Western Port trade was small, operated in the early years by schooners and ketches such as the *Swan, Vision,* and *John and Elizabeth* carrying general cargo and local produce to and from Phillip and French Islands. Most of the trade eventually went to the owners of steamers which began a regular ferry service from Hastings and Stony Point via Corinella and San Remo to Cowes on Phillip Island. From the *Eva* in 1858 more than a dozen steamers have ferried cargo and passengers in Western Port until the present day. The most famous of these was probably the *Genista* which brought into being the Phillip Island and Westernport Shipping Co. ; others have been the *Alvina, Narrabeen, Killara, Reliance,* and at the present day, the *Eagle Star.*

MELBOURNE HARBOR TRUST

Although ships brought passengers and cargo to Melbourne when the first settlement was established on the Yarra River in 1835, the Port of Melbourne was not established until 1876 when the Melbourne Harbor Trust Commissioners were constituted as the port authority under the Melbourne Harbor Trust Act. The Act came into force on 1 January 1877.

A demand for improved facilities for ships had been made as early as 1843, when the Melbourne Town Council called for a survey of the Yarra, as sand bars obstructed the passage of heavily laden ships which brought supplies to the growing population, then already numbering 24,000. In 1852 the Melbourne City Council and the Chamber of Commerce attempted to establish a harbour trust but their plans were unsuccessful, and in 1859 a Select Committee of Parliament appointed to consider the institution of a river and harbour authority reported that a harbour trust or some similar body was required to carry out the necessary harbour works adequately. In 1860 a Royal Commission was appointed to make an exhaustive inquiry into the question of accommodation in Hobsons Bay and along the river, and its comprehensive report favoured the establishment of a harbour trust : a second Royal Commission made a similar recommendation in 1872. In 1875 a joint committee of the Chamber of Commerce and the Underwriters Association submitted a report to the Commissioner of Trade and Customs, accompanied by a draft Bill to constitute a Board for the " Management and Improvement of the Port of Melbourne and for the Conservancy of Rivers ". A year later an Act establishing the Melbourne Harbor Trust was passed. Under this Act fifteen commissioners were to comprise the corporate body established and named the Melbourne Harbor Trust. Twelve commissioners were to be appointed by the municipalities, owners of ships, and merchants and traders in the municipalities, and three by the Governor in Council. The number of commissioners was increased to seventeen in 1883.

An English engineer, Sir John Coode, was engaged to prepare a

comprehensive scheme of harbour improvement; his report was presented in 1879 and was adopted with modifications. The existing course of the Yarra was to be largely maintained, although a cutting was planned to avoid Fishermens Bend, so providing an access route which was shorter by one mile to berths near the city; a dock system was to be constructed on the West Melbourne swamp behind the gas works, with a complete system of railway connection; and parts of the river were to be deepened. Work started on the cutting in 1884 and the channel, known as Coode Canal, was officially opened in 1887. It was 2,000 ft long, 300 ft wide, and 25 ft deep. Work on Coode's plans for Victoria Dock on the West Melbourne swamp was begun in 1887, and in 1892 water was let into the 96 acre basin. In 1893 the first ship entered the dock, which was to become Melbourne's principal import and export terminal. Despite Sir John Coode's opinion that masonry and concrete construction should be used for the Victoria Dock wharves, timber piling was adopted at the suggestion of Joseph Brady, engineer to the Commission, because of the speed with which wharves could be constructed, the nature of the ground, the large supply of fine hardwoods, and the comparative economy. These original timber foundations were used nearly eighty years later when Victoria Dock was deepened and berths were reconstructed to suit modern cargo handling requirements calling for heavy load carrying wharf aprons.

When the new Harbor Trust was established a number of wharves and jetties which the Government had built were handed over to the commissioners, and the value of these facilities was then estimated at £250,000. Much of the revenue of wharfage and tonnage rates received by the Government had been spent in dredging the river, which had had a depth of 10½ ft in 1856 and 14½ ft in 1876. The Act of Incorporation provided that the new Trust should pay the Government one fifth of its revenue every year as repayment for the property, and this charge, varied and amended from time to time, is now calculated at 20 per cent of the revenue gained from import wharfage and tonnage. Apart from this statutory payment to the Government the commissioners have always been financially independent and are responsible for their own revenue and the raising of loans for capital works. The commissioners' loan liability determined by the State Parliament varies, and in 1971 their maximum loan liability stood at $50m.

To meet increased trade and the demand of shipping, port facilities developed gradually along both sides of the river and in Hobsons Bay. The port has developed much as envisaged by the commissioners as early as 1884, with the exception of Webb Dock at the river entrance, and the cutting of Swanson Dock in the land cut off by Coode Canal. The Appleton Dock system was first proposed in 1914, and although some work started in 1926, it was not completed until 1956.

In 1913 the Act was amended to reduce the number of commissioners from seventeen to five. These comprised a permanent chairman and four part-time commissioners who, under the terms of the Act, were required to have special and separate qualifications : one was to be a shipowner, one an exporter, one an importer, and one was to be associated with primary producers. All five commissioners were to be appointed and not elected members. In 1954 a sixth commissioner, associated with the interests of

labour, was appointed. Until 1972 there had only been four chairmen of the Melbourne Harbor Trust since 1913, the year in which all wharves, piers, and jetties within the Port finally came under the authority of the Melbourne Harbor Trust Commissioners. Until then, the commissioners had not been responsible for the railway piers at either Port Melbourne or Williamstown.

During the 1960s a major reconstruction and modernisation of port facilities took place, the river was widened and deepened, and many projects were finally completed. With the introduction of major changes in shipping and cargo handling techniques (especially container and roll-on, roll-off facilities), berth utilisation and the handling of cargo reached new peaks. The port now handles annual cargo tonnages of about 16 million tons.

GEELONG HARBOR TRUST

Although port facilities have existed in Geelong's inner harbour since the early 1840s, the " bar " at the entrance prevented the larger commercial vessels entering to load wheat or wool unless they were towed into the inner harbour. It was not until 1893 when the Hopetoun Channel, with a low water depth of 23 ft and a navigable width of 130 ft, was opened that development became possible. Progress continued to be slow due mainly to the Colony's economic depression, but also to the fact that Melbourne far outranked Geelong as a port. Geelong was granted an autonomous Harbor Trust in 1905.

Despite the lack of finance until the late 1930s the commissioners pursued a continuing policy of port development, and in 1939 the Hopetoun Channel with a width of 300 ft had a dredged depth of 29 ft at low water. Trade development was assisted by the establishment of the Ford Motor Company near the port in 1925 and the International Harvester Company in 1938 ; two major superphosphate works were also set up nearby. After reorganisation of the Trust in 1933 large revenue deficits were written off and extraneous non-shipping activities were gradually reduced. The Grain Elevators Board built its Geelong terminal in 1936 on land vested in the Trust. The terminal, through which most of Victoria's export wheat passes, has a storage capacity of 30 million bushels.

After the Second World War the commissioners implemented a port development plan. Development was assisted by large capital grants from the Victorian Government, and an assured wharfage revenue on oil refinery imports which began in 1953. Although amended according to shipping trends, this plan is now complete and since 1971 the port has had twenty-one modern berths and a low water depth of 36 ft in its 17 miles of approach channels and at berths requiring deep water. To keep pace with the ever increasing need for deeper water, it was necessary to engage a contractor almost continuously from 1952 to 1968 to dredge approach channels from 29 to 36 ft and to widen them from 300 to 400 ft. Berths were also deepened as required.

The Port of Geelong now handles annual cargo tonnages of about 8.5 million tons with a fleet of modern tugs and mechanical equipment.

PORTLAND HARBOR TRUST

Portland is situated on the south-western coast of Victoria and is within a few miles of the main overseas and interstate shipping lanes. Natural deep

water approaches provide access to the entrance of the 250 acre harbour basin which offers depths of 36 ft at low water. With the inception of the Portland Harbor Trust in 1950 three local commissioners were appointed to take over the control and management of the port. The Board of Commissioners is a corporate body appointed on a part-time basis, and represents those concerned with port activities. Since 1950, when about 58,000 tons of cargo were handled, there has been a considerable increase in the volume of Portland's shipping; in 1970–71 over 842,000 tons of cargo were handled.

Nearly $12m was spent between 1950 and 1960 on the construction of the first stage of harbour development. Since this was completed in November 1960, expenditure on construction works has almost doubled to serve the requirements of shipping, cargo handling, and trade. These works include a modern tanker berth, the erection of a 2 million bushel bulk grain terminal, a 4 million bushel horizontal wheat store, two additional transit sheds and cold storage facilities, the construction of a new bulk cargo berth as the first stage of development of a second quay, and the reclamation of a substantial acreage of industrial land adjacent to the main shipping berths to meet the demands of secondary industry. Work to provide a minimum depth of 40 ft of water for bulk grain vessels alongside No. 1 berth is planned to be completed by the end of 1973. The Trust's tug fleet of one small and one medium sized vessel was enlarged in 1969 by the addition of a new 1,600 hp seagoing tug fitted with the latest fire-fighting equipment.

WESTERN PORT

In 1839, four years after the establishment of the Port Phillip settlement by John Batman, Lieutenant-Colonel John McHaffie was granted a pre-emptive right over what was known as the Phillip Island " run ". Development continued with the acquisition of land. Sheep farming was the principal industry, supplemented by agriculture, timber milling, oyster harvesting, fishing, and the coal trade from San Remo. The island was also a tourist resort. To service this area many small schooners and ketches traded between Melbourne and several places on the foreshore of Western Port, while a regular ferry service began between Phillip Island and Stony Point in 1868.

The Royal Australian Navy first became associated with the port in 1911 after the tabling of the Henderson Report, and on 12 February 1912 the construction of new naval buildings at Western Port began. Additional buildings were constructed in succeeding years, and in September 1920 the naval base was officially opened as H.M.A.S. *Cerberus*. In 1921 the base became the main training establishment for the Royal Australian Navy.

The first attempt to establish Western Port as a worthwhile commercial shipping terminal was made in 1932, when the *Vincas*, an oil tanker of 4,653 tons loaded with a cargo of motor spirit, anchored off Stony Point. The *Vincas* remained at anchor for three years while unloading its cargo, which was floated ashore in 66 gallon drums whenever markets became available. No further development took place until 1963. In that year the Victorian Government enacted the *Westernport (Oil Refinery) Act* 1963 to permit the establishment of the BP refinery on the bay's western shore. The Act also authorised the construction at a cost of $7m of State-owned port facilities

and harbour services for use by the company. These facilities comprised a two berth marine terminal of steel and reinforced concrete construction at Crib Point, with the main and secondary berths designed for tankers up to 100,000 and 40,000 tons d.w., respectively. The terminal is served by a 13 mile long buoyed channel with minimum widths of 1,300 ft in the undredged and 600 ft in the dredged sections. Depths provided are 49 ft and 47 ft below chart datum in the channels and the 2,000 ft diameter swinging circle, with 52 ft and 42 ft, respectively, alongside the two berths. Harbour services provided include two fire-fighting tugs with bollard pulls of 23 tons, mooring services, and a port office and depot ; this stage was commissioned in July 1966.

The *Westernport Development Act* 1967 enabled the Esso/B.H.P. fractionation plant and crude oil storage facility to be established at Long Island Point some 2 miles north of Hastings, in the second stage of development. It also authorised State expenditure of $3.5m to build a single berth marine terminal for the export of liquid petroleum gas and crude oil from the Bass Strait fields. The steel and reinforced concrete terminal was designed for 100,000 tons d.w. tankers, but the channel depths in the 800 ft wide channel from Crib Point and the 1,900 ft diameter swinging circle were limited to 42 ft at first, for a tanker size of 40,000 tons d.w. When additional drilling by Esso/B.H.P. in Bass Strait indicated that large reserves of crude oil had been discovered and proved in addition to natural gas, the jetty design was amended and channel depths increased to 47 ft to allow 100,000 tons d.w. tankers to use the facilities immediately on completion. The *Westernport Development Act* 1970 increased the financial limit to $6.05m for the additional works, and also permitted Esso/B.H.P. to use the Crib Point terminal to enable additional loading facilities to be used with any increased rate of shipping. The Long Island Point terminal was commissioned in March 1970.

The third stage of development of this region was authorised by the *Western Port (Steel Works) Act* 1970 which provided for the establishment by John Lysaght (Australia) Ltd of a fully integrated iron and steel works on some 2,000 acres of land at Tyabb ; it provided for wharf construction and ownership by the company, with dredging to be done by the State. The company in 1972 completed the wharf to serve the first stage of the works (cold reduction facilities) and the State has also completed the channel extension and swinging circle to serve this berth at a cost of approximately $1.6m.

The existence of large energy sources in Bass Strait as well as the depths available in the port and the markets near large centres of population could indicate the further large scale development of the port and industrial complex. Several major enterprises already hold large areas in the port, foreshadowing further development. The port traffic has increased from some seventy-seven tankers carrying 1,066,000 tons of petroleum products during 1966–67 to 118 tankers handling 3,046,000 tons of petroleum products in April, May, and June 1971.

In addition to providing the port facilities the Public Works Department, pending the proclamation of all the provisions of the *Environment Protection Act* 1970, controlled the standard of industrial effluent discharge, and high standards were set requiring extensive treatment facilities by the companies.

PORT PHILLIP PILOTS

Licensed pilots have been available at Port Phillip Heads since 1839 when merchants petitioned Governor Gipps to grant a licence to George Tobin, "a seaman and shipmaster for nearly twenty years". Tobin's licence was dated 24 June 1839, and he was allowed to charge the same rates as Sydney pilots. By 1841 six pilots were licensed and the cutter *Ranger* was sent to assist them, the Government claiming one sixth of the pilotage dues to maintain her. However, whaleboats from Shortlands Bluff were still used to board incoming ships, and in rough weather they led the ships through the Heads.

Tidal streams through the 1¾ mile wide entrance into Port Phillip Bay have scoured the limestone rock into a deep chasm around Point Nepean, the eastern headland. Ships approaching too closely, without local knowledge, often foundered on the reefs bordering both shores, and it became necessary for a pilot cruising station to be established well offshore. On 9 January 1853, therefore, the brigantine *Boomerang* established the continuous offshore cruising station which has since been maintained. The cutter-yacht *Corsair* relieved the *Boomerang* soon afterwards, and the pilot schooner *Anonyma* joined the *Corsair*. Pilots were put on a salary and the service was taken over by the Government.

The gold rushes brought many more ships to Port Phillip. By 1854 fifty-six pilots were on the payroll and the schooners *Empire* and *Pacific* were assisting the three pilot ships. These extra ships resulted in a rise in pilotage rates and the Pilot Board was established to administer the service. The pilots were invited to buy the three pilot ships, form themselves into companies, and take over the service on a co-operative basis. Each pilot received his individual earnings, with proportionate deductions to pay for the establishment. Vacancies in the service were advertised in the *Government Gazette* and the best qualified shipmasters to apply were licensed by the Pilot Board under a bond of £100. While one of the ships cruised 20 miles offshore to supply pilots to incoming ships, another was stationed just outside the Heads to disembark outward bound pilots. The third ship was anchored inside and the three changed stations as the supply of pilots demanded.

In 1857, when 2,190 ships entered the Heads, there were fifty-three pilots. One was in charge of each pilot ship with an apprentice pilot as chief officer. On 2 October 1859 the *Anonyma* was wrecked westwards of Point Lonsdale without loss of life. A sister ship to the *America* of yachting fame was built for the Port Phillip Pilots at a cost of £4,000; it was named the *Rip,* and was commissioned on 2 June 1860. Thirteen years later it was dismasted off Point Nepean while beating seawards on the ebb tide against a south-westerly gale. One pilot and three seamen were drowned but the schooner proved its capabilities by struggling back to the anchorage, waterlogged and badly damaged. Soon afterwards the *Corsair* was wrecked under similar circumstances, but without loss of life. The *Rip* was repaired and recommissioned, and the yacht *Mavis* was brought out from England to replace the *Corsair*. In 1887 the Pilot Board was disbanded, and the Marine Board was formed to administer the maritime affairs of the Colony and of the pilots.

As steamers were superseding sailing ships, the 330 ton *Victoria* was built at Williamstown for the pilots in 1901. Two years later the sailing craft

were finally paid off when the steam yacht *Alvina* joined the *Victoria* and maintained a continuous steam cruising station. By 1925 the *Alvina* was due for replacement and the *Komet,* the yacht of the former German Governor of New Guinea, a First World War prize renamed H.M.A.S. *Una,* was bought and renamed *Akuna.* The diesel-electric 1,300 ton *Wyuna,* which was designed and built for the pilots and went on station in 1953, can remain outside for six months without refuelling. Only one ship was now needed, and two crews were engaged for the *Wyuna,* a change-over being effected every Monday morning. *Akuna* was paid off and *Victoria* kept as a relieving ship. It was finally scrapped in 1956 when a Second World War corvette, H.M.A.S. *Gladstone,* was converted into a relieving pilot ship and renamed *Akuna II.*

In 1971 thirty-six former Australian shipmasters were licensed by the Marine Board to perform all pilotage within Port Phillip Bay and Western Port. One is permanently in charge of the Williamstown Pilot Office as secretary–treasurer ; the others, in turn, take charge of the *Wyuna* cruising off the Heads ; thirty-four are rostered for the various pilotage duties. Pilots for inward ships are organised by the Pilot-in-Charge of *Wyuna,* and all others by the Pilot Office. Vacancies are filled by shipmasters holding Pilotage Exemption Certificates who have undergone the necessary medical tests. Successful applicants then spend three months accompanying other pilots on their various duties. After examination before Board members they are licensed to pilot ships under 23 ft draught for not less than one year, followed by eighteen months during which they are restricted to a 29 ft draught, before becoming qualified for an unrestricted licence. The draught limit for Port Phillip Bay is 37 ft and for Western Port 47 ft.

Each pilot purchases a share in the pilot ships and other plant, and pilotage rates are set and collected by the Marine Board. Four per cent is deducted for the Board's expenses and 6 per cent for the Pilot Sick and Superannuation Fund. Ninety per cent is paid to the secretary–treasurer for crew and staff wages, stores, etc., and for the pilots' remuneration, which is determined by the Marine Board.

ROADS

From 1851, when Victoria became a separate Colony, the Government sought to establish an effective road system through trusts and district road boards. Certainly, in some parts of the State, where conditions were good and settlers had prospered, the roads were of a reasonable standard for contemporary traffic, and many fine bridges still remain. However, because of shortages of manpower and money, many roads were impassable to wheeled traffic in winter, and were regularly cut by flood waters.

The first effective move towards centralised control was made in 1910 in a report by the Inspector General of Public Works, who recommended that a roads board be established to manage main roads. A subsequent report published in December 1911 by the sub-accountant of the Treasury also recommended the establishment of a central road authority. It attributed existing conditions to a lack of co-operation between municipalities in the construction and maintenance of arterial routes, the distribution of State aid without supervision or thorough investigation into actual needs, and the absence of a central authority to organise local bodies.

Meanwhile, demands for better roads were being made by Gippsland residents for whom winter conditions were very difficult because of high rainfall and lack of proper road construction. At a meeting held in Warragul on 15 August 1911 representatives of eighteen councils suggested that the Government should grant a loan of £1m at 3¾ per cent, with a 1½ per cent sinking fund to establish a development trust to supervise the improvement of main roads, and to recommend proposals for railways and ports necessary for development. As a result of these demands the Country Roads Act was proclaimed on 1 January 1913 and the Country Roads Board was established. It was to carry out surveys and investigations to determine which roads should be main roads ; the nature and extent of Victorian roadmaking resources ; the most effective and economical methods of use ; the most effective methods of road construction and maintenance ; and what deviations should be made or what new roads constructed to improve traffic conditions. The Board was also to purchase all necessary land, machinery, tools, and materials, and to publish the results of its surveys and investigations.

The 1912 Act made available loans of £2m which were to be spent at the rate of £400,000 a year on permanent works, and also provided that the cost of maintenance should be shared equally by the Board and the municipalities. Municipalities were also required to repay half the expenditure incurred on permanent works. In 1924 the Highways and Vehicles Act reduced the statutory contribution from municipalities towards the maintenance of main roads to a maximum of one third. Provision was also made for a municipality's contribution to be reduced in certain circumstances, and this procedure, together with the use of Commonwealth aid without charge to the municipalities, has now fixed the Board's contribution to main road expenditure at approximately 90 per cent.

The Country Roads Board then divided the State into ten districts, and its three members visited every municipality in order of necessity, inspected the roads, and explained the Act to councillors. It was decided that the inspection of a district should be completed before determining which roads should be main roads. The following criteria were adopted : whether they were main arterial roads carrying extensive traffic, or likely to carry extensive traffic, between centres of population or from one district to another ; whether they were subject to considerable traffic from rural districts to the railway systems; and whether they were developmental in character, that is, whether their construction would be likely to lead to wider settlement or increased production.

As a result of the investigations, the Board declared about 5,000 miles of roads to be main roads, and outlined for the municipalities some considerations which were to be followed in the construction of the road system. The main problems were the variety of design standards between shires, lack of equipment, inadequate drainage, thin pavement materials, poor methods of construction, and irregular, unsystematic maintenance procedures. No construction was, therefore, to be approved until surveys and investigations had determined the most suitable location for the road, as faulty alignment had previously caused unnecessary expense. The first contract was let on 23 December 1913 ; it was for metalling on the Olinda road in the Shire of Fern Tree Gully, and the first contract to be completed

was for the construction of 1¾ miles on the main Gippsland road between Drouin and Warragul in the Shire of Warragul.

It soon became apparent that main roads alone were insufficient to provide the farmer with access to railways and markets. Consequently, in 1918 the Government empowered the Board to declare as developmental those roads which would give access to railway stations or to main roads. Loan money was provided, and municipalities were required to contribute 2 per cent towards interest on capital expenditure for 20 years. This was extended in 1922 to 31½ years. The loan and balance of interest were initially paid from Consolidated Revenue, but later charged to the Board. The programme of construction of developmental roads was completed in 1937.

Another category of road which helped in rural development was the " isolated settlers roads ". Short lengths of road were constructed from farm properties to main or developmental roads, and during the depression in the 1930s employment relief funds with additional grants from the Board's revenues substantially increased the rate of construction.

In 1924 the Highways and Vehicles Act was passed and the declaration of State highways authorised. This Act recognised the growing importance of the motor vehicle and removed the burden of providing for long distance " through " traffic from the municipalities. The full cost of both construction and maintenance of State highways is now borne by the Board. The State highways are the primary roads of the Board's system and provide the most important interstate links, as well as those between major provincial centres. The Princes Highway, National Route 1, runs from the South Australian border to New South Wales, passing through Warrnambool, Geelong, Melbourne, Warragul, Sale, and Bairnsdale in southern Victoria. Other State highways include the Hume Highway linking Melbourne to Sydney ; the Calder Highway to Mildura from Melbourne ; the Henty Highway from Portland to the Mallee through Hamilton and Horsham ; the Western Highway, which provides the most direct route between Melbourne and Adelaide, passing through Ballarat, Horsham, and Nhill ; the Murray Valley Highway, which runs from Corryong in north-eastern Victoria to Hattah in the north-west ; and the picturesque Omeo Highway, which passes through the mountainous country from Tallangatta in the north-east to Bairnsdale in the south-east.

Freeways are roads which generally have dual carriageways and the distinguishing feature of access being controlled from adjoining properties and from side roads. They provide safe direct routes for heavy volumes of traffic, and allow through traffic to by-pass centres of population. Specially designed interchanges provide connections with other roads and streets. An example of a freeway with full access control is the Maltby Freeway on the route between Melbourne and Geelong. Other freeways declared by the Board include the Princes Freeway from Moe to Morwell, the Tullamarine Freeway from Bell Street in Coburg to the Melbourne Airport at Tullamarine, and the Lower Yarra Freeway. The latter two are examples of urban freeways.

Under the *Country Roads (Tourists' Roads) Act* 1936 the Board may construct and maintain tourists roads as proclaimed by the Governor in Council on the recommendation of the Board. Tourists roads include the Ocean Road, roads opening up places of interest such as the Grampians and Wilsons Promontory, and roads to skiing and other resorts. Forest roads are proclaimed and constructed in areas within or adjacent to any State forest

area, or in places the Board considers to be timbered, mountainous, or undeveloped. Under the *Forest Roads and Stock Routes Act* 1943 municipalities are relieved of all costs of such roads.

On 1 July 1965 motor registration fees were increased, and the additional revenue has been absorbed in a special fund which has enabled the State's road construction programme to be accelerated beyond that which would have been possible from funds normally available; motor registration fees were further increased from March 1968. Two main sources of finance are available to the Board. From State sources it receives money mainly from motor registration fees, driving licence fees, the proceeds from the Commercial Goods Vehicles Act, and repayments from municipalities for their share of main road expenditure. From Commonwealth sources money is provided under the Commonwealth Aid Roads Act.

ROAD SAFETY AND TRAFFIC AUTHORITY

Before 1935 road traffic was administered by provisions of the Motor Car Act, the Police Offences Act, and the Local Government Act. In that year a Road Traffic Act was passed accompanied by separate regulations for country and metropolitan conditions. In 1956 the Traffic Commission of three full-time members was constituted, and in 1971 the Road Safety and Traffic Authority assumed the functions of the Commission together with the added functions of research and promotion of road safety practices.

The Authority has advised the Government about regulations for the improvement and control of traffic; made any necessary inquiries; and set down standards for traffic control items such as signals, pedestrian crossings, and certain signs, consulting with the operating authorities, which are the Country Roads Board, the Melbourne and Metropolitan Board of Works, and the municipal councils. In 1960 warrants were developed setting out the conditions for installing all major traffic control devices except speed restriction signs. The warrants are all quantitative, and assist council engineers to assess the need for control at any particular location.

The Authority has been the sole body responsible for the establishment and alteration of speed restriction zones, which range chiefly from 35 mph up to 50 mph in 5 mph intervals. However, in special circumstances it has approved limits lower than 35 mph. These supplement the State-wide 70 mph restrictions introduced in December 1971. The two engineering principles used in applying speed limits are based on either a speed study or a quantitative subjective method of evaluating contiguous development.

In 1958 new Road Traffic Regulations were issued. These were more easily understood, and encouraged easier, safer, and more orderly driving; they clearly stated the privileges and responsibilities of both motorist and pedestrian. An important feature was the inclusion of "sign board" legislation, which permitted traffic and parking to be controlled merely by the erection of signs; a severe penalty may be imposed for the illegal erection of a parking or traffic sign. The Regulations have been revised and re-issued regularly, usually at two year intervals, to allow for modifications in traffic control as new measures are evolved and prove satisfactory.

Since 1958 the Authority has received from the Police Department a comprehensive statistical report of every accident reported. Since 1960 the information in these reports has been transcribed by the Commonwealth

Bureau of Census and Statistics to punch cards which are used by the Traffic Authority for research and analysis purposes. Accident field data are collated by the Authority, and with the assistance of the Country Roads Board the State Traffic Accident Record was published in 1971 showing all reported accidents since 1968 by location and road user movement involved. Statistical tabulations correlating factors from 1963 to 1967 have been published together with tabulations by the Commonwealth Statistician and data supplementary to the location survey. The information forms the basis of research for use by the Government, the Parliamentary Road Safety Committee, and for promotion work in road safety practices.

In 1966 a metropolitan route numbering scheme was introduced to permit convenient identification of routes. A number was allocated to each route, odd numbers being used for north–south routes and even numbers for east–west routes. Studies on major approach routes to the city have been followed by recommendations to the municipalities concerned on such matters as the resetting of traffic lights, erection of signs, restriction of parking, and the siting of bus stops and taxi stands. Clearways have been established along more than 40 miles of street kerbsides with benefits in traffic capacity and in accident reduction.

Since 1952 finance to assist municipalities in traffic matters has been available. The purpose for which the funds could be used has varied from traffic control signs (1952), improving the standard of pedestrian crossings (1958), and improvements to existing traffic control signals (1959). The establishment in 1967 of the Traffic Commission Fund (now the Traffic Authority Fund) allowed recommendations to be made to the Minister to grant subsidies for traffic control signals, pedestrian crossings, and any works or projects calculated to improve road safety or traffic control. All subsidies recommended are on a priority basis, taking into account safety and congestion.

Since 1970 the Country Roads Board has allocated funds for Commonwealth arterial roads as assistance towards the installation of signals on the advice of the Authority, and the Commonwealth Government has subsidised research into the effects of the Victorian seat belt legislation.

RAILWAYS

The development of Victoria's railways has been closely tied to the State's demographic and economic development. Before the discovery of gold there was no effective demand for railway services; after 1851, however, the rapid growth of population made such services a pressing necessity. Most accounts of life in the 1840s and the following decade single out the condition of the roads as quite inadequate, and this proved to be the major spur behind railway development. The slow, cumbersome, and inefficient transport of persons and goods from the coast to the gold mining towns could only be corrected by a railway; the era of good roads lay very much further into the future.

Although the early attitude of the Government after Separation in 1851 was in favour of privately owned and controlled railways, the actual experience of these convinced Parliament soon after 1855 that the Colony's railways would eventually become a government responsibility. This became a fact when the Government purchased the early companies and in due

course began to construct as well as operate tracks and rolling stock. The financing of the Colony's railway system was made possible by the raising of successive loans in various places, interest on which in due course became a significant part of the State's debt.

State system

The earliest proposal for a railway was made in 1839 when Robert Hoddle, surveyor, planned a railway to link Melbourne with a town he had marked out and named The Beach, later to be called Sandridge, and now known as Port Melbourne. The planned line was to run virtually straight from near Queen Street to Hobsons Bay. However, the proposal never progressed beyond the drawing board as the Colony was not ready for a railway. In 1851 plans for railway proposals were considered, and during the next two years eight private railway syndicates were formed, but their appeals for financial support from residents of the Colony were not very successful and most of the projects were abandoned. However, three groups received authorisation from Parliament to build railways. These were the Melbourne and Hobson's Bay Railway Co., the Geelong and Melbourne Railway Co., and the Melbourne, Mt Alexander and Murray River Railway Co.

The first railway to become operational was the two and a quarter mile line from Flinders Street to Sandridge (Port Melbourne) which was opened for business on 13 September 1854; it was controlled by the Hobson's Bay Railway Co. On the previous day Melbourne's citizens had witnessed the ceremonial opening of the railway by the Lieutenant-Governor; large crowds had congregated at Flinders Street Station and along the line to watch not only Victoria's but also Australia's first public railway, the locomotive of which had been built in Melbourne. On the strength of its first year of operation the company built a branch line to St Kilda which was opened on 13 May 1857. The first country railway to open for traffic was the Geelong and Melbourne Company's line connecting the two main cities of the Colony. Work had commenced in 1853 and on 25 June 1857 the line was opened. An arrangement had been made with the Mt Alexander Co. for Geelong trains to travel over its Williamstown branch from Newport to Melbourne, but as this line was not ready in time the Geelong trains operated from a temporary terminus on the Yarra River near Newport; passengers and goods were conveyed by river craft to and from Melbourne. By 1859 Geelong trains were able to run to Spencer Street Station, but by this time the company was in difficulties because the railway had been built at a low cost, its equipment was poor, and competition by steamers operating between Melbourne and Geelong affected its revenue. In June of the following year the railway was purchased by the Government.

The third company authorised to construct a railway in 1853 was the Melbourne, Mt Alexander and Murray River Railway Co., which had an elaborate plan to build a main line from Melbourne to Castlemaine, Sandhurst (Bendigo), and Echuca together with a branch line to Williamstown. Construction started on the line from Williamstown to Melbourne a year later, but progress was desultory owing to a shortage of funds. Eventually, on 19 March 1856 the Government acquired the project. By this time

the Government was very conscious of the need for an adequate inland transport system; the high cost of transportation of food by road to the goldfields was a major factor in highlighting the transport deficiency.

During 1855 a number of committees investigated railway proposals, and surveys were made of 200 miles of prospective routes. Finally on 19 March of the following year the Government was advised to build simultaneously the line to Echuca and a line from Geelong to Ballarat. Staff was then appointed, action was taken to acquire railway plant and equipment from overseas, and tenders were called locally for the necessary earthworks and buildings. The time elapsing between placing of orders for material from overseas and their ultimate arrival delayed construction, and it was not until 13 January 1859 that the first government trains ran from Spencer Street Station to Williamstown and Sunbury. The Ballarat and Bendigo lines were completed during 1862, but Echuca, already a bustling river port, was not connected until 1864. The Bendigo and Ballarat lines were double-track railways built to high standards of construction with commodious stations and imposing viaducts. The Bendigo line alone cost £50,000 per mile, and Parliament was cautious and hesitant, with the limited funds at its disposal, to take on more projects. Many requests for railways were made to Parliament during the 1860s and by 1868 the clamour had become so persistent that, in an effort to provide transport to country areas, the concept of "cheap" or "light" lines was born. By restricting the railways to single track, and specifying lighter rails and more modest stations, cost could be limited to £5,000 per mile. Under the light line concept lines were authorised to Maryborough, to the west from both Ballarat and Geelong, to the north-east, and into Gippsland. By 1880 there were rail connections to Colac, Portland, Horsham, St Arnaud, Inglewood, Wodonga (extended to Albury in 1883), Beechworth, and Sale. The *Railway Construction Act* 1884 (the first of the so called "Octopus Acts") authorised the construction of more than sixty lines in various districts, while under a similar Act of 1888 many more railways were built. In the eleven years between 1884 and 1895 the route mileage had increased from 1,600 to 3,120.

Lines opened during the twentieth century have been mainly extensions to the existing main line system and branch lines to more remote areas. Much of the increased mileage comprises railways opened in connection with the development of the Mallee, the Wimmera, the Murray irrigation fruit growing areas, the forests in the north-eastern and Gippsland regions, and the pastoral land in the Western District. Major centres connected include Mildura in 1903, Tocumwal (N.S.W.) in 1908, and Mt Gambier (S.A.) in 1915. During the 1920s several lines were built into the Riverina under an agreement with New South Wales.

The railway network continued to grow with extensions and branch lines. In 1930 there were 4,721 miles but since then construction has tapered off. The maximum of 4,766 miles was reached in 1942. The only parts of the State not now served by the system are the mountainous areas where railway construction is expensive and settlement sparse. In an effort to provide a service to some mountain settlements narrow gauge lines (2 ft 6 in) were built from Wangaratta to Whitfield, from Ferntree Gully to Gembrook, from Colac to Crowes (in the Otways), and from Moe to Walhalla, a total of 122 route miles. Special locomotives and rolling stock were built, but the

lines did not prosper and all have been closed apart from a section of the Gembrook line between Belgrave and Emerald ; it is now operated as a tourist attraction.

The " light line " policy was based on the assumption that as the traffic grew on each line the facilities would be upgraded, and this has been the case. Since the early days trains have become longer and heavier, hauled by more powerful locomotives running on re-laid tracks and over strengthened and rebuilt bridges. New and improved signalling and operating procedures were adopted as the volume and speed of trains increased. The most sustained upgrading of the system began in 1950 and was given the name Operation Phoenix. The rehabilitation was based on the report of an English expert, and was necessary as the replacement of rolling stock and other plant had been curtailed by the shortage of money during the economic depression of the early 1930s and the demands on labour and material during the Second World War ; during the war the railways had been called on to carry increased loads and at the same time turn their workshops into factories for military supplies. Major items in the rehabilitation were the purchase of new locomotives and rolling stock. The re-laying of hundreds of miles of track using modern mechanised methods was begun, and the main Gippsland line between Dandenong and Traralgon was converted to electric traction. Modern diesel rail cars were introduced on branch lines, replacing slow mixed train services. As the new equipment arrived and the tracks improved, train speeds were increased and running times reduced.

In recent years improvements to the system have included the building of the standard gauge line from Albury to Melbourne in 1962, allowing straight-through running between New South Wales stations and South Brisbane to Melbourne. Within a year a bogie exchange service was introduced which has enabled fully loaded wagons to be transferred from the Victorian to the standard gauge or vice versa without disturbing the contents. The most recent modernisation project has been the completion of the electronically controlled " hump " goods classification yard in Melbourne.

Suburban network

The first suburban railways in Melbourne were the Hobsons Bay original line from Flinders Street to Port Melbourne opened in 1854 and its branch line to St Kilda opened three years later. In 1859 the Government opened lines to Williamstown and Sunbury ; the St Kilda and Brighton Railway Co. opened a line between the two settlements via Windsor, using Hobson's Bay equipment ; and the Melbourne and Suburban Railway Co. opened lines to Richmond and Cremorne from its Princes Bridge terminus. The Melbourne and Essendon Railway Co. opened a line from North Melbourne to Essendon on 1 November 1860. Early the following year, the company opened the branch line to Flemington racecourse. The " Suburban " Co. extended its line to Windsor, and in 1861 reached Hawthorn. Later in the same year the Brighton line was extended from North Brighton to Brighton Beach.

When the Melbourne and Suburban Railway Co. was in financial difficulties in 1862 its assets were sold to a new group known as the Melbourne Railway Co. The Essendon company was in the same predicament and closed its line on 1 July 1864. In the following year for the same reason the Melbourne Railway Co. merged with the Hobson's Bay

company to form the Melbourne and Hobson's Bay United Railway Co. Later the St Kilda and Brighton Co. was absorbed. The " United " company now controlled all lines from the city to the southern and eastern suburbs. A subway was built under Swanston Street which allowed all trains to use Flinders Street Station, Princes Bridge Station having been closed to passenger traffic in 1866. In 1867 the Government purchased the Essendon railway and was able to re-open the Flemington racecourse line in time for the Melbourne Cup.

In 1878 the government railway linking Melbourne with Gippsland was nearing completion but lacked a route into the city. The Engineer-in-Chief recommended a line from Oakleigh to Spencer Street, then the government station, via East Malvern, Camberwell, Fairfield, and North Melbourne, the so called Outer Circle railway. But the Government decided to purchase the " United " company's system and brought their Gippsland railway from Oakleigh to join the suburban network at South Yarra. The State now controlled all the suburban railways in Melbourne, though the company's lines were operated as a separate entity until 1881. Under government control the metropolitan network expanded rapidly. By 1880 it was possible to travel to Williamstown, Sunshine, Essendon, Hawthorn, Dandenong, Brighton Beach, St Kilda, and Port Melbourne, and by 1890 trains were running as far as, and in some cases beyond, Melton, Broadmeadows, Coburg, Whittlesea, Heidelberg, Lilydale, Ferntree Gully, Frankston, and Sandringham. Although the Gippsland railway entered the city from the south, the Outer Circle line was included in the 1884 Octopus Act. A line connecting with the Outer Circle railway at Waverley Road was also authorised at the same time. This was known for some time as the Inner Circle. By 1900 the suburban system as it is today was virtually complete, but not all lines were successful. The Outer Circle railway which ran from Oakleigh to Fairfield was abandoned in stages. The only section now operating is between Riversdale and Alamein. The Rosstown railway between Elsternwick and Oakleigh, built as a private venture in 1888, was never brought into use. The line to Altona, also opened by private interests in 1888, only operated intermittently until 1924 when it was absorbed into the government system.

In the early years of this century the Government became interested in the concept of the electrification of the metropolitan network ; this had been mooted as early as 1896. After two Parliamentary inquiries, C. H. Merz, a London consulting engineer, in 1908 investigated and reported favourably on the feasibility of electrification ; no action resulted, but in 1912 following a revised report, Parliament authorised the electrification of most of the suburban system. Work began in 1913, but progress was slow because of the First World War. Electricity for railway traction was first generated in June 1918 and the first test train ran on 6 October of the same year. The inaugural electric train service began to operate between Sandringham and Essendon on 28 May 1919. Electrification of other lines followed, and on 15 April 1923 the final stage of the original scheme was completed when electric trains ran to Eltham ; there were then 150 miles of line available for electric traction. The following year electrification of outer lines commenced, this work being completed in 1930 when the new line from East Malvern to Glen Waverley was opened. Since the Second World

War short extensions to the electrical suburban network have been made to Upfield, Epping, Belgrave, and Alamein.

The first electric trains were composed of two types of rolling stock. A number of swing door carriages previously used on steam hauled suburban trains were altered for use as electric trains, and new sliding door "Tait" trains were built as part of the electrification scheme. Under the Operation Phoenix rehabilitation scheme the blue steel "Harris" trains were introduced. In 1970 new trains were ordered with many improved features, including a better load to tare weight ratio which was expected to reduce running costs appreciably. In 1971 the Government appointed the Melbourne Underground Loop Authority to finance and construct an underground city railway, on which work commenced in June of that year.

Management

The Government, on acquiring the Melbourne, Mt Alexander and Murray River Railway Co., placed it in control of two trustees, the Commissioner for Public Works and the Surveyor-General. They were responsible to the Legislative Council, the only Parliamentary body at the time. A Board of Land and Works was established in 1857 with authority to build railways and other public works, and with power to supervise all railways, public and private. The President of the Board was a Member of Parliament as were some other members. However, the system proved unsatisfactory ; in the 26 years of the Board's control there were thirty-two Ministers and twenty-four Presidents of the Board.

The *Victorian Railways Commissioners Act* 1883 provided for the appointment of three Commissioners as a body corporate to administer all railway activities previously controlled by the Board of Land and Works. The first Chairman of Commissioners was Richard Speight, who came from the Midland Railway in England. Apart from operating the existing lines the new administration was to build new railways authorised under legislation. When deficits of more than £1.3m over four years occurred as a result of continuous construction, the Department came under heavy criticism, and in 1890 the Parliamentary Standing Committee on Railways was established with the responsibility of investigating all future railway proposals in excess of £20,000. In 1892 the actual building of new railways was restored to the Board of Land and Works. Drastic economies in railway operation were still needed and retrenchment also became necessary. When the Commissioners indicated that they could not decrease expenses and raise revenue to the extent directed by the Government, their appointments were terminated. During the next four years a succession of acting and deputy Commissioners tried to restore the financial position, but the deficits remained. In the early 1890s the *Age* had severely criticised the Commissioners, accusing them of incompetence, extravagance, waste, and condoning political influence. Commissioner Speight replied with a suit for libel but received only token damages for only two of the eleven points specified. On 1 July 1896 the management was transferred to a sole Commissioner, but in 1903 the board of three Commissioners was restored. The Board of Land and Works has now been abolished, and new construction is now vested in the Railway Construction Board.

Passenger services

Early journeys on country lines were slow by modern standards of travel, but appreciably better than the coach services which preceded the railway. Mixed trains comprising both goods and passenger vehicles were a common feature on the Victorian Railways for many years, particularly in country areas. As improved locomotives became available the timings improved noticeably. The carriages used on the first trains were small four and six wheel vehicles of the " dog box " compartment style. Bogie stock did not appear until 1874 when American saloon-style coaches seating up to sixty-four passengers were introduced.

The first through passenger service to Adelaide began on 19 January 1887. Included in the train were specially imported " Boudoir " carriages for sleeping passengers ; sleeping services for Victorian intrastate passengers began in 1890 when a sleeping car was introduced on the Portland line. By the turn of the century major express trains were composed of predominantly bogie stock ; sleeping and sitting carriages were built for the Adelaide express followed by matching sitting cars for the Sydney express service to Albury. Among the new carriages introduced for the Sydney service was a parlour observation car and a dining car, the first in the State. Dining cars later became a feature of a number of Victorian express trains. During the 1920s and 1930s train schedules were accelerated appreciably.

The first air-conditioned carriage was placed in service in 1935. Air-conditioning became standard for all new carriage building, culminating in the production at the Newport workshops of Australia's first completely all steel, air-conditioned streamlined train, the *Spirit of Progress.* This luxurious train took over the *Sydney Limited* service and ran non-stop to Albury in three hours and fifty minutes. Further air-conditioned carriages were built until construction was curtailed due to the prior needs of the Second World War. Existing sleeping cars were air-conditioned for use on the Adelaide and Mildura services.

The use of diesel electric locomotives provided the potential for further improvements, but the decrease of traffic due to increased use of motor vehicles and aircraft has led to the relegation of some express trains to the status of stopping trains. However, the new motive power made possible a day return service to Bairnsdale, and a new train, the *Gippslander,* was introduced with modern sitting carriages and a buffet car. Self-propelled rail cars were first introduced successfully in 1922 and various types have been used both on main line and branch line work. New air-conditioned rail cars capable of speeds up to seventy miles an hour were introduced on the Ararat to Portland line in 1971.

The interstate services have been maintained. The standard gauge line, opened in 1962 from Sydney to Melbourne, permits direct service without changing trains at Albury. Three services run, the sleeping car service *Southern Aurora,* the combined sitting and sleeping service which has taken the name *Spirit of Progress,* and the *Intercapital Daylight.* The *Overland* operates to Adelaide daily as an overnight service.

Freight services

Early goods trains were slow and comprised small locomotives hauling

unbraked, low capacity four-wheel wagons. Two types of goods trains evolved, the roadside or pickup service stopping at intermediate stations to detach or attach as required, and the express or through goods trains. This latter type consisted of wagons consigned to major centres or those to be taken beyond by a roadside train.

Over the years, particularly during the Second World War, the pattern of goods traffic changed. The roadside traffic declined, and diesel-hauled express trains of up to 50 vehicles aggregating 3,000 gross tons were introduced. These travel at near passenger train speeds. Only steel bogie-type goods wagons are now constructed, and special vehicles are built for particular uses.

Since the completion of the standard gauge line from Albury to Melbourne in 1962, the practice of bogie exchange of wagons between the Victorian and the standard gauges has been adopted. This facility, together with greater standardisation of wagon characteristics by the interstate railway systems, has enabled wagons from all mainland States except Queensland to run on Victorian tracks.

Containers are well suited to railway transportation, and train loads of containers are now a feature of the Victorian Railways, with many of the units carrying the markings of overseas shipping lines.

Interstate traffic, motor vehicles, grains, steel, bulk materials, livestock, and containers are seen as the main source of freight revenue during the 1970s.

Technical developments

The earliest operating locomotive in Victoria was the locally built engine used by the Hobson's Bay Railway Co. pending the arrival of equipment ordered from England. English manufacturers supplied all the other early locomotives, which were small, low powered, and typical of their time, but inadequate for Victorian country line work. Some had to be rebuilt at the railway workshops at Williamstown, which produced their first fully built locomotive in 1872. An interesting practice introduced at the time was the importation of designs together with one or two prototype engines, with local builders supplying the balance of the order; this practice remained in force for many years.

One of the early tasks undertaken by the first full-time railway Commissioners was the rationalisation of the traction system. During the 1860s and 1870s the types and makes of locomotives purchased had varied, and between 1872 and 1882 the number of different classes rose from seven to twenty-five; some of these had come from the absorbed companies and there was need for some sort of standardisation. New classes specified for local conditions had interchangeable components, giving more efficient operation with cheaper maintenance. Passenger engines were of the 4-4-0 type, heavy goods locomotives were 0-6-0 type, and 4-4-0 tank engines were provided for the suburban services. Phoenix Foundry, Ballarat, which between 1873 and 1904 built 352 engines for the Victorian Railways, was the major builder, using plans supplied by the United States and United Kingdom constructors. In 1902 the first of a new D^p class 4-6-0 type passenger locomotives was completed at the Newport workshops; locomotives could be built considerably cheaper by the railway workshops

than by the Phoenix Foundry, so the department commenced locomotive construction at Newport, Ballarat, and Bendigo. The D^p class proved very successful and continued to be built for nearly twenty years. The next major class was the A2 class, a 4-6-0 main line passenger engine which proved equally useful on goods work. The largest locomotive built at Newport Workshops was the H class 4-8-4 engine which appeared in 1941, and at the time was the largest in Australia. During the Second World War the railway workshop resources were largely diverted to manufacturing a wide range of military equipment, but some locomotives were completed and put into service. After the Second World War it was apparent that the large number of locomotives required could not be built in Victoria, or indeed in Australia, within a reasonable time, so for the first time since 1912 locomotives were ordered from overseas. Altogether seventy R class main line passenger and 110 light line mixed traffic engines were imported between 1949 and 1954.

In 1951 restrictions on the importation of certain equipment from the U.S.A. were lifted and tenders were called from Australian companies for the supply of modern diesel electric locomotives ; the first order was for twenty-six 1,500 hp mixed traffic main line locomotives which were built in Australia from American components. These were not the first diesel electric locomotives to have been introduced into Victoria. In 1951 small shunting engines had been purchased from the United Kingdom, but the arrival of the main line engines saw the start of a complete dieselisation programme, and steam traction is now virtually superseded in Victoria. It is used on occasional shunting duties and to haul special chartered passenger trains organised by railway enthusiast groups.

The first Victorian railway tracks were laid with double-headed iron rails 80 lb in weight to the yard and 12 to 15 ft long, seated in cast iron chairs, the standard British practice. In 1871 the flat bottom rail became standard and a replacement programme began. During the era of the " light " or cheap railways the rails were 60 lb to the yard, but as the years advanced upgrading of tracks took place, and the minimum size of rails is now 94 lb per yard for country main lines and 110 lb in suburban areas. In the early 1930s welding of rails into long lengths began, and in 1971 lengths of 1,080 ft were in use. Present day track re-laying and maintenance is highly mechanised using modern specialised equipment. Bridges of iron and masonry construction on the Bendigo and Ballarat lines, of a high standard for their time, have been strengthened to carry the present heavier trains. On the light lines wooden trestles are being replaced by steel or concrete structures.

Signalling equipment and procedures have also improved. Major steps were the installation of interlocking gear in 1876 and the provision of power-operated three-position signalling equipment in the suburban area in 1915 ; this latter device will stop a train should it have failed to come to a stand at a " danger " signal. The latest system (centralised traffic control), as used on the standard gauge line from Wodonga to West Footscray, controls all signals and points from Melbourne ; remotely controlled points and signals over shorter distances have been used for some years. Safe-working on most lines is supervised by controllers who plot the movement of all trains under their control, making adjustments to schedules where necessary.

TRAMWAYS

Melbourne

In 1916 legislation was passed to amalgamate all Melbourne tramway systems, except two owned by the Victorian Railways, and to appoint an interim board, which was superseded in 1919 by the Melbourne and Metropolitan Tramways Board comprising a full-time chairman and six part-time members. It assumed control of the cable tram system which had first carried passengers between the city and Richmond on 11 November 1885, and by 1891 had 41 miles of cable tramways in Melbourne. Several suburban cable and electric tram systems, mostly owned and operated by local municipal trusts, were also placed under its control. During the 1920s and 1930s the Board converted all cable tramways to electric power, replacing obsolete systems with modern rolling stock and equipment ; the last cable tram ran on 26 October 1940.

Apart from a decline during the depression of the early 1930s, the number of passengers carried by the tramways system increased, and with the scarcity of motor cars, as well as petrol rationing during the Second World War, the number of journeys by tram and bus passengers reached 354 million in 1945. Although for some fifteen years after the war the number was higher than before the war it has since declined year by year. This has largely been because of changing social patterns, including the increasing use of motor cars, the development of shopping centres and supermarkets in suburban areas, and the movement of population from the inner municipalities to outer suburban areas where electric trains have provided the quickest city services.

Melbourne in 1970 had 133 miles of electric tramways and 140 miles of tramway bus routes, together carrying over 130 million passengers a year. They provide a general service with concession travel for certain passengers such as pensioners and students.

Provincial

The Ballarat Tramways (originally a horse-drawn service) and the Bendigo Tramways (originally steam) began operations in 1905 and 1903, respectively, under the control of the Electric Supply Company of Victoria Ltd. Both systems were acquired by the State Electricity Commission of Victoria in 1934. The Ballarat system covered 13.8 route miles and the Bendigo system 8.6 route miles. In their peak years in the mid-1940s the two systems together carried about 10 million passengers annually, but the number of passengers declined steadily over the years to just over 2.6 million in 1970–71; from 1934 until 30 June 1971 losses on the two systems exceeded $8.6m. The services have been discontinued and replaced by privately owned buses.

Tramways were operated in Geelong by the Melbourne Electric Supply Co. from 1912 to 1930, and then by the State Electricity Commission until 1956, when they were replaced by privately owned buses.

AVIATION

Flying in Victoria can be traced back to 1858 when the balloonists Brown and Dean made several flights, but it was not until 1909 that the Aerial League of Australia was formed, and with the pioneer aviator

Lawrence Hargrave as chairman, a branch was established in Victoria. On 18 March 1910 Harry Houdini, flying a French built Voison biplane, made a short circular flight of about one minute's duration, reaching a height of 50 ft from the ground. This was the first recorded flight of a heavier-than-air machine in Victoria. During the First World War aviation developed, and many pilots who were to figure prominently in post-war civil aviation activities were trained at Point Cook.

In 1920 the Commonwealth Parliament passed the Air Navigation Act establishing national responsibility for civil aviation under the provisions of the International Convention on Air Navigation of 1919. Regulations made under the Act established rules for safety standards and provided for the registration and inspection of aircraft, the licensing of aerodromes, and the examination and licensing of personnel engaged in flying and maintaining aircraft. A Civil Aviation Branch of the Department of Defence was formed to acquire and prepare sites for aerodromes and to call tenders for regular air services.

In 1921 a site of 91 acres for an airport was acquired at North Essendon. The airport now covers about 900 acres and has two main runways. The first regular air services operated out of Essendon to Hay, passing abeam of Mt Macedon. This topographical feature provided an excellent visual marker for daylight operations, but in 1930 it became necessary to install powerful electric lights to identify aerodromes, and to provide *en route* guidance for night flying on the Sydney–Melbourne route. Green aerodrome identification lights were installed, and red lights marked hazardous structures ; orange boundary lights and landing strip flares were also used.

The increase in regular public transport activities, and the introduction of larger and heavier aircraft requiring greater pavement strength and length of runway, eventually necessitated the construction of a new main airport for Melbourne. This is located at Tullamarine and its construction was begun in 1964. The cost of the project was estimated at $45m. It was opened for international operations in 1970, with the domestic operations transferring from Essendon in the following year.

Operations

Airways operations, which include air traffic and operational controls as well as flight information and search and rescue services, all had their origins in communications. Ground to air communications were introduced in Victoria in 1934 when a DH-86 aircraft was equipped with special apparatus for the service to Launceston. Initially ground communications to aircraft were supplied, serviced, and handled by Amalgamated Wireless (Australasia) Ltd. Known as Aeradio from its inception, it was taken over by the Civil Aviation Branch in the 1930s. Wood and wire aircraft were in use at this time, and the ground services available to these included meteorological observations and forecasts, and regular in-flight communications on medium and high frequencies. A rudimentary aerodrome control service based on light signals was also established, and Bellini Tosi high-frequency direction-finding apparatus was provided late in 1935 to enable Aeradio to establish bearings on radio-equipped aircraft. Assistance was also provided in less orthodox form, and it was not unknown for an Aeradio operator to assist an approaching aircraft by informing the pilot

when his engines were heard through an overcast sky. In 1936 the responsibilities of the Controller of Civil Aviation were reviewed, and a Civil Aviation Board was established to apportion these responsibilities among specialist members.

On 25 October 1938 a DC-2 aircraft, the *Kyeema,* crashed near Mount Dandenong with the loss of all on board, and the resultant inquiry had a profound effect on civil aviation services. It recommended that flight checking officers, selected for their extensive flying experience, be appointed to check each position report and to brief the pilot on weather conditions. This service is now known as operational control. New navigation aids capable of interrogation from the air were also to be installed, and the very high frequency German Lorenz beacon operating on 33 Mc/s was to be used, not only as an approach aid, but rather to provide both terminal and *en route* guidance. The introduction of radio ranges also channelled airline aircraft into closely defined aerial lanes. The Civil Aviation Board was reorganised and became the Department of Civil Aviation. Supplementing Essendon, smaller Aeradio stations were opened at Nhill and Mildura and new methods of individually lighting runways and taxiways were introduced.

During the Second World War a vast expansion in aviation activity took place. The radio range and direction finding equipment acquired immediate military significance, particularly on the initial inter-city trunk routes. In the early war years medium-frequency homer or non-directional beacons were imported from the United States of America to give greater flexibility to the route pattern available. Control tower techniques were refined, and radio communications were improved to deal with the increasing volume of air traffic and the finer standards of instrument flight. Airport fire service facilities made their first appearance. The medium-frequency direction-finding equipment was replaced with high-frequency equipment which was originally under the control of the Royal Australian Air Force, and after the war this served civil aviation requirements. At the end of the Second World War there were numerous well proven transport aircraft available, as well as competent crews to operate them; as a result there was a rapid growth in civil aviation, predominantly based on the Douglas DC-3 aircraft, but also using some DC-4, Lockheed, and Anson aircraft. Improved techniques became necessary to control aircraft at terminals and to ensure separation *en route,* and after 1946 air traffic control was divided into aerodrome control, approach control, and area control, and movement of aircraft was recorded by use of wooden replicas.

The development of civil aviation services was again affected by an accident when the DC-3 aircraft *Lutana* crashed in mountainous country near Nundle, New South Wales, in September 1948. Following an inquiry the Department reorganised air traffic control into airport control, area control, and operational control, functions which are now exercised from the operations centre at Melbourne Airport. More refined instrument approach procedures were introduced for all aerodromes equipped with radio navigation aids, and the 33 Mc/s beacons were replaced by visual aural ranges. These were very high frequency (VHF) facilities which provided increased reliability and accuracy, and were free from the atmospheric interference associated with medium frequency facilities. Another navigational aid, the

Distance Measuring Equipment (DME), was developed by the C.S.I.R.O. and installed in 1952. It enabled pilots to read accurately from instruments their distance from the beacon.

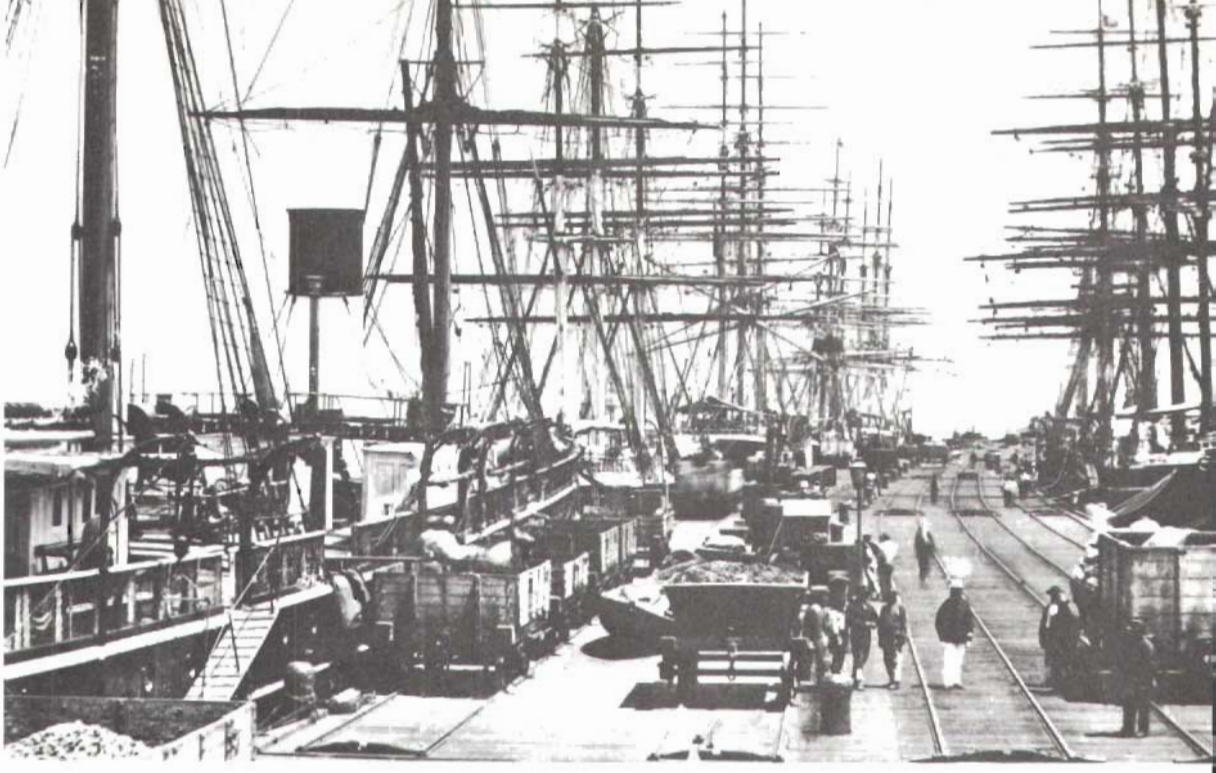
In the early 1950s airway facilities were extended. A system of high intensity approach lighting extending about one mile off the end of the runway was installed at Essendon, and this was supplemented by runway lighting capable of varying brilliance according to visibility. Taxiway and apron area lighting was also improved, and the instrument landing system was introduced. This enabled aircraft to position themselves some 10 miles from the airport. Approach control radar, which replaced the earlier radar at Essendon, enabled the controller to monitor aircraft directly on their approach to land.

In 1956 an aircraft disaster again affected the development of civil aviation services. The loss of passengers and crew on a Constellation aircraft which caught fire at Singapore resulted in the reorganisation and re-equipment of Australia's airport fire service. As there was no specific search and rescue organisation, it was decided that the Department's operational control personnel would be trained to act as such and that the operating companies would contribute search aircraft as required. This is the basis of the present search and rescue organisation.

Aeronautical communications in Victoria have undergone radical changes since 1960. Increased numbers of aircraft flying both inside and outside controlled airspace at vastly increased speeds have made it unsatisfactory to rely upon small low powered transmitters situated at or near aerodromes. An extensive network of VHF repeater stations has been established and ultra-high frequency (UHF) facilities are also being installed at these repeater stations. New high powered transmission and reception equipment was installed at Mt Macedon and Arthurs Seat to facilitate communication over a greatly increased radius. Mt Major near Shepparton was originally chosen as a communications repeater station but was changed to a VHF link repeater when the new communications repeater station was installed at Mt Mittamatite near Dederang in 1970, giving increased northern area cover overlapping into New South Wales. At Mt William in the Grampians a repeater station installed in 1967 gave a wide coverage over northern and south-western Victoria. The Gippsland area, previously neglected in VHF communications, was provided with a VHF communications repeater station at Mt Tassie, the highest point in the Strzelecki Ranges, which covered all Gippsland except the low altitudes in the far east. The entire State now has a VHF communications cover to all but the lowest altitudes, which are covered by a high frequency (HF) network. All VHF and HF communications are operated from the new control centre at Melbourne Airport, Tullamarine.

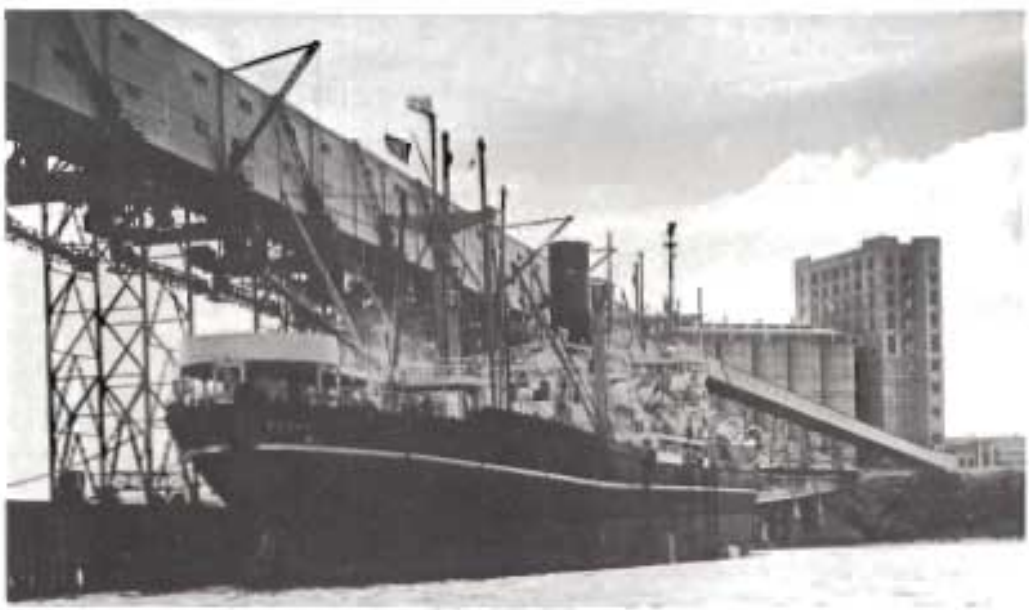
Airlines

In the early 1930s Holyman Airways Pty Ltd, an associate of the shipping company of William Holyman and Sons, began operating a DH-84 between Launceston and Melbourne, and also organised a Bass Strait airmail service. In 1935 they first imported an all-metal airliner to Australia. It was a 14-passenger monoplane, the DC-2 *Bungana*. Two other shipping companies had formed Adelaide Airways to operate between Adelaide and Melbourne, and the two airlines merged in 1936 to form the Australian National Airways. Ansett Airways was formed in the same year.



Shipping at Railway Pier, Sandridge (Port Melbourne) in 1862.
Melbourne Harbor Trust

Riverside docks on the Yarra, with Melbourne in the background, 1971.
Melbourne Harbor Trust



Echuca wharf during the time of the Murray River shipping trade (top) and the *Hygeia*, one of the former Port Phillip Bay excursion steamers (centre).

La Trobe Collection, State Library of Victoria

(Bottom) Loading facilities at the Geelong bulk grain terminal permit two ships to be loaded simultaneously; the gallery loads 1,600 tons an hour.

Australian News and Information Bureau

(Top left) This illustration shows the poor state of the early roads.
La Trobe Collection, State Library of Victoria

(Top right) A group of motorists at Manyung near Mornington in 1917.
Kodak Museum of Photography

(Bottom) Bullock teams were important in early transport.
The Herald and Weekly Times Ltd

The St Kilda Road underpass, Melbourn
opened to traffic late in 1971.

Melbourne and Metropolitan Board of Wo

The then Prime Minister of Australia, M
J. B. Chifley, introducing the first Holde
manufactured at Fishermens Bend, in 19

General Motors-Holden's Pty

The *Southern Aurora*, an overnight express train between Melbourne and Sydney.

Victorian Railways

Princes Bridge railway station prior to the Princes Gate development in the 1960s.

Victorian Railways

A Melbourne cable tram, the last of which ran in 1940 (left) and a present day electric tram (below).

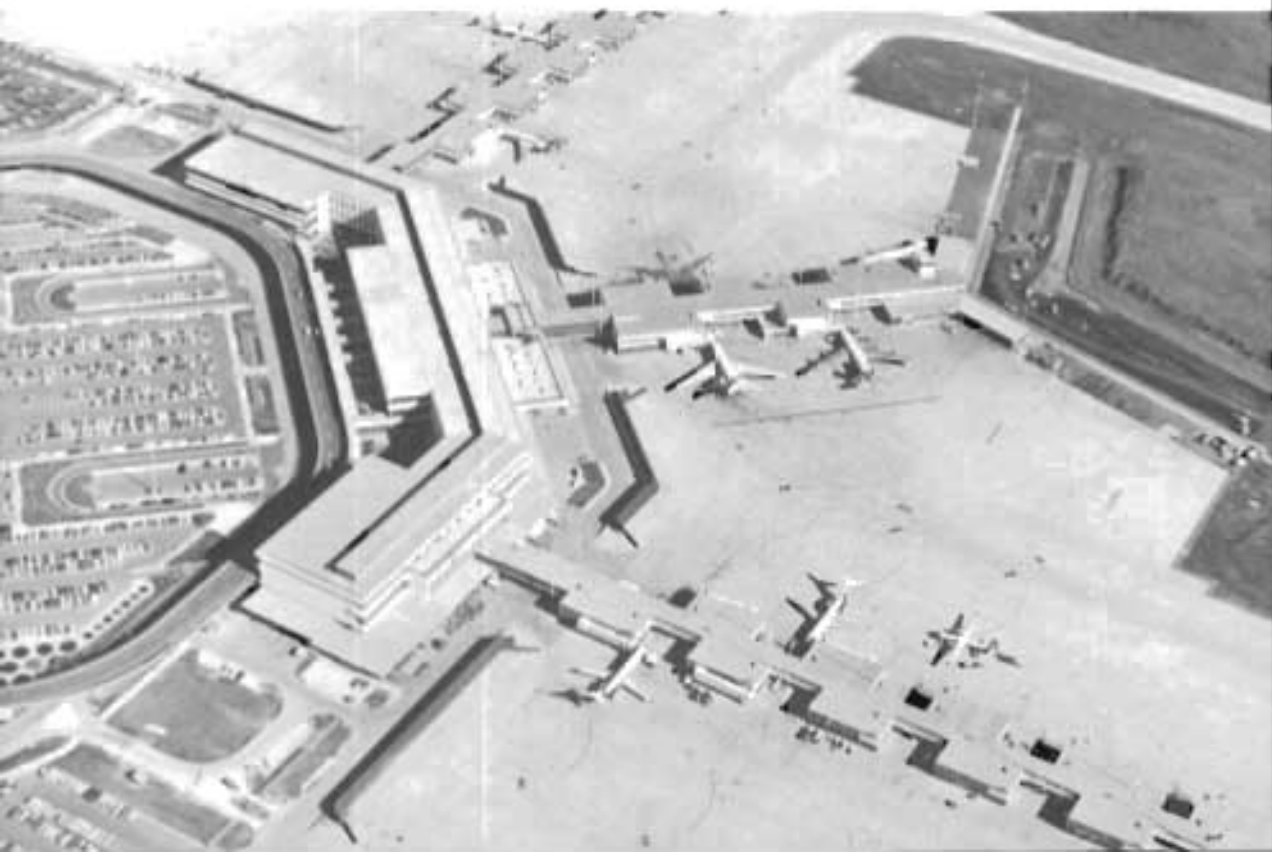
Melbourne and Metropolitan Tramways Board

Trams in Geelong (above) and Bendigo (right) have now ceased operation.

State Electricity Commission

Scene at Essendon Airport in the 1930s.
Department of Civil Aviation

Melbourne Airport at Tullamarine in 1971.
Department of Civil Aviation



Melbourne's first post office (in Flinde Street) with Batman's house in the le background, c. 1838.

La Trobe Collection, State Library of Victor

The Melbourne radio relay terminal Surrey Hills.

Postmaster-General's Departme

The economics of Australian domestic airline operations changed radically when legislation provided for the establishment and operation of national airline services by the Commonwealth, and the resultant Australian National Airlines Act, which received assent on 16 August 1945, established the Australian National Airlines Commission. This legislation was challenged by the private airline operators, and in December 1945 the High Court denied the Commonwealth the authority to monopolise air services, but upheld its right to establish a Commission to operate in competition with the privately owned airlines. In February 1946 the Commission was appointed and the formation of Trans-Australia Airlines was undertaken. An application to the High Court by the private operators for leave to appeal to the Privy Council against the Court's decision was disallowed, and in September T.A.A. began operations, with an interim once-daily service between Melbourne and Sydney, using converted R.A.A.F. C-47 aircraft. In the following month A.N.A. applied direct to the Privy Council for leave to appeal against the High Court judgment, but this application was disallowed. By the end of 1946 T.A.A. was carrying passengers, mail, and freight between all States of the Commonwealth. Further litigation ensued in 1950 when A.N.A. and Ansett Airways challenged the provisions of the *Air Navigation Act* 1920–1947 and regulations levying charges on airline operators. In November 1952 assent was given to the Civil Aviation Agreement Act, under which A.N.A. was given free and equal access with T.A.A. to government airline business, including mail contracts. The Government also agreed to underwrite a loan of $6m for replacement aircraft and to accept approximately one third of the $1.8m debited against A.N.A. for air route charges. A comparable reduction in the indebtedness of Ansett Airways was also granted, and T.A.A., which had paid the charges, received a book entry refund.

Ansett Airways Pty Ltd, though operating on a smaller scale than A.N.A. or T.A.A., became more significant after October 1947, when A.N.A. and T.A.A. increased their fares by some 15 per cent; Ansett's operations then impinged increasingly on those of the two major companies. A.N.A.'s financial position worsened, and the company accepted the offer of $6.6m from Ansett Transport Industries Ltd for the purchase of the airline and its assets. Ansett Airlines of Australia, as it has become known, introduced special "coach" services, using high density seating DC-3 aircraft on a similar basis to those used by the company for tourist services. With the introduction of the Fokker Friendship aircraft, the DC-3 aircraft were replaced. Flights serving many of the Victorian towns were withdrawn until in 1968 only Mildura, Warrnambool, Portland, and Hamilton were included in the schedule. Ansett Airlines of Australia, the private enterprise company, and T.A.A., the national airline, now operate parallel fleets of turboprop and turbojet aircraft. Both companies are based at Melbourne, where they have set up extensive maintenance, checking, training, and administrative facilities.

General aviation

General aviation includes flying training, charter operations, agricultural operations, and private flying.

Although civilian flying training in Victoria can be traced back to 1925, it was not until the years following the Second World War that there was a large growth in activity. In 1960 the State had only four training organisa-

tions, but by 1970 a total of thirty-five flying training schools were in operation. This was reflected by the increase in the number of student pilots from 675 in 1960 to 2,586 in 1970.

Charter flying had a similar growth rate and in 1970 there were 110 operators using a variety of single engined and light twin-engined aircraft. Following the withdrawal of airline services to those centres which could not support the larger capacity F27 aircraft, a number of charter operators in October 1967 began services linking country centres with Melbourne, working to fixed schedules with light twin-engined aircraft of capacity ranging up to 12 passengers. There are a number of factors, chiefly economic, which have precluded the establishment of a firmly defined pattern, and further experiment and adjustment will be likely until the public acceptance and demand are accurately measured and economic viability achieved.

Aerial agriculture has also grown rapidly. The first spraying was carried out on a pine forest near Ballarat in 1929, but by 1966 the annual average area sprayed or dusted from the air had reached a peak of 2.2 million acres. In 1956 the Tiger Moth was used for 90 per cent of the total hours flown in agriculture operations, but it has now been replaced by more modern aircraft.

The number of light aircraft operated by private flyers in Victoria has increased threefold since 1960 and the number of pilots holding private licences has increased fourfold during the same decade. The increase in aerial activities in general aviation has made existing airport facilities inadequate. The main general aviation airport in Victoria, Moorabbin, is the busiest airport in the State and the establishment of a number of private training fields at Whittlesea, Tyabb, Lilydale, Melton, Sunbury, and Geelong has been necessary.

POSTAL SERVICES AND COMMUNICATIONS

The Port Phillip settlement was established in 1835, and as government approval for the settlement was not obtained until the following year, settlers had to make their own postal arrangements and mail was deposited or collected at the home of John Batman. When Captain Lonsdale was appointed Superintendent of Port Phillip in the following year the postal service came under his control. The senior Customs Officer agreed to act temporarily as postmaster until a permanent appointment could be made, and he performed the duties from about 4 February 1837 until 13 April of the same year. E. J. Foster, Clerk to the Bench, then became the first officially appointed postmaster at Melbourne.

Foster rented a small bark hut in Collins Street, and this served as both residence and post office. By 31 December 1837, after almost nine months of operation, the Melbourne Post Office had handled a total of 1,050 letters and 1,355 newspapers. The postal revenue amounted to £33.10.10. The office of the postmaster was moved frequently until 1841, when an official post office was erected on the site of the present General Post Office at a cost of £1,415. A postal clerk and a letter carrier were provided at the same time. The first bag of mail to be sent from Melbourne to London left on 15 January 1839 aboard the 300 ton barque *Thomas Laurie*.

Victoria's second post office was established at Geelong early in 1840, followed by one at Portland soon after. By 1845 there were fourteen post offices operating in the State, and in 1852 there were forty-six. During 1844 the first post boxes were installed in Melbourne. These were made of wood, and one was placed at each end of the city. Clearances were made twice a day, except on Sunday.

An Act to establish a uniform rate of postage became operative on 1 January 1850 ; the weight of a single letter (letter consisting of a single sheet of paper) was fixed at half an ounce ; postage on inland letters was 2d, and on town letters (for local delivery within a town) 1d. Under this Act, authorisation was given to permit the placing of a contract for the printing of the Port Phillip District's first adhesive postage stamps. The contract was awarded to Thomas Ham, a local engraver, and the stamps became available to the public on 3 January 1850. With the discovery of gold during 1851 the population increased, as also did the volume of mail ; in 1850 the Post Office handled a total of 381,651 letters, while in the following year there were over 1.5 million handled by a staff of twenty-two clerks and twelve postmen. Considerable additions were made to the post office building in 1853, extending it to the corner of Elizabeth Street. The main entrance, however, still faced Bourke Street. During 1853 a record 3.5 million postal items were handled. There were then fifty-four post offices in Victoria, and the total staff for the State was ninety-seven.

Telegraphy was introduced into Australia in February 1854 when a line linking Melbourne with Williamstown was brought into operation. The service became available to the public on 3 March 1854, and by 1858 interstate telegraph lines linked Melbourne with Sydney and Adelaide.

An Act to amend the law relating to the Post Office was passed in April 1854. Letters under half an ounce for local delivery within a town were 2d; for delivery to other towns in Victoria 6d ; and for carriage by ship to places beyond Victoria 1s. Letters over half an ounce but not exceeding one ounce were charged double rate. Postal rates were reduced the following year. Local letters under half an ounce remained at 2d but letters for delivery to other Victorian towns were reduced to 4d and the cost of ship letters was halved to 6d. In April 1857 the control of the Post Office Department changed, and the position of Postmaster-General became a political office, while the permanent head of the Department was given the title of Deputy Postmaster-General. On 4 June 1858 an Act was passed authorising the issue of money orders in Victoria from 1 July 1858, and during the same year cast-iron letter receivers were first installed in the city and suburbs.

The old wooden G.P.O. soon became inadequate to deal with the greatly increased volume of mail, and although it occupied an ideal central location it was on low-lying ground receiving the natural drainage from the surrounding area. Accordingly, in an atmosphere of growing prosperity and optimism the Government planned a new prestige building capable of handling mail and other post office business for many years to come, and in 1857 offered cash prizes for the best design. The first prize of £300 for the exterior design was won by Messrs Crouch and Wilson, and E. Ramsay won £300 for the best interior design. Demolition work on the old G.P.O. began early in 1859, but a portion of the building was retained so that business could be continued during the rebuilding operations. The low-lying, swampy ground provided

many difficult technical problems for the builders, and elaborate measures were taken to provide adequate drainage. In its original form, the G.P.O. consisted of two floors and an attic. It had a large impressive Postal Hall and a colonnaded exterior, and was completed at a cost of £140,000. The new G.P.O., opened on 1 July 1867, is still in use today. In 1869 a clock which had been designed by R. E. J. Ellery, the Government Astronomer, and made at the Locomotive Workshops, Williamstown, was installed, and a set of five bells was added in 1871.

As Melbourne continued to grow, Australia's first telephone exchange was established there in May 1880; it was operated by the Melbourne Telephone Exchange Co. Ltd. Within two years the company had also opened exchanges at Ballarat and Bendigo, and had changed its name to the Victorian Telephone Exchange Co. The Victorian Government bought out the company in September 1887. Additions to the G.P.O. were planned, and in 1888 a third floor was added and the height of the clock tower was increased to 188 ft. A new clock (still in use today) was installed during 1890, and seven bells were added to the original set of five in 1891.

At this time postal and telephone services in the State were all controlled by the Victorian Government. Following Federation in 1901, postal, telegraphic, and telephone services throughout Australia were unified under one Commonwealth Department controlled by the Postmaster-General. However, the States continued to issue their own postage stamps, and postal rates were not standardised until 1 May 1911. The first issue of uniform postage stamps was made throughout the Commonwealth on 2 January 1913.

Interstate communications were improved in 1907 when the Melbourne to Sydney telephone trunk line service was established. An important telephone development occurred in 1912 when the first automatic telephone exchange was opened at Geelong. Other interesting developments included Australia's first airmail flight, which was made between Melbourne and Sydney in 1914, and the gradual conversion from manually operated morse code to machine operation which began on the main telegraph routes in 1923. During 1915 members of the Telephone Construction and Maintenance Union and the Postal Sorters Union formed the Postal Institute and rented a large room for recreational and instructional purposes. In October 1918 the Postmaster-General's Department took over management of the Postal Institute and provided the second floor of what is now the Melbourne Mail Exchange for Postal Institute purposes.

Melbourne's first broadcasting station was licensed in 1924. It was privately operated by the Associated Radio Company, under the call-sign of 3AR. A national network came into operation in July 1929 with the Postmaster-General's Department providing the technical facilities and the Australian Broadcasting Company the programmes. In 1932 the Australian Broadcasting Commission was constituted by Parliament to take over the broadcasting of programmes for the National network.

By the early 1930s progress in aviation led to expansion in airmail services. An airmail service introduced between Darwin and Singapore was designed to link up with the Imperial Airways London to Singapore service, the inaugural flight taking place on 10 December 1934. Internal airmail flights within Australia were also inaugurated during the same year ; Flight Lieutenant C. T. P. Ulm made an experimental airmail flight from Australia

to New Zealand in the *Faith in Australia*, leaving Sydney on 11 April 1934 and arriving at New Plymouth the following day. He also made the first official airmail flight from Australia to New Guinea in the same year.

During 1935 a 161 nautical mile submarine cable was laid across Bass Strait from Apollo Bay to King Island and then on to Stanley, Tasmania, by the cable ship *Faraday*. The installation of equipment to provide telephone, telegraph, and broadcasting channels was completed early the following year, and the cable system came into service on 25 March 1936.

The outbreak of the Second World War in 1939 caused the curtailment of some civilian services and reduced the development of others. From February 1942 restrictions were introduced on the provision of telephone facilities, except where required by the Armed Services, organisations concerned actively with national defence, security, or welfare, or persons engaged in the production of vital food products. These restrictions were basically due to the diversion of materials from production not essential to the war effort ; also many P.M.G. personnel had joined the Armed Forces, including many with years of specialised training. On the cessation of hostilities the Postmaster-General's Department faced many problems. With only a skeleton staff of trained personnel, suspended services had to be re-introduced ; much of the existing equipment needed modernising ; and new equipment was required to meet the demand for new services which had built up during the war years. There was an urgent need to recruit staff and introduce simplified training courses to provide trained personnel quickly. Measures were taken to meet the position and the three-year rehabilitation programme agreed to by the Government embraced capital works, including buildings and sites, to a value of $84m, and a new system of financing postal works enabled the Department to recruit staff and order materials on a long-range basis.

A mobile radio-telephone service was introduced in Australia during 1950, and in 1954 the Teleprinter Exchange Service (Telex), became available to the public. Further developments followed; television transmission began in 1956, and during that year a restricted form of trunk dialling was made available to several large commercial firms operating in the Dandenong area. The service operated between Melbourne and Dandenong. In 1959 the Automatic Teleprinter Reperforator Switching System (Tress) was introduced. With this system, a telegram transmitted by teleprinter from the originating office to the switching centre is reproduced on perforated tape and re-transmitted over the appropriate circuit to the office of destination without manual handling.

Subscriber Trunk Dialling (S.T.D.) was introduced in Victoria in December 1960 when Geelong and Bendigo subscribers were given direct dialling access to the Melbourne telephone network. In 1962 the Melbourne to Sydney co-axial cable came into service, and the first automatic postal station in Australia was installed at Melbourne. Lightweight coloured telephones became available in Australia during the year.

The Department built a television relay and radio-telephone station at Surrey Hills during 1963 to act as the Melbourne terminal for the various systems serving country areas. In that year the first relay of television programmes was made over the Melbourne to Sydney co-axial cable, and

the first public demonstration of the Data Transmission Service operating between Melbourne and Sydney took place. A noteworthy technical development which came into general use from 1963 was the employment of compressed air in cables to prevent moisture from entering if a small leak occurs; the system also assists in indicating the location of larger leaks.

In 1964 the departmental building in Spencer Street which, since its erection in 1917 had replaced the Elizabeth Street Office as the G.P.O., became the Melbourne Mail Exchange. The Elizabeth Street Office then reverted to its original title as the G.P.O. Also, early in that year, Telepost, a development of the first automatic postal station, was opened and provided a continuous service to the public for the first time. In the same year a famous Melbourne landmark, "The Old Tin Shed", formerly erected alongside the G.P.O. on the Post Office Place corner, was demolished. It had been built in 1906 as a temporary telegraph office, but had remained for nearly sixty years until it was demolished to provide the site for the new Plaza and P.M.G. Information Centre which was completed in September 1965.

The Australian currency was converted to the decimal system in February 1966, and provided a major project for the Postmaster-General's Department, since it involved not only the design and printing of new postage stamps, money orders, postal notes, etc., but also the conversion of equipment. Considerable development took place at this time in the major trunk line routes of telecommunications. These new trunk systems (some co-axial cable, others micro-wave radio) employ repeater stations throughout the country areas and a terminal station in the city. They form the broadband network. During August 1966 a broadband micro-wave system was opened between Melbourne and Adelaide. Two months later a similar system commenced operation between Melbourne and Albury, and still another opened between Melbourne and Launceston in November 1966.

Automatic Telex was introduced in all States during 1966, enabling Telex subscribers to make direct calls without the assistance of a P.M.G. operator. The following year saw the introduction of the "Postcode" system, designed to facilitate sorting the increasing quantities of mail which pass through centres such as the Melbourne Mail Exchange.

In February 1971 a new type of letter processing machine was installed at the Melbourne Mail Exchange. It rejects articles unsuitable for machine handling, then arranges the accepted mail face upwards and postmarks the stamps. The postmarked mail is then collected in a single output stacker ready for the sorting process.

By 1971, 134 years after the appointment of the first postmaster, the number of staff employed by the Victorian section of the Postmaster-General's Department had increased to 28,500. Post offices had increased from one to 1,823, of which 334 were official offices, and 1,489 had non-official status. About four million postal items were handled daily at the Melbourne Mail Exchange.