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The Spatial Structure of the Australian Sugar Industry

B. S. Hoyle

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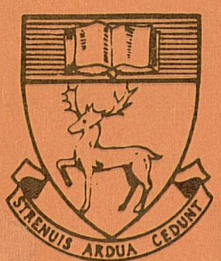

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B.S. HOYLE

ABSTRACT

The agricultural economy of the coastal zone of Queensland and adjacent areas of New South Wales is dominated by sugar production designed for inter-state and overseas export destinations. The modern bulk-cargo terminals which provide shipment facilities at six Queensland sugarports constitute a critical element in a complex system of cultivation, processing, transport and marketing which is closely supervised and controlled at every stage. Attention is focused in this paper on two inter-related aspects of the Australian sugar industry. First, the spatial relationships between sugar cane cultivation areas, sugar mills and sugarports are examined in terms of the factors involved in hinterland structures. Second, attention is given to the role of the sugarports within this system and in the regional economy of the area. The evolution of a series of sugarport systems is outlined, and the modern terminals are discussed in the context of their various predecessors and in terms of comparative cargo throughputs.

ACKNOWLEDGEMENTS

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INTRODUCTION

The cultivation of sugar cane, the harvesting and milling of the crop, and the export of raw sugar from coastal ports, together constitute the most important agricultural activity in the coastal zone of Queensland and adjacent parts of north-eastern New South Wales (Fig. 1). Behind the generally well-watered coastal areas the eastern scarplands of the continent yield a series of ranges through which several permanent rivers and their tributaries have cut deep gorges. The fertile alluvial coastal plains, discontinuous but significant in overall extent, provide the essential environment for sugar cane cultivation. Access from the sea is ensured by the estuaries of deltas of the principal river systems, and successive hierarchies of sugarports have been established in close association with these natural waterways and fertile soils. One of the chief problems of commercial agricultural development in tropical areas - particularly in economically, physically or spatially marginal zones - is the establishment and maintenance of an efficient transport system, closely integrated with hinterland conditions of production and with external patterns of market demand. Within such a system, ports constitute a critical element, able to facilitate or to frustrate the degree of efficiency with which commodity movements take place between producing and consuming areas.

The greater part of the coastal zone of Queensland lies north of the Tropic of Capricorn, and in present-day spatial terms is located well outside the economic heartland of the Australian continent in the south-east. For a variety of reasons, including particular historical circumstances, sugar production is the only major primary industry which has been able to adapt successfully to the physical problems posed by the tropical environment and to the economic difficulties that result from peripheral location. The cultivation and milling of the crop, and the marketing of raw sugar, are essentially directed towards a range of overseas foreign markets and towards movements by sea to refineries situated in the major urban areas of south-eastern, southern and western Australia. The domestic market within Australia is effectively

assured by strict controls on sugar imports from overseas, but the competitive position of Australian sugar on the world market is dependent upon comparative price levels, the maintenance of high standards of cultivation and processing within the producing areas, and the regulation of world sugar flows by international trade agreements.

ORIGINS AND DEVELOPMENT OF THE SUGAR INDUSTRY

The occupation of the coastal zone of Queensland by people of European origin dates from the 1820s and was initially associated with penal settlements which were offshoots of those established earlier in New South Wales. The first such settlement in Queensland was at Brisbane (1823-24), and from this point in the south-eastern corner of the territory exploration and settlement gradually spread northwards and westwards, and a substantial proportion of the present area of the state had been effectively occupied by the time Queensland was proclaimed a separate colony in 1859. Free settlers were mainly interested in the development of pastoral industries and in the exploitation of goldfields, and it was for these purposes that a series of small ports was gradually established along the coast, including Mackay (1863) and Townsville (1864). The introduction of sugar cane cultivation into Queensland is generally associated with the name of Captain Louis Hope who established a plantation near Brisbane in 1862, and two years later successfully operated Australia's first commercial sugar mill. Although the viability of any form of commercial tropical agriculture was frequently questioned, the expansion of sugar cultivation was generally successful. From the mid-1860s canegrowing was established increasingly further north in a series of coastal enclaves, each with its cluster of mills and with a number of primitive port outlets. Sugar growers, like other farmers, experienced a good deal of difficulty in coming to terms with the tropical environment; there were many problems with crop diseases, and a good deal of experimentation with crop varieties. At the time sugar-milling technology was very primitive, and transport was always a problem given the absence of navigable rivers and reliable roads throughout most of the sugar-producing areas.

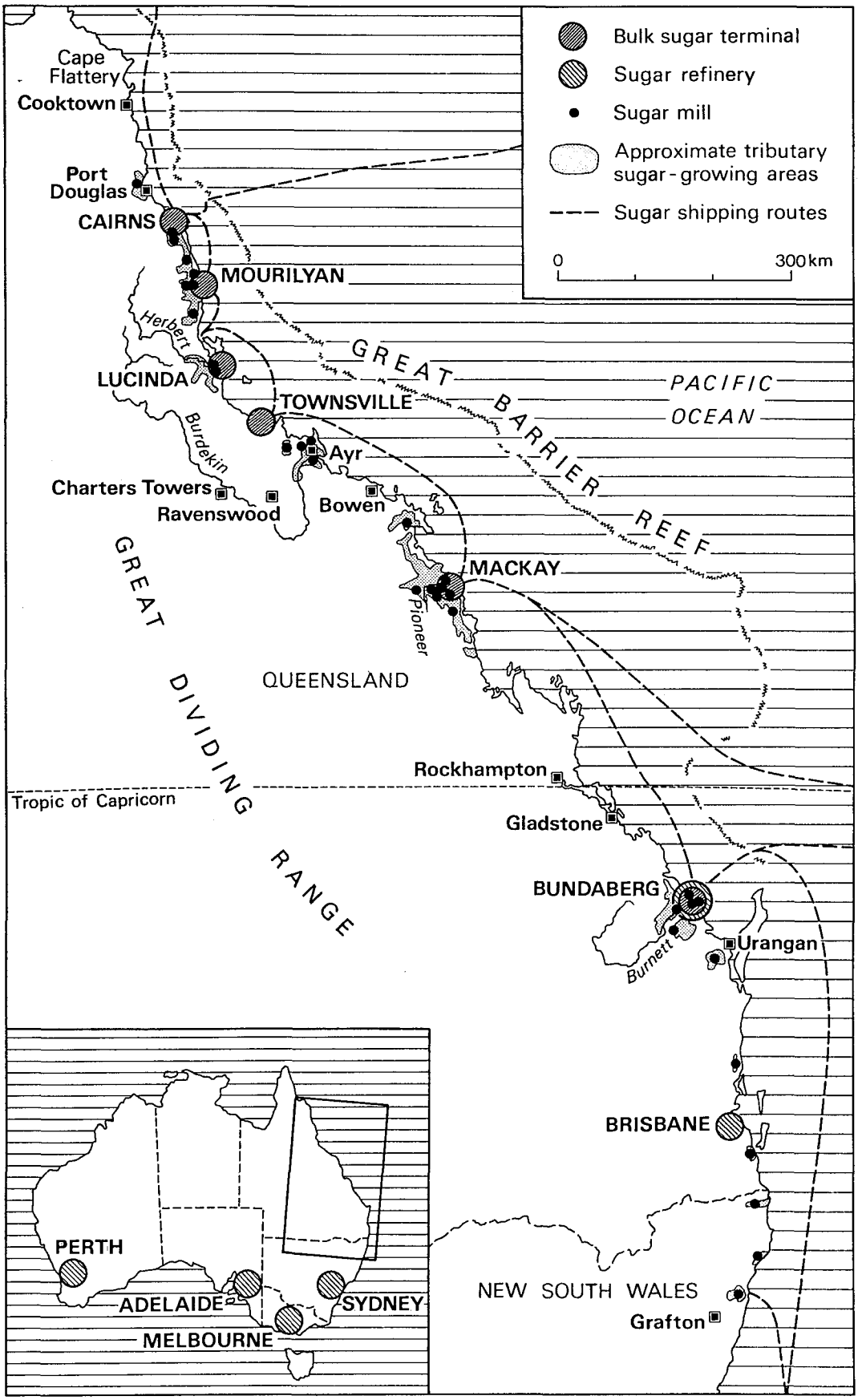

Fig. 1 The geographical distribution of the Australian sugar industry

Sugar cultivation in nineteenth-century Queensland was based initially upon the traditional tropical monocultural plantation system, upon the establishment of a large number of small sugar mills and upon the importation of coloured labourers from the islands of the South Pacific (Docker, 1970). Economically and politically the industry was highly unstable, especially during the 1870s when European sugar-beet production was increasing rapidly on a subsidised basis. Improved market conditions enhanced the importance of Queensland sugar exports from the early 1880s, however, and increased investment in the industry involved the expansion of cultivation as far north as Cooktown. The development of the sugar industry did not initially require the establishment of any additional port outlets, but the sugar trade was vital to the survival of numerous small ports set up in association with the still tentative development of the pastoral hinterland. The sugar export trade was a major factor in the process of consolidation, specialisation and development of selected port outlets in response to the character and patterns of Queensland's emergent economy.

From these precarious beginnings the sugar industry of the Queensland coast gradually attained a position of agricultural supremacy in the tropical Australia of the mid-twentieth century (Courtenay, 1978a and 1983). Considerable expansion took place in the mid-1960s as a result of major changes in the international sugar market following the Cuban revolution of 1959. The effective collapse of the International Sugar Agreement, and subsequent poor harvests in other producer countries, encouraged the Australian government to take advantage of rising sugar prices and to extend the areas assigned for sugar cultivation. The Gibbs Report (Queensland Government, 1963) recommended a total expansion of sugar-growing areas of 60,900 hectares, and the implementation of this recommendation introduced over 1000 new sugar growers into the system. Further increases took place during the 1970s, primarily as a result of the successful negotiation of contracts with Japanese markets.

The position of the sugar industry in the Australian economy is dependent upon rigid statutory controls and privileges, largely denied to other crops, and reinforced by substantial technical services and achievements.

The regulation and protection of the sugar industry dates from the incorporation of Queensland within the Commonwealth of Australia in 1901; the first federal parliament introduced legislation to prohibit any further immigration of Pacific Island labourers (Kanakas) and to facilitate the repatriation of those already resident. Although dependent thenceforward on European labour, and in due course upon a gradually increasing degree of mechanisation, the emergent sugar industry was defended from foreign competition by controls on sugar imports into Australia imposed by the Commonwealth Government in return for an undertaking to supply the domestic market with sugar at a price determined by that Government.

The preservation of the Australian sugar industry today as a largely successful and export-oriented tropical agricultural enterprise, in competition with output from other parts of the tropical world where labour is generally cheaper, is dependent within the producing areas upon a closely-regulated system of operation (Fig. 2). The regulation of production and division of proceeds is the responsibility of the Central Sugar Cane Prices Board, established in 1915 under the Regulation of Sugar Cane Prices Act. The Board controls the areas of land on which individual farmers grow sugar cane through the system of farm assignments. It also makes recommendations to the Queensland Government regarding the level of production quotas or mill peaks for Queensland sugar mills. The aggregate of peaks corresponds approximately to the Board's assessment of the quantity of raw sugar required for home consumption and reasonably assured export market outlets. The Sugar Board, constituted in 1923 under the Sugar Acquisition Act of 1915, is responsible for recommending to the Queensland Government the quantities of raw sugar required for home consumption, exports within peaks, exports in excess of peaks and the net proceeds from sales of all sugar for the purpose of determining final prices for the season. The Board is also responsible for recommending to and advising the Queensland Government upon policy and programmes carried out to maintain and improve the quality of Australian raw sugar.

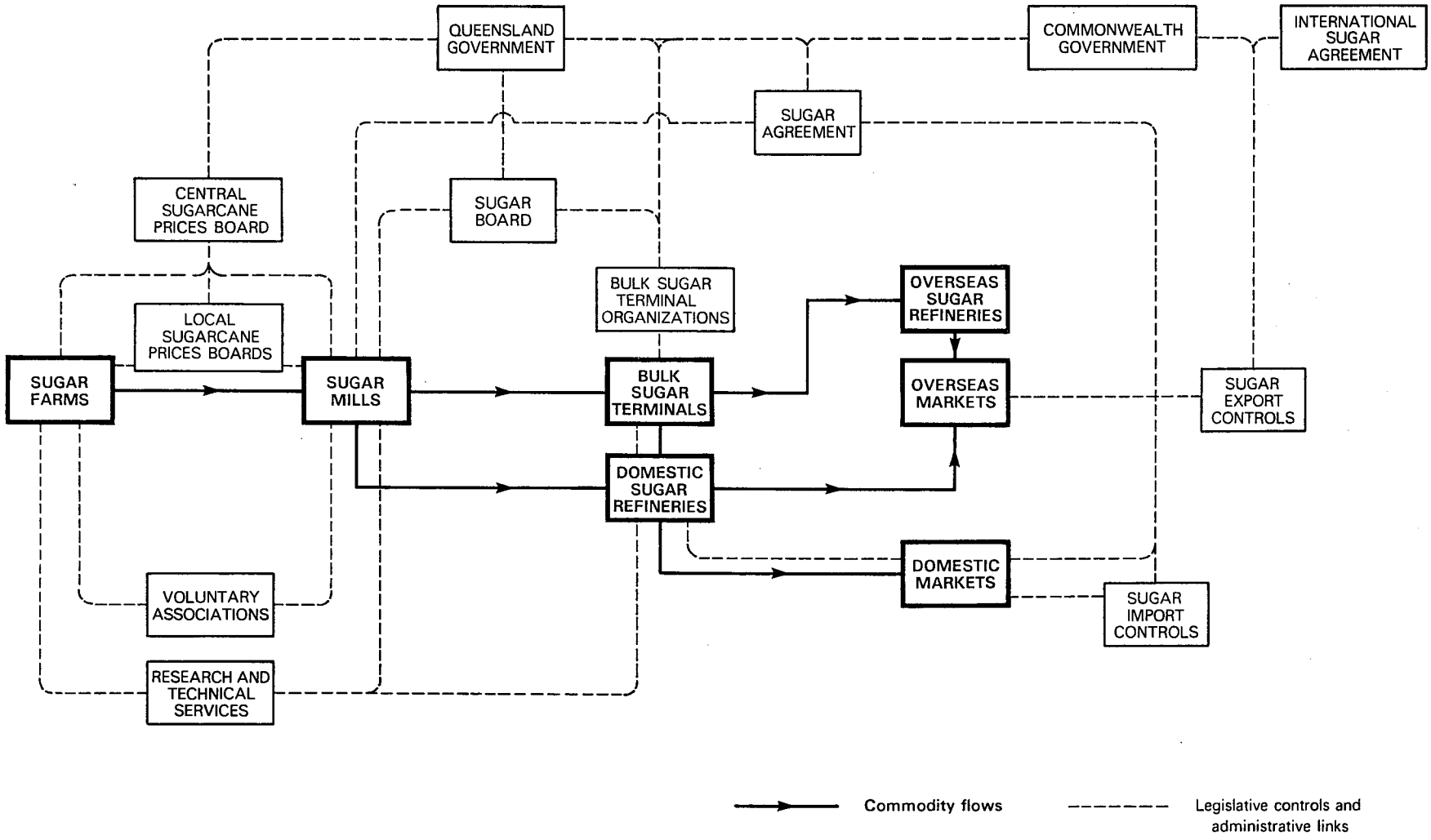

Fig. 2 Some elements in the structure of the Australian sugar industry

This system, by controlling the area of land under sugarcane at the individual farm level, and by exercising quality and volume controls at the level of the sugar mills, effectively encourages the intensification of high-quality production. In terms of marketing, the sugar industry relies to a relatively small extent in relation to its major competitors upon the protected domestic market, through the intermediary services of the sugar refineries located within the principal areas of population concentration, and under the terms of the Sugar Agreement between the Commonwealth Government and that of Queensland. Exports of raw sugar to a wide range of overseas destinations are far more important, especially to North America and to eastern and south-eastern Asia. Australia is a member of the International Sugar Agreement and all these exports therefore come within ISA quota provisions. However, sales are made on a variety of bases, including long-term contracts of up to about five years duration.

PORTS, MILLS AND TRIBUTARY AREAS

The spatial structure of the Australian sugar industry, in terms of the patterns of sugarcane cultivation and their relationships with the location and distribution of sugar mills, with the hinterlands of the sugarports, and with domestic and foreign markets, is clearly a reflection of a wide variety of historical and present-day factors operating on many different scales. The modern spatial system comprises, in essence, a series of bulk sugar terminals along the maritime facade of north-eastern Australia, each of which serves a well-defined sugar hinterland. Within each sugar hinterland are located several sugar mills, and the sugar-growing areas tributary to each of these mills are again clearly specified. The relationships between canegrowing areas, mills and ports are largely determined today in administrative terms by the Central Sugar Cane Prices Board. One of the chief functions of the Board is to establish and control the area and distribution of land on which sugar may be grown; under this system, the Board assigns particular areas of cane land to each mill,

and farmers growing sugarcane on assigned land must deliver their cane to the associated mill. The area of assigned land, both in relation to specific mill areas and in terms of the canegrowing areas as a whole, is revised periodically in the light of production and market trends. The system encourages the use of land closest to the mills, helps to ensure rational land use and promotes efficient transport arrangements.

Almost all the sugarcane grown in Queensland and northern New South Wales is produced on farms owned and operated by the sugar growers themselves. There are at present about 7000 sugar growers, and the total area of land allocated to cane cultivation in 1982 was approximately 370,000 hectares. The average farm size is therefore 55 ha although in fact farms vary from about 20 to over 70 ha. Details of the relationships between individual farmers and the sugar mills are determined by Local Sugar Cane Prices Boards which establish individual farm quotas each season, in terms of hectares of cane land, tonnes of cane or tonnes of raw sugar. A Local Board Award also covers each year such matters as the commencement of crushing, the delivery of cane to the mill, sampling and analysis procedures, prices and payment for cane. Farm quotas are allocated to growers on assigned land in such a way that each mill can expect to fill its quota in a normal season. Raw sugar in excess of the mill peaks may be accepted if markets are available; farmers often grow excess sugar which, if not required, is either destroyed or held over for harvesting during the following year.

There are at present 30 sugar mills in Queensland and a further three in north-eastern New South Wales (Fig. 1); fifteen are owned cooperatively by canegrowers, and 18 by proprietary companies. In the 1981 season these mills crushed about 25 million tonnes of sugarcane and produced about 3.4 million tonnes of raw sugar. The mills, together with their tributary canegrowing areas, comprise a series of well-defined subsystems within the spatial structure of the Australian sugar industry as a whole; most of these subsystems are directly dependent upon one of the bulk sugar terminals and thus constitute the sugar hinterland of that terminal. The six port-dependent subsystems are outlined below, and illustrated in Figures 3 to 8. Details of the sugar mills are also

summarised in Table 1.

The Cairns subsystem

Within the sugar hinterland of the port of Cairns, where the most northerly of the six Australian bulk sugar terminals is located, four sugar mills are supplied from a gross assigned area of 39,500 ha farmed by 754 sugar growers (Fig. 3, Table 1). The oldest of the four mills is the Hambledon mill at Edmonton which dates from 1881 and serves growers from the immediate hinterland of the port to the north, west and south. Hambledon mill was established by Thomas Swallow, a pioneer farmer who named his estate after his birthplace in Surrey, England; his mill was originally linked by tramway to a coastal inlet where sugar was shipped across a wharf some 10 km from the sea. A short distance to the south, at Gordonvale, the Mulgrave mill (1893) is supplied from the alluvial plains of the Mulgrave river and adjacent areas. Continuing southwards along the line of the main coastal road and railway, a substantial area of assigned land is tributary to the Babinda sugar mill located some 63 km from the sugarport at Cairns. North of Cairns there is a break in the coastal sugar belt until the vicinity of Mossman is reached. Here, beyond the limits of the coastal railway and isolated from all other canegrowing and milling areas, some 161 sugar growers supply the Mossman mill which dates from 1897 and was for many years served by Port Douglas. Together the four sugar mills in the Cairns subsystem produced 302,000 tonnes of raw sugar in the 1981 season, and the mill peaks established for the 1982 season totalled 352,100 tonnes.

The Mourilyan sybsystem

The sugarport of Mourilyan also contains within its hinterland four sugar mills (Fig. 4), and the general pattern and scale of operation is not unlike that within the Cairns subsystem. Many of the cane-producing areas tributary to these four mills lie within the valleys of the South Johnstone and Tully rivers. The oldest mills lie closest to the port: Mourilyan mill itself (1882) and the Goondi mill near Innisfail (1885). These two mills are rather smaller than the other

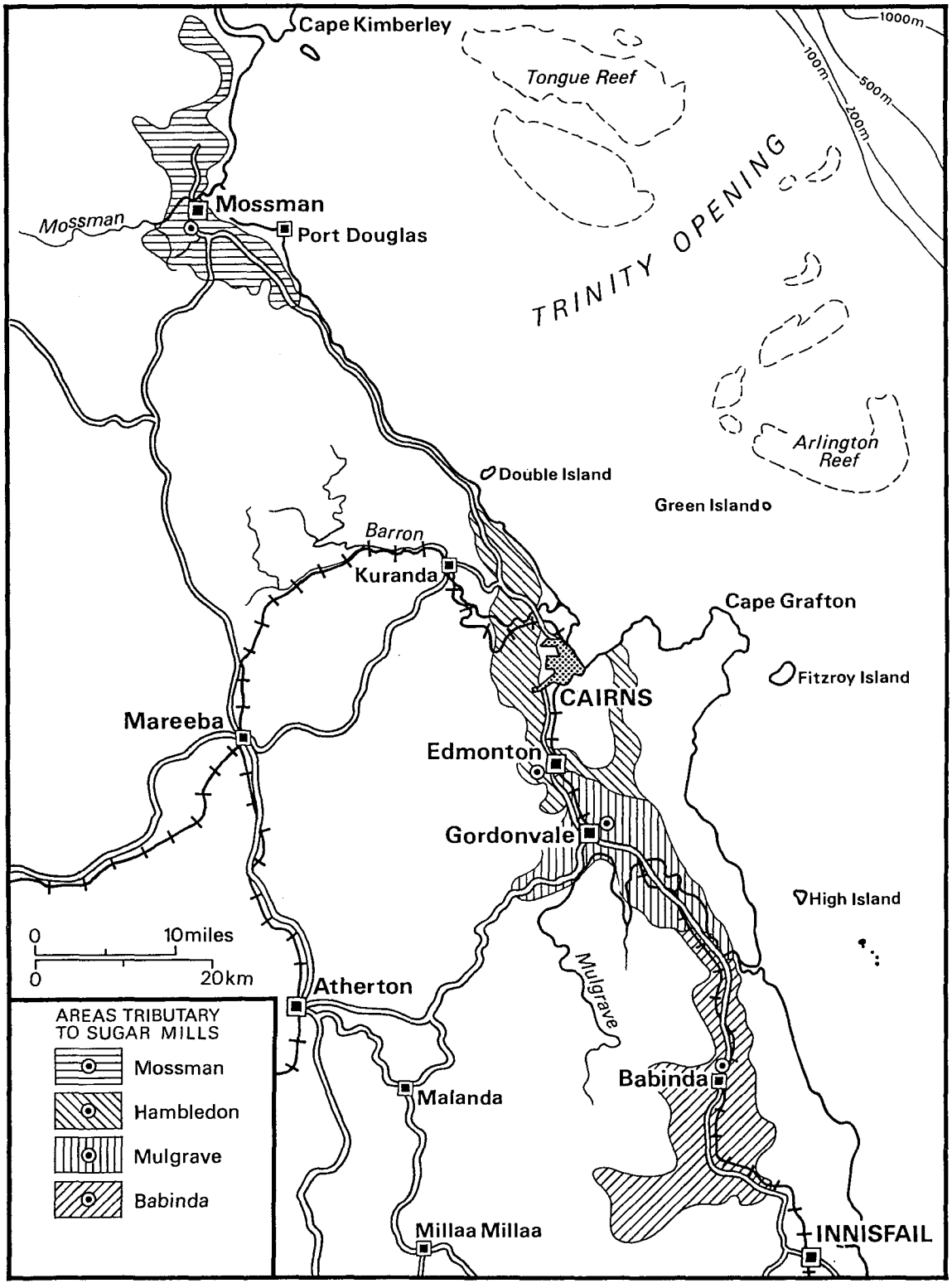

Fig.3 The sugar hinterland of the port of Cairns

TABLE 1: Australian raw sugar production by mills and regions

Region	Mills	Date[1]	Gross assigned area (ha.)	Number of suppliers	Production: 1981 season (tonnes)[2]	Mill peaks: 1982 season (tonnes)
Cairns	1 Mossman	1897	8,880	161	72,800	80,000
	2 Hambledon	1881	9,745	193	81,200	91,400
	3 Mulgrave	1893	9,734	167	80,500	93,200
	4 Babinda	1915	11,143	233	67,500	87,500
Sub-total			39,502	754	302,000	352,100
Mourilyan	5 Goondi	1886	7,980	165	67,600	78,600
	6 Mourilyan	1882	8,883	170	61,600	80,300
	7 South Johnstone	1916	12,916	259	100,900	116,900
	8 Tully	1925	13,293	254	108,700	121,600
Sub-total			43,072	848	338,800	397,400
Lucinda	9 Victoria	1885	26,071	511	200,000	231,800
	10 Macknade	1874	13,319	248	92,100	118,600
Sub-total			39,390	759	292,100	350,400
Townsville	11 Invicta	1921	8,274	198	110,200	94,900
	12 Pioneer	1884	9,269	155	135,300	129,800
	13 Kalamia	1883	10,479	177	141,800	137,500
	14 Inkerman	1915	11,610	235	163,100	162,500
Sub-total			39,632	765	550,400	524,700

Region	Mills	Date[1]	Gross assigned area (ha.)	Number of suppliers	Production: 1981 season (tonnes)[2]	Mill peaks: 1982 season (tonnes)
Mackay	15 Proserpine	1897	15,357	220	145,200	125,300
	16 Farleigh	1883	14,887	269	145,500	127,870
	17 Racecourse	1889	12,480	199	144,100	120,500
	18 Pleystowe	1872	13,197	256	140,800	125,730
	19 Marian	1895	14,707	242	136,900	118,500
	20 Cattle Creek	1906	6,850	129	66,400	58,800
	21 North Eton	1888	10,060	155	89,700	78,900
	22 Plane Creek	1896	14,223	254	148,900	123,100
Sub-total			101,761	1,724	1,018,500	878,700
Bundaberg	23 Fairymead	1884	14,344	247	154,600	129,890
	24 Qunaba	1883	4,244	92	46,400	47,200
	25 Millaquin	1883	9,970	295	109,300	98,700
	26 Bingera	1885	16,390	314	148,500	124,610
	27 Isis	1897	13,674	207	120,400	99,000
	28 Maryborough	1897	8,468	215	68,800	65,000
Sub-total			67,090	1,370	648,000	564,400
Brisbane	29 Moreton	1897	6,431	147	58,800	60,400
	30 Rocky Point	1886	4,626	123	41,800	43,100
Sub-total			11,057	270	100,600	103,500
NSW	31 Condong	1880	8,027	136	)	
	32 Broadwater	1881	11,443	197	)184,500	183,200
	33 Harwood	1874	10,114	230	)	
Sub-total			29,584	563	184,500	183,200
Total:			371,088	7,053	3,433,900	3,354,400

Sources: Australian Sugar Yearbook (1982), and Colonial Sugar Refinery Company Ltd.

Notes: (1) Date of first commercial crushing on present site.

(2) Tonnes 94 nt (net titre): an empirical measure of the commercial value, for refining purposes, of raw sugar.

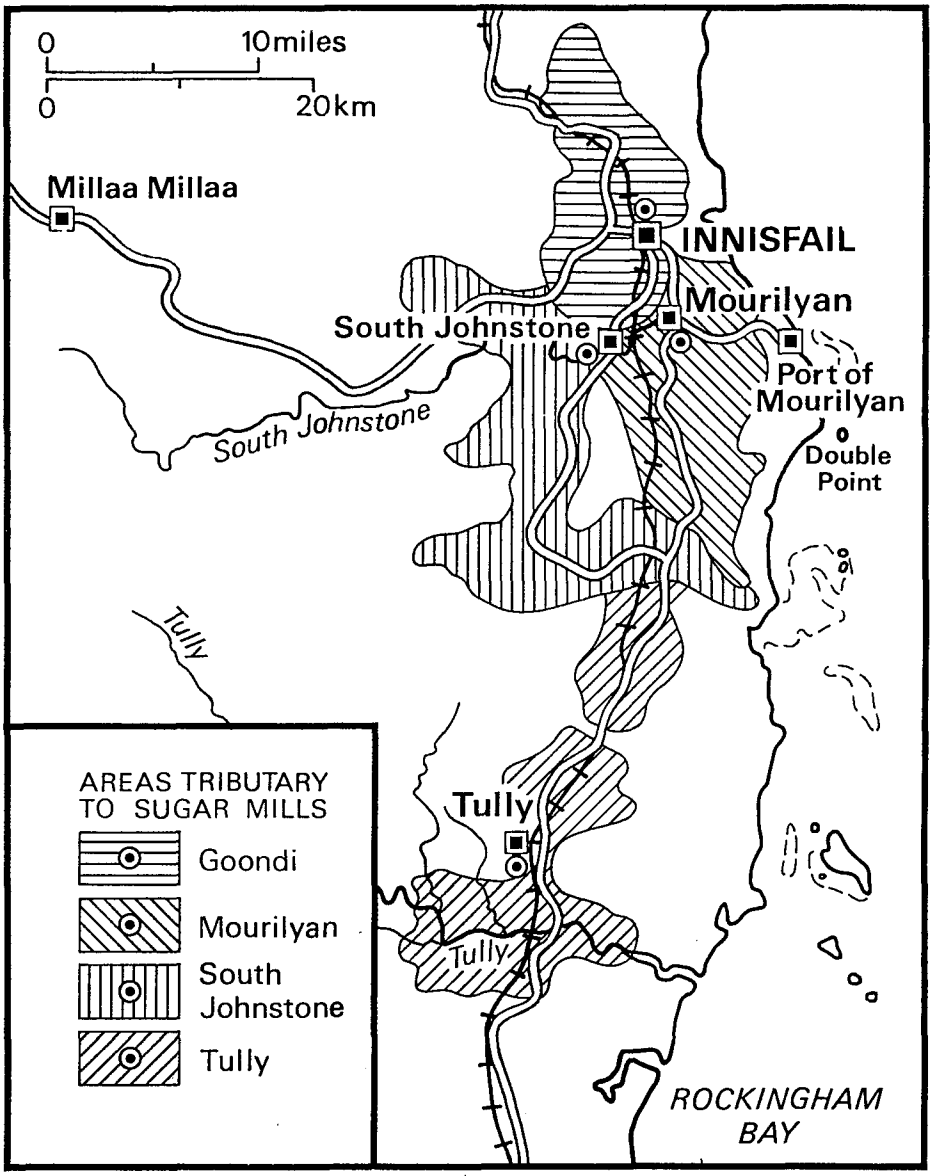

Fig.4 The sugar hinterland of the port of Mourilyan

two mills in this subsystem, both of which belong to a small minority of Australian sugar mills (6 out of 33) established in the twentieth century. / The South Johnstone mill (1916) serves a substantial area of cane-producing land lying to the west of the main coastal transport axis. The Tully mill (1925), Australia's youngest sugar mill, serves an important producing area which centres upon the intersection of the north-south transport axis and the west-east axis of the Tully river valley. Within the Mourilyan subsystem some 848 sugar growers farm 43,072 hectares of assigned land. Production from the four mills totalled 338,800 tonnes of raw sugar in 1981, and the mill peaks for the 1982 season were set at 397,400 tonnes.

The Lucinda subsystem

The sugarport of Lucinda serves an important sugar-producing area which stretches inland along the Herbert river valley to the vicinity of Abergowrie and southwards along the tributary Stone river valley and along the coastal transport axis. Ingham, the principal town of the area, is located at the intersection of these coastal and west-east routes. The greater part of the sugar hinterland of Lucinda consists of the 26,071 hectares of assigned cane-growing land, farmed by 511 growers, that supply Australia's largest sugar mill, the Victoria mill near Ingham. This mill, which dates from 1885 and is one of the largest sugar mills in the world, produced over 200,000 tonnes of raw sugar in 1981. The older Macknade mill (1874), located north of the Herbert river between Ingham and Lucinda, is also smaller; supplied by 248 growers farming a gross assigned area of 13,319 hectares, the Macknade mill produced 92,100 tonnes of raw sugar in 1981 and was allocated a mill peak of 118,600 tonnes for 1982.

The Townsville subsystem

In terms of sugar growing and processing the Townsville subsystem is primarily associated with the alluvial floodplains and levees of the lower Burdekin and Haughton rivers (Fig. 6). Rainfall in this area is low and unreliable (1075 mm at Ayr compared with 1667 mm at Mackay), and as a result this part of the coastal zone was intially regarded as

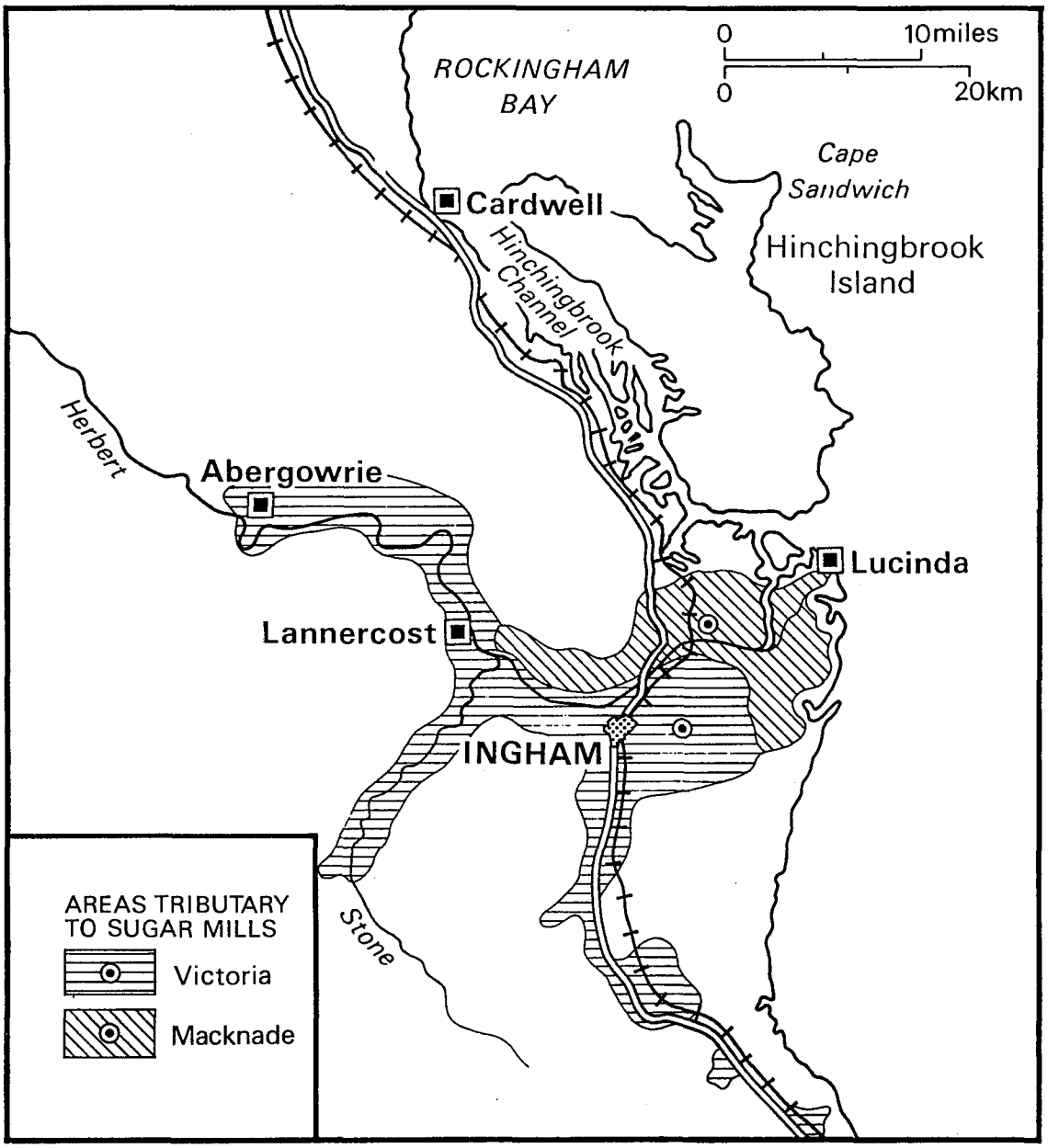

Fig.5 The sugar hinterland of the port of Lucinda

unsuitable for sugarcane cultivation during the expansion of the industry to North Queensland in the early 1870s. Later, however, the possibility of developing sugarcane production under irrigation was investigated, and from the 1890s sugarcane was grown by this method both on estates and by individual farmers. Subsequent expansion on the basis of progressively more advanced irrigation techniques has given rise to substantial increases in production in this area (Courtenay, 1978b). Three of the four sugar mills within the Townsville subsystem are located close to the twin townships of Ayr and Home Hill which lie respectively north and south of the intersection of the lower Burdekin river and the coastal transport axis. On the south bank of the river at Home Hill the Inkerman mill (1915) is the largest and most recent of this group and serves an assigned area of 11,610 hectares with 235 growers; prior to the introduction of bulk sugar-exporting facilities at Townsville in 1959, this mill lay within the sugar hinterland of the port of Bowen. Most of the 10,479 hectares assigned to the Kalamia mill - the oldest mill in this group, dating from 1883 - lie between Ayr and the coast; the Kalamia estate was initially developed for sugarcane cultivation by pioneer pastoralists, the brothers Charles and John Young. West of the railway line and north of the river is a 9269-hectare zone tributary to the Pioneer mill (1884), originally associated with the name of another early Queensland pioneer, John Drysdale; much of the early development of this area is attributable to the work of the Drysdale family. These three mill tributary areas are contiguous, but the Invicta mill (1921) at Giru serves an isolated cane-producing zone in the Houghton river area comprising 8274 hectares farmed by 198 suppliers, and also crushes cane from farms along the Burdekin river valley to the south. Production of raw sugar from the four mills in the Townsville subsystem exceeded 550,000 tonnes in 1981; in terms of output (although not in terms of the total gross assigned area or the number of suppliers) the Townsville subsystem is more important than any of the other three North Queensland subsystems. This is Australia's - and probably the world's - most high-yielding sugarcane district.

The Mackay subsystem

Mackay is the most important sugarport on the Queensland coast, and one of the largest in the world. It contains within its sugar hinterland a substantially larger assigned area (101,761 hectares) and considerably more suppliers (1724) than any of the other five Australian bulk terminals. Eight sugar mills lie within this subsystem (Fig. 7), and six of them are located close to the port or along the west-east axis of the Pioneer river valley. Outside this nucleus the two remaining mills are those at Sarina and Proserpine, respectively south and north of the Mackay complex. The oldest mill in the area is the Pleystowe mill, located some 18 km west of Mackay on the south bank of the Pioneer river. The Pleystowe sugar plantation began operations in 1869 when the land now occupied by the mill was purchased from a pioneer farmer growing cotton and tobacco, and the first sugar manufactured at the mill was sent to Mackay by horse-drawn carts for shipment to Brisbane in 1872. On the north side of the Pioneer river, about 13 km from Mackay, the Farleigh mill was built in 1883 by Sir John Bennett Lawes, the founder of the Rothamsted agricultural research station, England. Early in the present century this mill was improved and gradually absorbed the cane previously treated at nine other small sugar mills in the area, thus illustrating particularly well the process of consolidation and rationalisation which was a major feature of the industry around the turn of the century.

Most of the surviving mills in the Mackay area date from the later 1880s and 1890s: North Eton (1888) was the first cooperative central mill in Queensland built under the provisions of the Central Sugar Mills Act, and serves a substantial area south-west of Mackay. Racecourse mill (1889) was established on a similar basis, just 6 km south of the town. Marian mill, located about 27 km west of Mackay on the south bank of the Pioneer river, dates from 1895, although it occupies the site of another mill established ten years earlier. Further west along the Pioneer river valley axis, the Cattle Creek mill at Finch Hatton is 60 km from the port and is the most recent mill in the area, having been built in 1905-06. Two other mills served by the port of Mackay both lie

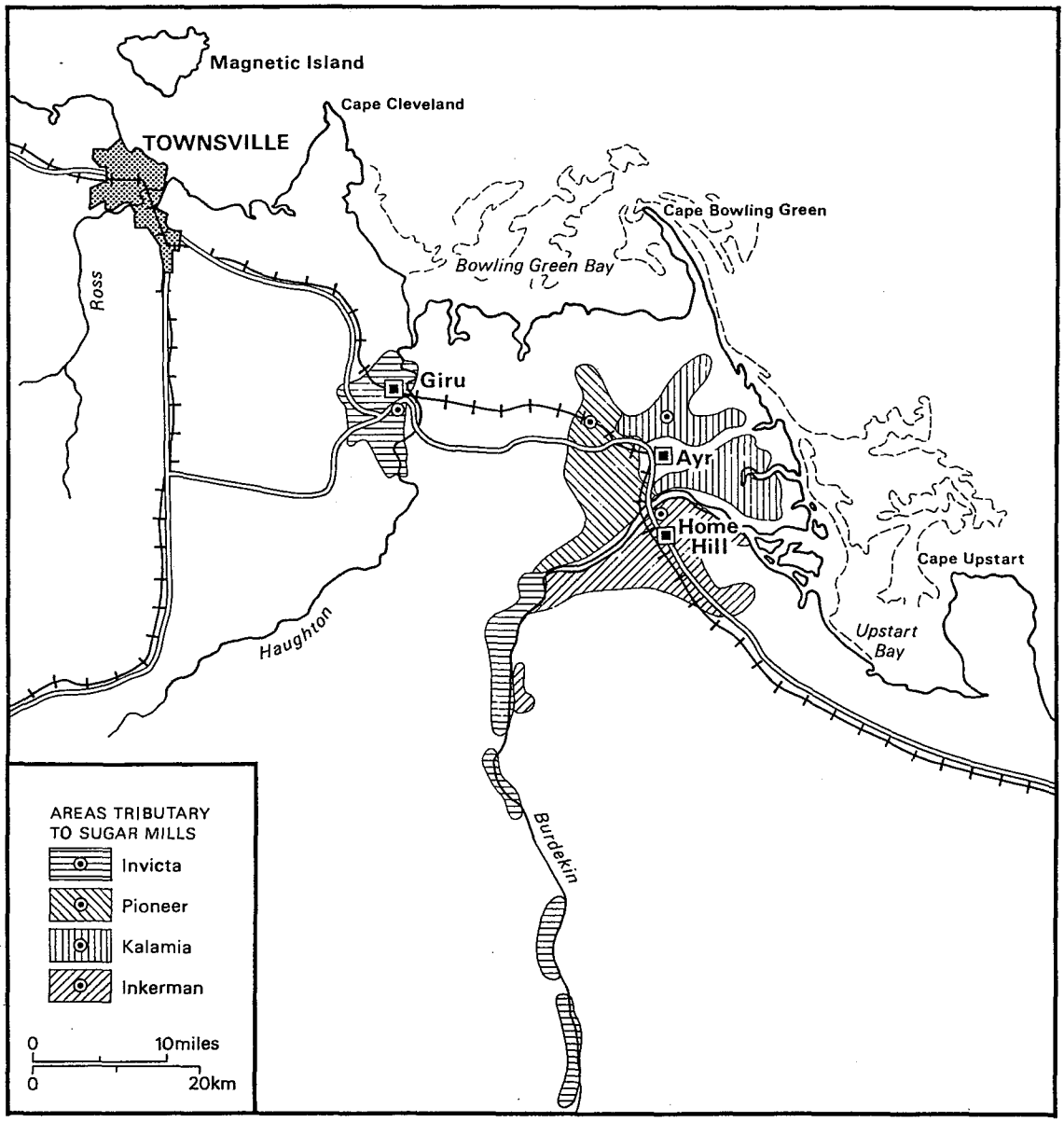

Fig.6 The sugar hinterland of the port of Townsville

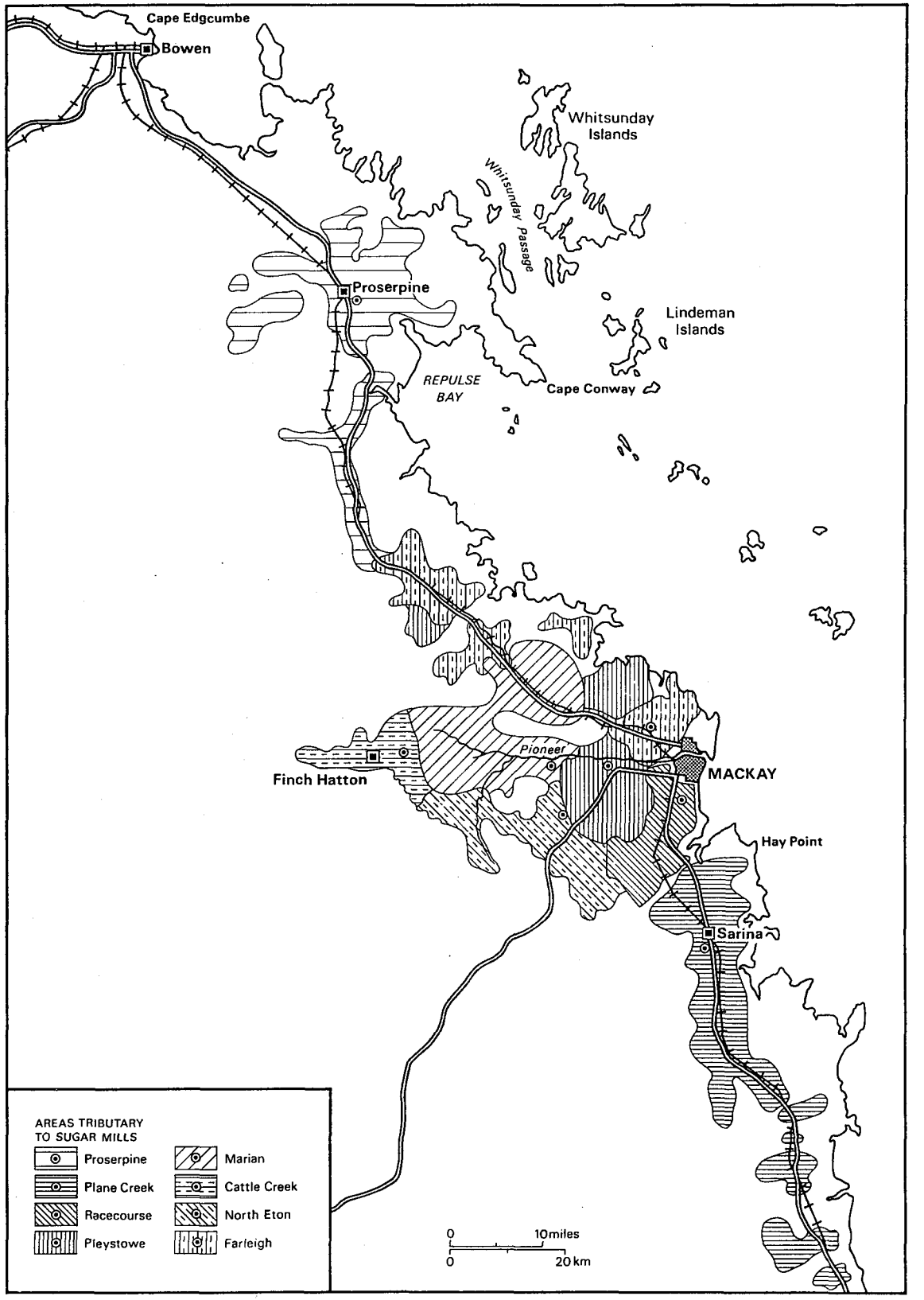

Fig.7 The sugar hinterland of the port of Mackay

on the north-south coastal road/rail axis: the Plane Creek mill at Sarina (1896) lies 37 km south of the port, and the Proserpine mill (1897) which was within the sugar hinterland of the port of Bowen prior to the introduction of bulk sugar terminal facilities at Mackay in 1957, is disadvantageously located over 130 km from the port. Of the eight mills now operating in the Mackay subsystem, Proserpine is the largest in terms of its assigned tributary area; but Farleigh, Pleystowe and Plane Creek are all supplied by larger numbers of canegrowers. The smallest surviving mill in the area - Cattle Creek - is also the most recent. Together the eight mills crushed over one million tonnes of cane in the 1981 season, representing almost 30 per cent of the Australian total.

The Bundaberg subsystem

South of the Mackay - Bundaberg sugar gap in the economy of the Queensland coast, the Bundaberg subsystem comprises six sugar mills of which four are closely associated with the lower Burnett river valley (Fig. 8). Three mills - Fairymead, Qunaba and Millaquin - are located between the town of Bundaberg and the bulk sugar terminal facilities near the mouth of the river. Upstream lies the Bingera mill, and to the south the Isis mill serves sugar growers in the Childers - Gregory river area. All the surviving mills in this area date from the 1880s and 1890s, the oldest being located as usual closest to the river and port. The Maryborough mill occupies a relatively isolated position in this subsystem, in some respects comparable with that of the Proserpine mill in the Mackay group and with that of the Mossman mill served by Cairns. The Maryborough mill exported raw sugar via the Mary river and the port of Urangan prior to the opening of the Bundaberg bulk terminal in 1958. Together the six mills in this subsystem crushed 648,000 tonnes of cane in the 1981 season. Bundaberg is the site of a sugar refinery as well as a bulk terminal, and the refinery normally draws most of its supplies from the neighbouring Millaquin mill. Some raw sugar from the Moreton mill at Nambour, north of Brisbane, is also exported through the Bundaberg bulk sugar terminal.

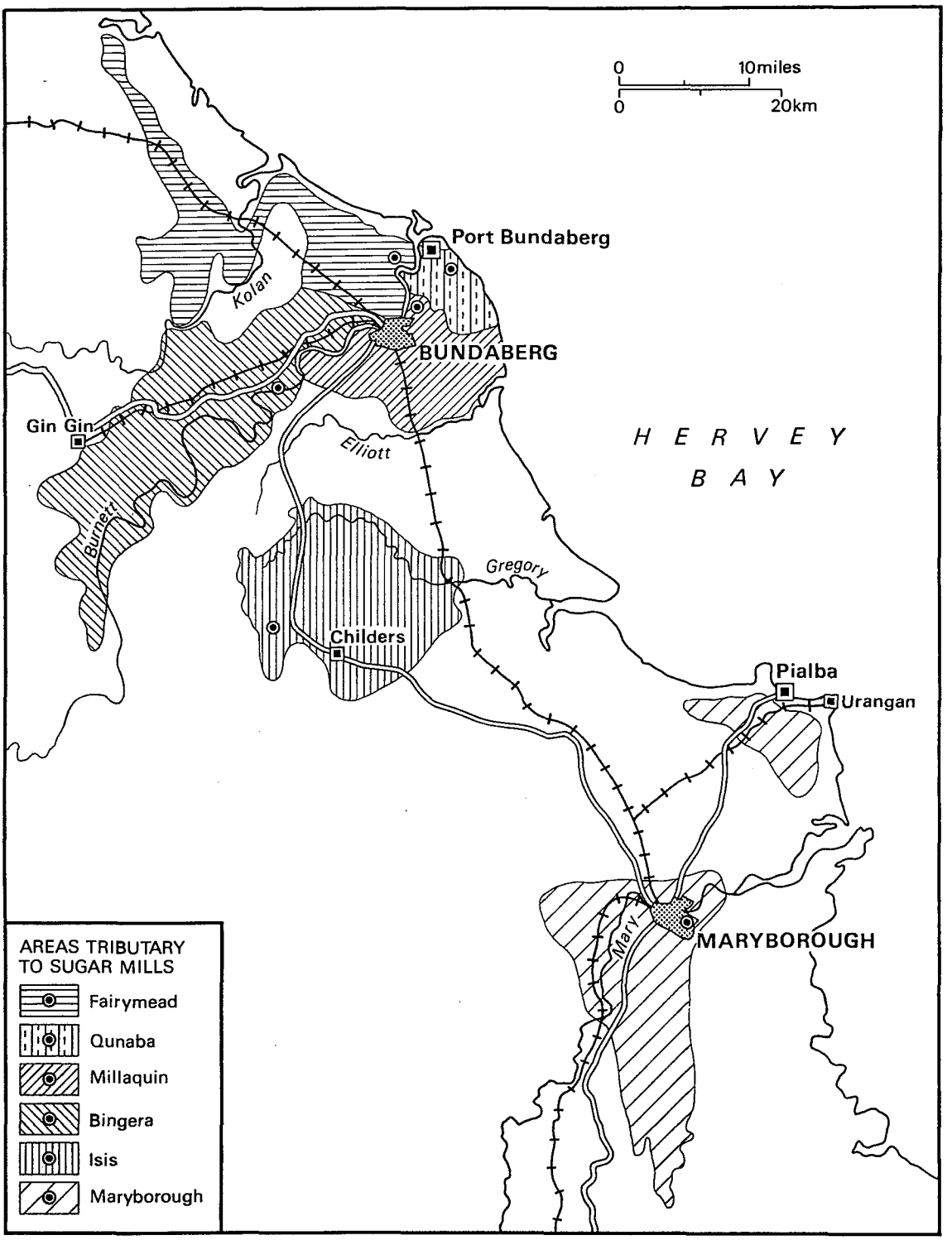

Fig. 8 The sugar hinterland of the port of Bundaberg

THE CONCEPT OF SUGARPORT

The sugarport system by means of which raw sugar is exported from the producing areas and mills to domestic refineries and overseas destinations has changed considerably over time, in response to the spatial and economic organisation of the industry and as a reflection of the technology of maritime transport and the methods of cargo handling. Originally, the primary objective of nineteenth-century farmers and millers was to ship their sugar across the nearest available waterfront suitable for lighterage or coastal steamers, and numerous quays and jetties located well up-river were utilised in this way. Subsequently the consolidation of the Queensland port system involved the use of a smaller number of more advanced ports located in deep water, but still based mainly on the transport of sugar in jute bags from the mills and the quaysides into the ships' holds. The introduction of the present-day system of six bulk sugar terminals involved heavy capital investment and a further consolidation and rationalisation of port sites, as well as the development of sophisticated systems of mechanical operation. Today the spatial relationships between ports, mills and cane-growing areas lie at the heart of an industry in which each interdependent element in the process from the planting of the crop to the operations at the quayside is very carefully regulated and controlled.

Any export-oriented industry necessarily displays a high degree of transport dependence at various levels and scales. In the case of the Australian sugar industry, this dependence is apparent in several contexts. The transport of the cut cane from the sugarfields to the mills is largely achieved by an extensive and complex system of light-gauge railways, and also by a substantial amount of road haulage (Willis, 1972). These tramway and road transport systems are mainly owned and operated by the milling companies. The transport of raw sugar from the mills to the export terminals is effected by Government or mill-owned railways or by road haulage companies, and is financially the responsibility of the mill operators. Beyond the maritime facade, the scale of transport operations increases as bulk carriers link the coastal terminals with domestic and overseas refineries. Although in

terms of the operational and administrative structure of the sugar industry the key component in the system is undoubtedly the sugar mill, in transport terms the critical element is the sugarport which marks the interface between land and maritime transport systems and between the world of the sugar producers and that of the international sugar market.

The concept of sugarport, as an element in the historical evolution and spatial organization of the sugar industry, is associated in one sense with the idea that whereas the essential functions of sugar shipment points have always been the same, the locational and technological means by which these functions have been and are effected have changed substantially as the sugar industry as a whole has evolved from primitive beginnings to the strictly-regulated systems of today. In methodological terms the idea is derived from Bird's Anyport model, devised as a hypothetical pattern and standard against which to measure and assess the development of specific ports and based on the particular morphological characteristics associated with successive phases of development. In his study of Australian seaports (Bird, 1968), Bird applied the Anyport concept to the Australian experience of port growth and introduced the concept of sugarport in his discussion of seaports and national development. This concept is elaborated and updated in this paper, with special reference to the evolutionary phases involved and to the role of sugarport in its various forms in the context of the regional economic development of the coastal zone of Queensland (Fig. 9, Table 2).

Primitive sugarport

An initial primitive port system was established on the Queensland coast before the development of an experimental sugar industry. The first ports, other than the penal settlements, were associated with the pastoralists and prospectors of the 1860s and 1870s, and many small coastal outlets were established to serve the expansion of the cattle industry and the needs of the goldminers. When the sugar industry made a second start on the northern rivers of New South Wales and in the Brisbane area of Queensland (earlier attempts further south having failed),

TABLE 2: The development of sugarport in Queensland

	Era	Characteristics	Period	Terminated by	Present-day evidence
I	Primitive sugarport	Lighterage of bagged sugar from numerous small ports on rivers and creeks	1870s - 1890s	Opening of facilities at old sugarport and consolidation of port system	Relict sugar wharves and jetties; storage sheds; lighterage
II	Old sugarport	Handling of bagged sugar across quays directly into ships' holds	1890s - 1957	Opening of first bulk sugar terminal and further consolidation of port system	Quays, ports and storage areas adapted to other uses
III	New sugarport	Bulk handling of raw sugar at specialised terminals	1957 -	-	Bulk sugar terminals

cane growing spread rapidly northwards encouraged by Captain Hope's operation of Australia's first commercial sugar mill near Brisbane in 1864. By the later 1860s Mackay had begun to emerge as a major focus of the sugar industry, as Bolton records: "On 1 June 1865 John Spiller planted a small plot of canes brought from a Javanese plantation where he had learnt sugar growing and manufacture. On this, the Pioneer plantation, Spiller and a partner put up a wooden horse-driven mill - mostly a home-made contraption - with which, at the end of June 1867, they crushed some cane and reduced the juice in an ordinary boiler, thus producing the first sugar in North Queensland ... By 1874 Mackay, with sixteen mills in operation and 4,927 acres cultivated, grew one-third of Queensland's sugar cane" (Bolton, 1963, 73-74).

The expansion of sugar cultivation towards the north was accomplished rapidly: between 1878, when the port-town of Mackay was already established as the 'sugaropolis' of the north, and 1885, when sugar was grown as far north as Cooktown, the acreage under the crop trebled, the number of small-scale primitive sugar mills increased rapidly, and significant quantities of raw sugar were exported from Queensland to other parts of Australia. The spread of sugar cultivation and milling northwards was paralleled by the adaptation and utilisation for sugar exports of previously-established ports designed originally to serve the needs of inland pastoralists. By the later 1880s at least fourteen ports had been established on the Queensland coast: in the south, in addition to Brisbane, the port of Bundaberg was founded in 1866; further north, Bowen was already an important pastoral outlet in the early 1860s, whilst Mackay and Townsville soon became important foci of the sugar industry. In the far north the goldports of Cairns. Port Douglas and Cooktown began to function also as sugarports; Cairns, founded in 1876 to serve the Hodgkinson goldfield, shipped sugar from Swallow's Wharf from 1882 to 1897. Sugar growing in the Cooktown area was not successful, however, and after 1885 Mossman came to mark the northern limit of cultivation and milling.

The primitive sugarport of the Queensland coast (Fig. 9a) was characteristically sited on a navigable river, wherever possible some

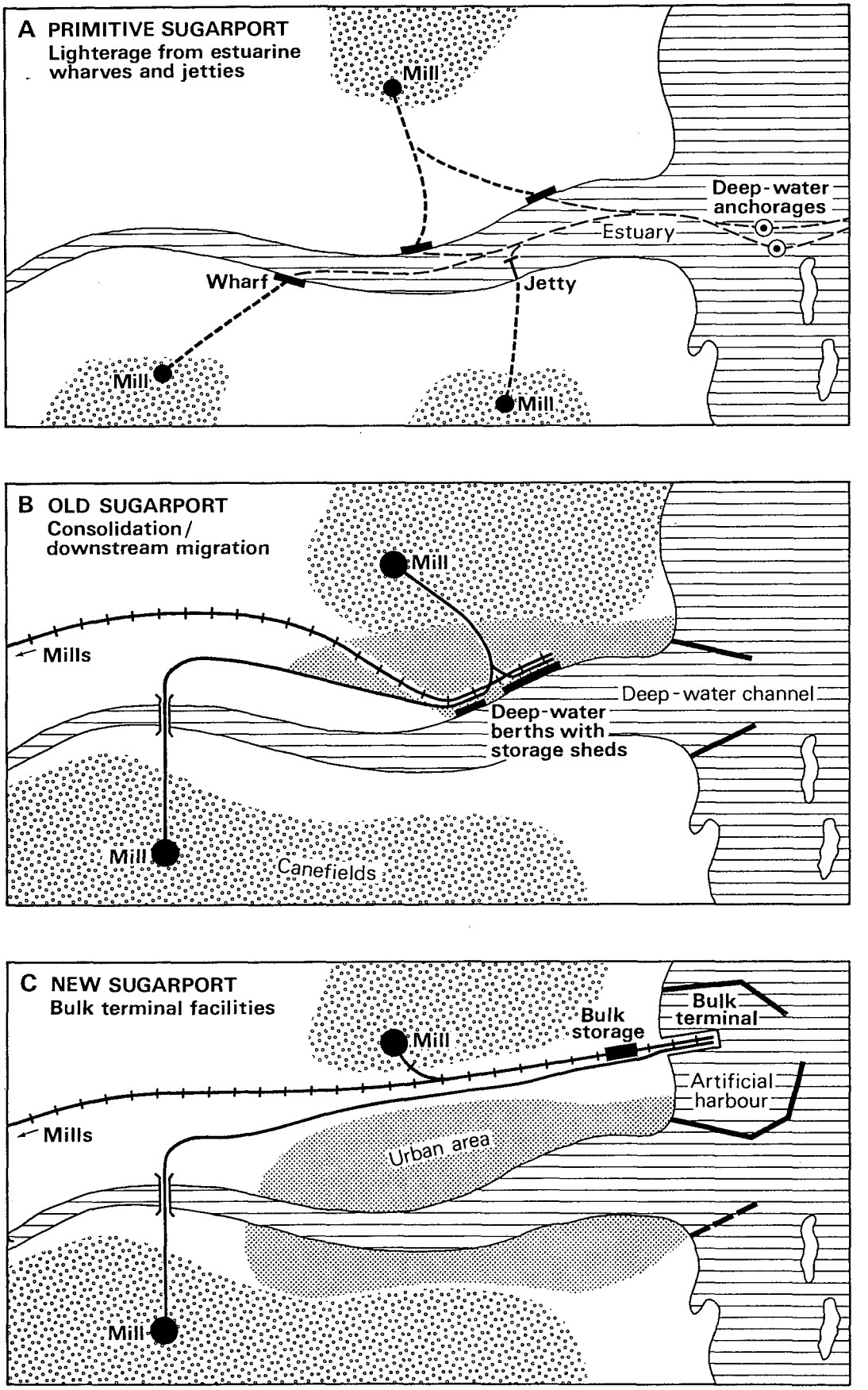

Fig.9 The evolution of sugarport, Queensland

distance upstream and as close as possible to the sugarfields and mills. "As was the case with anciently-established ports upon European drowned estuaries ... the pioneers of Queensland had no wish to leave the water for the rough bullock trail until absolutely so obliged" (Bird, 1968, 190). In the pre-railway era the rivers provided the main transport arteries from the coast towards the pastoral hinterland, and inland transport was for many years a hazardous affair involving pack-horses and bullock-carts. The distances between sugarfields, mills and shipment points were therefore minimized as far as possible. Raw sugar was transported in jute sacks from the mills to the waterfront, where in some cases it was possible to run a wooden jetty out from the riverbank into deeper water so that loading could take place directly into the holds of coastal vessels. More commonly, however, it was necessary to use the lighterage process to transport the bagged sugar from the primitive upstream shipment points to steamships anchored downriver in deeper water or to larger ports nearby. Relict features of this era include redundant sugar wharves on the Pioneer river near Mackay.

The establishment of a scatter of primitive port outlets along the Queensland coast during this period was essentially a response to the pioneer economic development of the hinterland, and the process of port-site selection was associated more closely with the demands of the interior for convenient port outlets than with the physical characteristics of the ports themselves. Several good natural harbours remain unutilised to this day and, as Lewis has pointed out, "the original preference of British-born administrators for fine natural harbours had to be ignored by the local producers wherever satisfactory hinterland access did not exist" (Lewis, 1973, 62). This affords an interesting contrast with many other areas of the former colonial world where the selection of natural harbours, the establishment of ports and the subsequent development of hinterlands have been basic processes involved in the emergence of modern patterns of economic geography.

Given the somewhat tentative nature of primitive port development, and the rather precarious character of the emergent hinterland economy upon

which it depended, it is not surprising that a considerable measure of interport competition emerged during these formative years. Several factors were involved in this situation and in the process of port consolidation to which it led. Exports - whether pastoral, agricultural or mineral - were limited in quantity as well as in variety, and traffic through most primitive ports must have been at a very low level for much of the time. The addition of sugar exports into this system inevitably favoured some established ports (Mackay, Townsville), rescued others from threatened commercial oblivion (Cairns, Bowen), and left others largely unaffected (Gladstone, Rockhampton). As the sugar industry developed and became an increasingly important factor in the port consolidation process, a substantial degree of friction and rivalry developed not only between individual ports but also between the northern, central and southern zones of the Queensland coast. The political economy of the colony in the 1880s was thus affected not only by the 'internal' problem of coloured labour and by the 'external' problem of moves towards an Australian federation, but also by separatist movements within Queensland aimed towards the establishment of a separate colony in the Far North. The internal pattern of the sugar industry was changing, too, for after the Land Act of 1876 a number of smallholder farmers began to develop homesteads in the sugar-growing areas. Although smallholders were at first totally dependent upon the established plantation and mill systems, their security gradually increased and technological improvements led to the separation of sugar-growing and sugar-milling, to the establishment of larger centralised mills and the consequent abandonment of many older more primitive ones. The most fundamental factor in the decline of the plantation system, however, was the withdrawal of coloured labour following the incorporation of the colony of Queensland in the Commonwealth of Australia in 1901.

The process of interport competition and the consolidation of the port hierarchy were also affected by the locational characteristics of the ports themselves. Many of the colony's ports were sited on river estuaries, at some distance from the sea, and could only be reached by small coastal sailing vessels of shallow draft. The development of the

colonial economy required the introduction of larger steamships which presented the primitive sugarports with the difficult alternatives of dredging their river sites, moving downstream to deeper water, or going out of business. The consolidation process in the sugarport system was thus on the one hand a reflection of a similar process involving the centralisation of sugar milling, and on the other hand an illustration of the general principle of port geography that the design of shipping rather than the condition of harbours is generally the pacemaker in maritime transport developments.

An interesting example of interport competition within the primitive era is provided by the two North Queensland ports of Bowen and Townsville. Following the discovery of the harbour of Port Denison in 1859 by Captain Henry Sinclair, the port-town of Bowen was founded nearby in 1861; a jetty was built out into deep water, and the port soon became an important outlet for the developing pastoral industries of North Queensland. Townsville was similarly founded in 1864 by John Melton Black, the North Queensland manager for Captain Robert Towns, a Sydney businessman with interests in sheep and cattle properties. Both ports thus originated as minor regional outlets exporting the meagre products of a vast hinterland and supplying the limited needs of a sparse pioneer population. The fortunes of Townsville were soon diversified, however, by the discovery of gold in the immediate hinterland at Ravenswood (1868) and Charters Towers (1871), by the completion of a railway to Charters Towers in 1882 and by the substantial development of sugarcane cultivation in the Burdekin valley and delta from 1879. Pioneer sugar estates and mills were established, and raw sugar was transported to Townsville by small steamers from a number of minor tributary shipping points until a railway was built to connect Townsville with Ayr in 1901 (Hoyle, 1978). No comparable diversification of functions took place at Bowen and, although Townsville's harbour was originally inferior to that of Bowen, the more northerly port's developing hinterland enabled it to gain ascendancy over its southerly rival. Lewis has described the situation in the mid-1880s: "As Townsville grew, Bowen waned, and the government became less concerned with the port. All wharfage

at that time was built of hardwoods which could rapidly deteriorate under unfavourable conditions. By 1872 the Bowen jetty was infested with woodrot, and three years later was coming apart. The government patched it up and did a small amount of dredging in the port ... but the level of trade did not warrant any further improvements" (Lewis, 1973, 57).

Old sugarport: the era of consolidation

In the closing years of the nineteenth century the Queensland economy began to demand a higher level of port investment, a closer correspondence between port infrastructures and hinterland economic activities, and therefore a measure of consolidation within the emergent port system. In particular, the coming of the railways exercised a powerful influence over the comparative growth of port outlets; and the increasing size of steamships, together with the growing volume and increasing variety of trade, meant that some relocation of port activity in the direction of more spacious deep-water sites became essential to the continued prosperity of those ports which had already emerged as relatively favoured by inland communications and development.

The era of consolidation began, in terms of the sugar industry as a whole, as soon as the 'sugar boom' period of the 1880s was over. The contraction of sugar-growing areas, the reduction in the number of operating mills, the decline of the plantation system and the centralisation of milling operations were among the chief indicators of this general trend. In terms of the sugarport system, the modification of which eventually reflected these inland developments, the beginning of the era of consolidation was marked by the Queensland Harbour Boards Act of 1892 which enabled the control of port affairs to be devolved to local levels and, by implication, underlined the critical importance of improved port facilities in the developing economy of the constituent sub-regions of the coastal sugar-producing zone as well as in that of Queensland as a whole.

By the turn of the century several of the principal ports of Queensland - Brisbane, Rockhampton, Townsville and Cairns - were all linked with their respective hinterlands by rail, but southern Queensland was not yet provided with direct rail links with the central and northern areas. During the first two decades of the twentieth century, therefore, the Queensland ports attained their maximum effectiveness in terms of west-east traffic flows; this orientation, dependent upon arterial railways and coastal shipping services, was substantially modified as the main coastal railway was extended northwards from Brisbane to Mackay (1921), Townsville (1923) and Cairns (1924). The consequent interposition of north-south traffic flows by rail, and the extension and consolidation of the hinterland of the premier port of Brisbane, effectively reduced the relative importance of the more northerly ports and of their coastal shipping links; this process helped, nevertheless, to ensure the longer-term survival of the most advantageously-located ports by incorporating the new State of Queensland more effectively within the economy of the Commonwealth of Australia.

Although there was, perhaps inevitably, a good deal of argument in the context of interport competition concerning the development of port-hinterland rail links, the northward extension of the coastal line and the changing role of coastal shipping services, there was no doubt about the fact that sugar had emerged by the early 1920s as the principal economic activity in Queensland in terms of export production. The mining industry had declined, following the gold rushes of the later 1860s and 1870s, and no substantial manufacturing industry had yet been established. In spite of a host of problems - including droughts, cyclone devastation, the withdrawal of coloured labour, frequent industrial disputes and wartime price controls, the sugar industry survived and became established as one of the principal elements in the North Queensland economy. This naturally had the effect of strengthening the relative importance of those ports which had previously emerged as <u>primitive</u> sugar shipment points and, having survived the eliminations inevitably involved during the earlier years of the consolidation era, were now able to adapt

successfully to the new demands of the twentieth century. At various times between the 1890s and the 1930s several sugarports made the decisive move seawards in the direction of deeper water (Fig. 9b). Townsville began the development of an artifical outer harbour at the mouth of Ross Creek; Maryborough transferred sugar shipments to Urangan in Hervey Bay; Mackay, which had long relied on lighterage to vessels anchored in sheltered water offshore, also attempted (initially with little success) to develop an artifical port. Bundaberg did not attempt to move downstream during this period, and Cairns did not find it necessary to do so. At Innisfail there was a campaign during the 1890s to adopt Mourilyan as the sugarport for the South Johnstone river area by building a light tramway from the town to the deep-water harbour (Lewis, 1973, 104). Various minor sugarports such as Lucinda and Cardwell continued to operate on a small scale, but Bowen did not succeed in improving its competitive position. Inevitably, most of the original primitive sugar shipment points had been abandoned in favour of the centralised ports with superior facilities. Relict features of this period include not only the ports from which the sugar trade moved away but also storage sheds at the mills, and sheds and quays at the new sugarports, now re-used for other purposes.

Throughout the era of old sugarport raw sugar was bagged at the central mills, transported by road or rail to the most convenient port, and there loaded into the ships' holds by port labourers. This process involved a considerable amount of manhandling of sugar bags at the mills and at the quaysides; it was heavy and unpleasant work, especially towards the end of the cane-cutting season in December. Sugar loading at the ports was carried out by gangs of workers known as 'lumpers' who had to spend a good deal of time waiting around the port areas without any certain prospect of employment. "It was perhaps not surprising", Bolton comments, "that the North Queensland waterfront had a lively tradition of strikes and stoppages over pay and conditions" (Bolton, 1963, 324).

By the early 1920s the main outlines of the present-day economic geography of Queensland had been established; most of the best soils in the humid parts of the coastlands had been selected for cane growing and the pioneering periods of experimentation and subsequent consolidation were largely at an end. During the inter-war years the continued growth of the sugar industry - from 1924 directed towards overseas exports as well as domestic markets - was paralleled by a steady improvement in the facilities and conditions at the old sugarports. The Mackay outer harbour scheme was eventually completed in 1939, and at Cairns the beginnings of mechanical sugar handling were marked in the later 1930s by the introduction of an electric conveyor. Additional sugar storage sheds were built, deep-water quays were extended, and hinterland road and rail services were gradually improved. By these various means the competitive position of the established sugarports was further improved, while the immediate prospects of some of the minor ones (such as Mourilyan and Innisfail) were reduced. The process of consolidation continued, and some small northern ports ceased to function as sugar shipment points by the end of the Second World War.

New sugarport: the era of bulk handling

The movement towards the further consolidation of the Queensland sugarport system, involving the bulk handling of raw sugar at the quayside and a greatly enhanced level of mechanization throughout the industry, began to gain momentum soon after the end of the Second World War. Several major factors loomed large in the debate, which lasted for a number of years, concerning the advantages and disadvantages of the proposed developments. In terms of global maritime transport the paramount factor was the progressive conversion to bulk handling in sugar-importing ports around the world. As a result, the emergence of a select series of streamlined sugarports was essential to the long-term survival of a competitive Queensland sugar industry. In domestic terms one of the most critical factors was the traditional instability of labour at the old Queensland sugarports; disruptive action at the waterfront frequently involved a considerable degree of inconvenience to sugar growers,

millers, shippers and ship operators alike - an interesting illustration of the way in which efficient port operation is essential to the ordered development and progress of an industry or region. A second domestic factor of outstanding importance was the gradual introduction of a much higher level of mechanization in other parts of the sugar industry: this involved not only the milling operations but also, and more significantly in terms of costs and labour inputs, the process of cane cutting. The introduction of mechanical cane-cutting harvesters throughout the Queensland sugarfields in the 1960s and 1970s was a major revolution in farming techniques, and it is appropriate to regard the introduction of bulk-handling methods at the waterfront as a necessary corollary of the spread of mechanisation on the farms. In social terms the broad effect of these inter-related developments was, of course, a marked reduction in the demand for labour both in the sugar-growing areas and at the ports. In both contexts, however, towards the close of the old sugarport era, seasonal labour was becoming expensive and increasingly difficult to obtain; by moving into the new sugarport era the sugar industry was able to dispense with most of its seasonal labour requirements and thereby to remove what had become one of the principle obstacles to its continued development.

In more specific terms it was argued that the introduction of a bulk-handling system at the ports would greatly improve working conditions for the reduced labour force, particularly by the elimination of the jute bag, and would also result in much shorter turnround times for vessels. The consequent reductions in port operational costs would therefore eventually offset the capital costs involved in the installation of the new facilities. There were, however, some serious disadvantages, notably the problem of re-absorbing into the labour market the considerable numbers of permanent and seasonal workers in the sugar industry who were no longer needed. In 1962 Chapman recorded that "the mean daily work-force, many but not all annual migrants from southern ports, at Queensland sugar ports (excluding Brisbane) has been halved since 1957, and more than 1000 men have lost regular employment. The problem would not exist if

alternative employment were readily available, but the small towns along the Queensland littoral from Maryborough to Cairns offer little scope" (Chapman, 1962, 313). In addition, the introduction of bulk handling necessarily implied a further rationalisation of the Queensland sugarport system, involving a further reduction in the total number of sugar shipment points and the consequent withdrawal of sugar traffic from a number of old sugarports which were not included in the plans for the new sugarport era.

The site requirements for the new sugarport developments were essentially straightforward, but different from those associated with earlier eras in the development of Queensland port systems. There were two essential factors. The water site had to include a sheltered area of deep water close inshore, protected where necessary by an artifical harbour, and with a minimum depth alongside the deep-water quays of 8.5 metres. The land site, on the other hand, had to include not only efficient means of access by road and rail but also adequate suitable areas for the construction of storage sheds capable of holding up to 60 per cent of the anticipated annual throughput. The development of sugar storage facilities at the ports, to a higher level than previously, was a most important element in the planned transfer to the new sugarport era and, as Bird points out, provides "a simple but vivid example of the reservoir function of ports in the traffic of seasonal agricultural produce" (Bird, 1968, 190). The necessity for storage arises from the fact that the sugar-harvesting season in Queensland, and therefore the crushing season at the mills, extends from June to December, whereas sugar exports take place throughout the year. Bulk storage at the ports is the most convenient method of providing for export cargo flows during the period of the year when the sugar mills are not operating. In earlier eras of sugarport development, seasonal storage was dispersed between ports and mills, and the concentration of storage at the new sugarports was obviously a significant factor in the rationalisation programme.

The decision to develop a series of bulk sugar terminals along the Queensland coast, and thereby to inaugurate the new sugarport era, was taken by the Queensland Government in consultation with sugar industry organizations. In 1951 an experimental bulk shipment of raw sugar was despatched from Mackay to London via Suez, and survived the journey from a humid Queensland summer to a severe English winter without apparent harm. In the following year approval was given for the construction of bulk-terminal facilities at Mackay and Lucinda, and decisions in favour of four further new sugarports - at Bundaberg, Townsville, Mourilyan and Cairns - were subsequently announced. The official opening of the first bulk sugar terminal at Mackay in 1957 marks the beginning of the new sugarport era (Fig. 9c) which was quickly strengthened by the introduction of similar facilities at the other five selected locations between 1958 and 1964. Each of the new terminals included in its original layout a series of standard elements - a sugar receiving station, storage shed, weighing facilities and a bulk loading quay, these elements being linked together by mechanical conveyors.

The transfer of operations to the new sugarport system was effected smoothly and efficiently over a relatively short period of time. The layout and characteristics of the old sugarports could not in most cases be successfully adapted to the requirements of the new era, because built-up areas did not allow adequate storage space and water sites did not include adequate depths. New sugarport is therefore normally sited seawards of the earlier manifestations of the sugarport phenomenon, either near the mouth of an estuary or on a stretch of open coast protected by artificial breakwaters. The Mackay bulk terminal was incorporated in an artifical harbour sited on the coast a short distance north of the Pioneer river on which the town is based. Opened in 1939, this harbour had effectively removed the traditional dependence of the port of Mackay on the vagaries of the Pioneer river. The new harbour was originally equipped for the export of sugar in bags, but from 1947 onwards this system was found to be increasingly unsatisfactory. Storage sheds in the port and at the mills were dangerously overstacked, resulting

in structural damage, loss of sugar, slow loading and shortages of sugar bags. The incorporation of Australia's first bulk sugar terminal within the outer harbour from 1957 soon resolved these problems, and the port which in the 1870s had been described as the 'sugaropolis' of Queensland has subsequently maintained its position as the leading sugar exporter in Australia and one of the largest in the world.

At Bundaberg, where Queensland's second bulk sugar terminal was opened in 1958, the storage sheds and sugar shipment facilities associated with the old sugarport era had been largely destroyed by a disastrous flood in 1942, and this had accelerated the port's previously unsuccessful efforts to migrate towards deeper water. At the new Bundaberg port, 17 km from the original settlement on the Burnett river, a deep-water harbour was opened primarily for the bulk sugar trade, and other traffics (oil, molasses) were added later. In contrast to Mackay, therefore, where the transition from the old sugarport era to that of new sugarport followed the inauguration of the deep-water harbour after a gap of several years, at Bundaberg the transition from one era to the next and the development of modern port facilities were simultaneous.

Two further bulk sugar terminals were inaugurated in 1959, at Lucinda and Townsville, and a fifth was opened at Mourilyan in the following year. The terminals at Lucinda and Mourilyan introduce a distinction between these unifunctional sugar-exporting ports which have no other traffic of significance, and the four other new sugarports where the bulk sugar-handling facilities are incorporated within a multifunctional port complex handling a variety of bulk and break-bulk traffic. Sugar was exported in earlier eras from the Herbert river district through Lucinda, and at Mourilyan the old sugarport era involved the export of bagged sugar via small coastal vessels to Cairns where transhipment took place. This was another of the many inefficiencies removed by the transfer to the new sugarport system, but in the face of some understandable opposition from the Cairns Harbour Board in view of the substantial loss of

sugar traffic which the opening of the Mourilyan terminal entailed. At Townsville the development of the bulk sugar terminal followed a similar pattern to that at Mackay, the new facilities being incorporated within an artifical outer harbour constructed before the coming of the bulk sugar era. The unsuitability of Ross Creek for modern port development had been recognised as early as the 1870s, and the transfer to a deep-water site downstream had effectively been made by the turn of the century. Townsville continued to handle bagged sugar exports for a number of years after the inauguration of the bulk era, so that Queensland could continue to serve those markets not initially equipped to receive sugar imports in bulk.

The opening of the sixth bulk sugar terminal at Cairns in 1964 completed the transition of the Queensland sugarport system to the new era of bulk handling. The relatively late introduction of the bulk facilities at Cairns is explained by the fact that the transfer from the bagged sugar era to the new bulk methods was constrained for a time by conditions in sugar-importing ports in various overseas market areas, notably Japan. By 1962, however, Japanese importing ports had been equipped to handle sugar in bulk, and bulk-exporting facilities were introduced at Cairns two years later. Trinity Inlet, on which the port of Cairns is sited, is a drowned estuary which provides one of the best natural harbours on the Queensland coast. This enabled Cairns to diverge from the normal sequence of sugarport development in that the bulk terminal facilities of the new sugarport era are located upstream of the older areas of the port.

The further consolidation of the Queensland sugarport system represented by the transition to the new sugarport era inevitably involved a reduction in the number of ports involved and the complete loss of sugar traffic through some formerly important sugar-exporting centres. In particular the port of Bowen, "the consistently unfortunate mother-town of North Queensland" (Bolton, 1963, 324), which in terms of situation rather than site had been a problem port from the early years of the century, did not survive the transition to the new sugarport era. Exports of bagged sugar through Bowen had declined during the

early 1950s; in 1958 output from the Proserpine mill south of the town was diverted to the new bulk terminal at Mackay, and in the following year that from the Inkerman mill near Ayr was transferred to Townsville. The demise of Bowen as an old sugarport in 1958, the year in which the last cargoes of bagged sugar were loaded, was hastened by cyclone damage and by the very low general level of activity at the port. Bowen provides, in retrospect, a good example of a port which, although equipped with a good natural harbour has hitherto failed to develop either a unifunctional or a multifunctional role in the regional economy. In the far north the opening of the bulk terminal at Cairns in 1964 signalled the end of the old sugarport era at Port Douglas, which had served as an outlet for the Mossman mill. In the south, bulk handling at Bundaberg similarly brought finally to an end sugar shipments through Maryborough and Urangan, and exports of bagged sugar through Brisbane also ceased.

RAW SUGAR THROUGHPUT AT THE BULK TERMINALS

The spatial structure of the Australian sugar industry now comprises a series of six modern terminals each of which serves a specific set of sugar mills and sugar-growing areas (Fig. 10). Each sugarport is a vital functional element in a national and international system linking producers and consumers, and efficient operation through the sugarports is a critical factor in the maintenance and development of the competitive position of the Australian sugar industry in international markets. The consolidation of the sugarport system by the introduction of the new sugarport era between 1957 and 1964, on the basis of heavy capital investment and in response to recognised industrial trends, did not in any sense imply a fossilisation of the system in functional terms. Although there have been no major changes in recent years in the established spatial relationships between sugar-growing areas, mills and ports, there nevertheless exists a considerable measure of flexibility in the operation of the system on both the landward and the maritime sides. Natural hazards

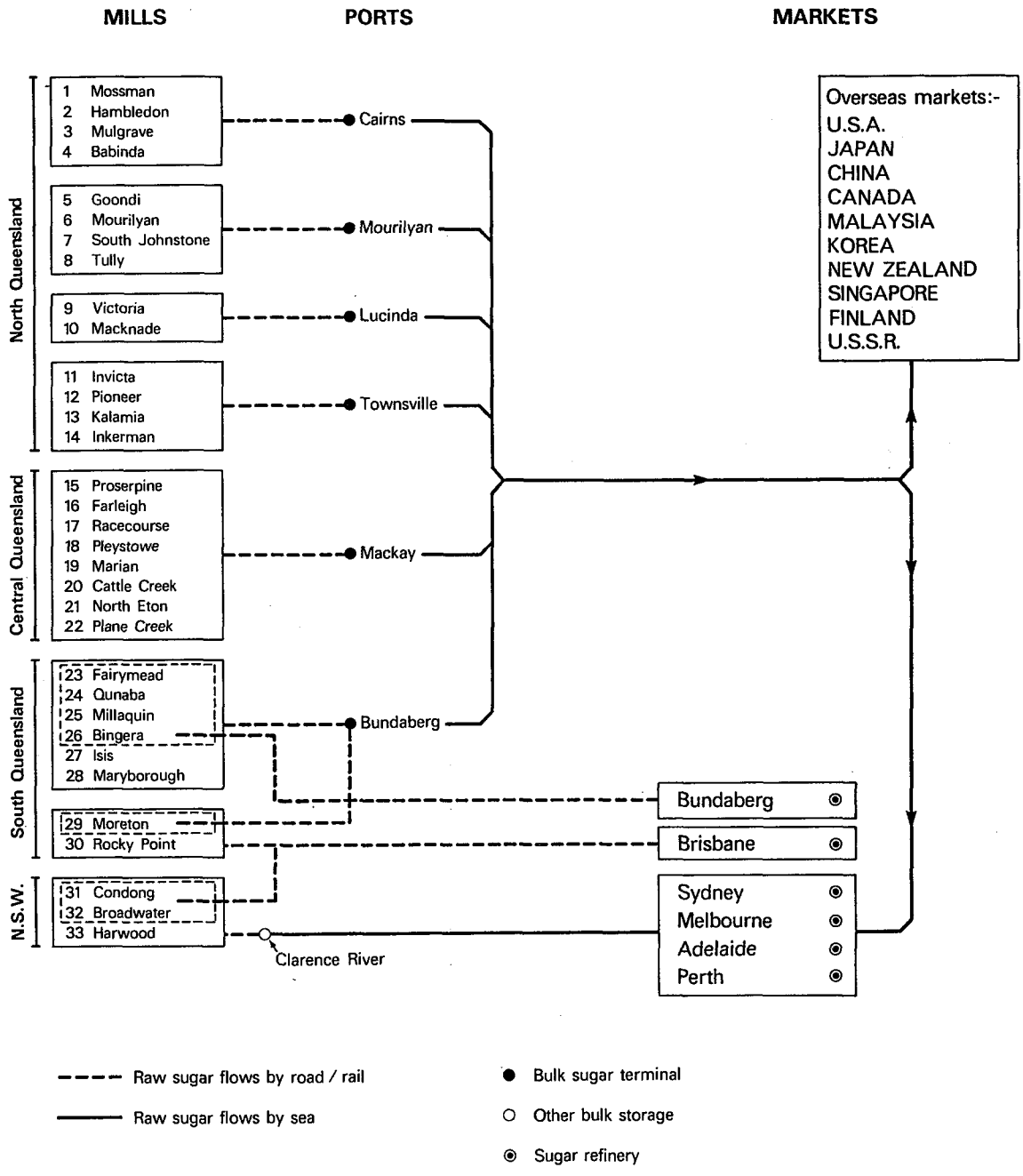

Fig. 10 The Australian sugar industry : relationships between mills, ports and markets

such as floods or cyclones occasionally threaten to close ports and to interrupt normal patterns of commodity flow between the sugar mills and the waterfront. On the maritime side the general principle that all six bulk terminals serve overseas and domestic markets is flexibly interpreted, in that market proportions at individual terminals vary from one season to another according to supply and demand. Most of the raw sugar destined for Australian refineries outside Queensland (in Sydney, Melbourne, Adelaide and Perth) is shipped through the Bundaberg bulk terminal, with smaller quantities passing through Mackay. The more northerly bulk terminals usually supply only small amounts to the domestic market. Within Queensland, the Bundaberg and Brisbane refineries are not served by the bulk terminals; the Bundaberg refinery obtains most of its supplies from Millaquin Mill and sometimes from other South Queensland mills, while the Brisbane refinery is served by several mills in South Queensland and northern New South Wales. Some sugar from Broadwater Mill and occasionally from Condong Mill is transported by road to Harwood Mill which is linked via the Clarence River and coastal shipping services with the refineries in Sydney and Melbourne. Approximately 25 per cent of Australia's annual raw sugar output is sold on the domestic market.

Between 1960 and the early 1980s the annual raw sugar throughput at the Queensland bulk terminals increased from about one million to over three million tonnes (Fig. 11), and substantial increases in storage capacity have consequently been introduced. At Mackay, which retains its pre-eminent position as a sugar-exporting port, storage capacity now stands at 667,000 tonnes. Similar expansion has taken place on a smaller scale at Bundaberg (316,000 tonnes) and Cairns (234,000 tonnes), and also at Townsville (285,000 tonnes) where a disastrous fire in 1963 necessitated the reconstruction of a storage shed. At Lucinda the storage capacity has been increased to 231,000 tonnes and offshore loading facilities introduced in 1979 enable the port to receive larger vessels and to serve overseas markets. At Mourilyan (capacity 175,000 tonnes) the water site poses

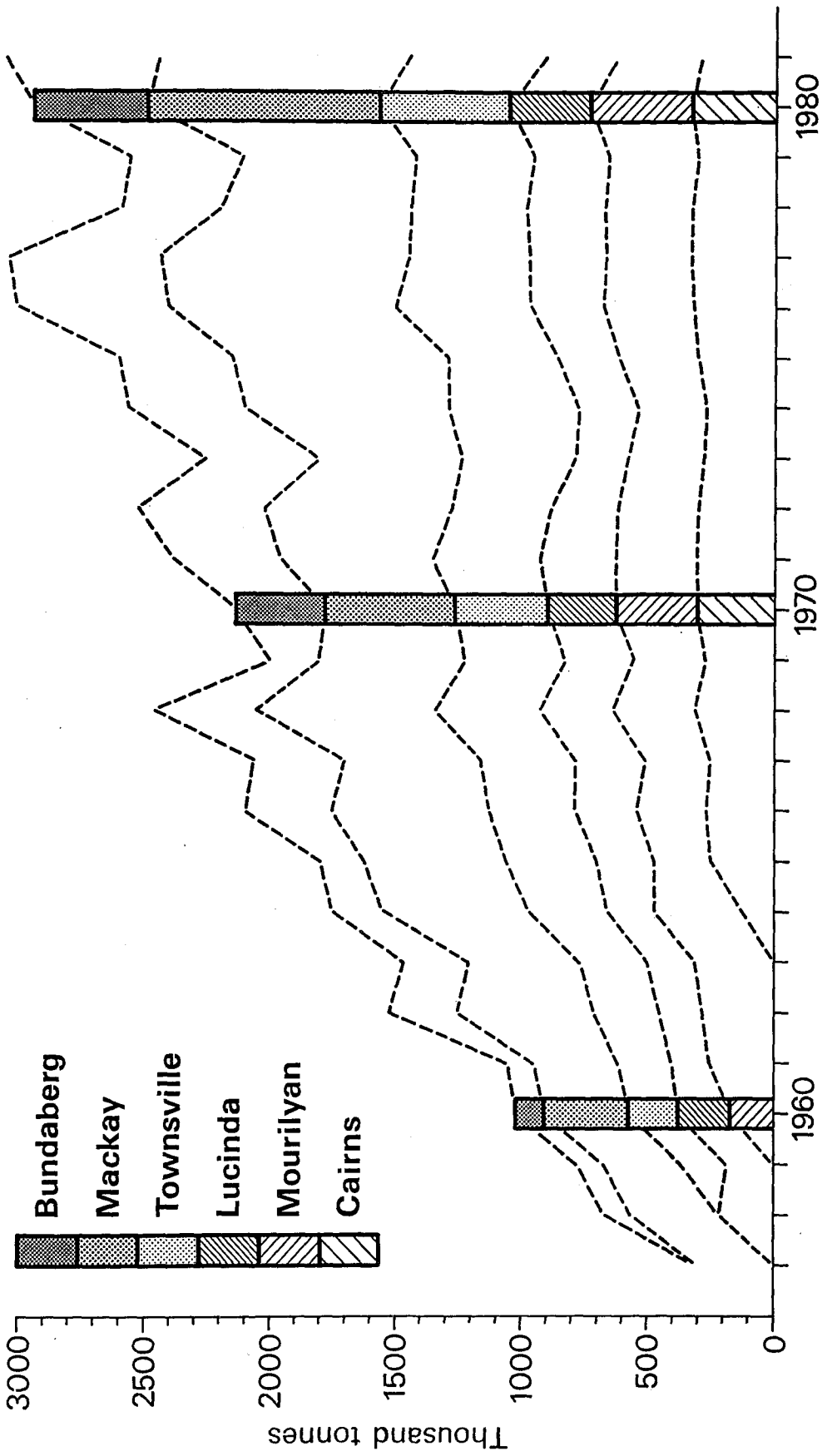

Fig. 11 Raw sugar throughput at Australian bulk sugar terminals, 1957-81
(Source : Bulk Sugar Terminal Organisations, Sydney)

physical problems; this port is likely to remain the terminal with the smallest storage capability within the Queensland sugarport system in the foreseeable future.

In 1981 the raw sugar throughput at the six Queensland bulk terminals totalled 3.4 million tonnes, of which 2.8 million tonnes were exported to overseas markets. These movements take place in the context of the International Sugar Agreement and involve sales on the basis of long-term contracts (to China, Korea, Malaysia, Singapore and New Zealand) and other sales on a 'free' market basis at prices related to world market values (to the USA, Japan, the USSR and Canada). The current International Sugar Agreement dates from 1977 and, like its predecessors, seeks to regulate world sugar flows to the satisfaction of producers and consumers by means of an export quota system and the establishment of reserve stocks. Raw sugar exports through the sugarports of Queensland and those of other producing areas that are members of the ISA are restricted by the agreed quota system when world sugar prices fall within a specified range, as in 1978-79 and in 1981-82. At other times, when world sugar prices increase (as in 1980) above the level of the specified ISA range, export quotas are lifted and reserve stocks are released for sale. In this context the level and pattern of raw sugar throughput at the bulk terminals is directly influenced by the operation of the ISA, the international world price mechanism, the bilateral agreements between Australia and a range of countries around the margins of the Pacific Ocean, and the operation of the 'free' market system which involves trading links with a number of other countries. In these various ways the pattern of activity at the waterfront is closely dependent upon factors from the maritime side, which underlines again the importance of the port storage factor in the sugar industry as a whole.

CONCLUSION

The present-day structure of the Australian sugar industry has been achieved only after many years of experimentation, a good deal of

argument and a fair measure of compromise. The processes of change and development that have led to the sugar industry of today have involved interaction between farmers, millers, transporters, refiners, consumers and governments in a wide range of contexts and at many different levels. In one context, the sugar industry provides perhaps the best illustration of a stable and successful agricultural community of European origin in the tropics. In another context, sugar contributed over 1,000 million Australian dollars in export earnings in 1981, representing 12.7 per cent of the value of Australian exports of agricultural origin and 5.4 per cent of Australian exports as a whole for that year. Within the complex and dynamic structure of the sugar industry the sugarport system continues to perform a vital role. In an historical sense it provides a clear illustration of an evolutionary sequence of port development in response to an initially experimental but increasingly scientific agricultural economy. In geographical terms, the sugarports provide not only an example of a set of specialised terminals closely attuned technologically to specific economic sectors and areas, but also show clearly how patterns of port development along a coast reflect a variety of factors at various scales on the landward and maritime sides. As an element within the seaport system of Australia, and as part of the global maritime transport network, the sugarports of Queensland express a degree of interdependence between time and place and between land and sea that is fundamental to any explanation of the geography of port development.

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