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RECENT DEVELOPMENTS IN THE AGRICULTURAL PETROCHEMICAL INDUSTRY[1/]

by

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[illegible]ION

[illegible] Australia is not considered one of the less-developed [illegible], the development of [illegible] petrochemical industry exhibits [illegible] currently being experienced [illegible] this symposium. [illegible] relatively small [illegible] concentrated in a few [illegible] of raw material [illegible] absence of proven oil reserves and [illegible] experience, coupled [illegible] of [illegible] enterprise [illegible]. In common with petro- [illegible] economies, the Australian petro- [illegible] industry [illegible] small domestic [illegible] with its implications for [illegible] scale and fixed costs [illegible] frequently suffered from [illegible] costs of raw material [illegible] and [illegible] costs, and from other costs [illegible] by government policies. [illegible] industry has relied largely [illegible] overseas technology and [illegible], and as a result of liberal official [illegible] towards foreign [illegible] investment, has become largely foreign- [illegible] and controlled.

The purpose of this paper is not to attempt an assessment of the costs and benefits to the Australian economy of the specific manner in which the petrochemical industry has evolved, but rather to set out the nature of this development and the economic and non-economic factors underlying it, and to indicate the direction of future growth.

THE AUSTRALIAN [illegible]

Since [illegible] industry is a comparatively recent development in the Austral[illegible], and [illegible] integrated [illegible] even [illegible] Australian [illegible] portant development [illegible] of the oil refining [illegible].

The [illegible] with gold [illegible] development [illegible] was little [illegible] and production [illegible] demand, and therefore [illegible] of natural [illegible] were [illegible] of the [illegible] fertilizer [illegible].

During [illegible] importance [illegible] the war the [illegible] growth rate of population [illegible] ment plan[illegible] and government [illegible] government polic[illegible] immigration, [illegible] encourage [illegible]

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(1) The history, [illegible] of the Australian [illegible] Industr[illegible] The Economi[illegible] 1962), [illegible]

(2) Between [illegible] annually [illegible] population grew by 2.4 [illegible] annually.

[illegible] on foreign investment. At no time, however, was it considered [illegible] to offer special federal incentives, such as tax holidays or [illegible] to attract foreign capital, although [illegible] which proved [illegible] Up to 196[illegible] growth occurred [illegible], ethylene derived [illegible], acetylene derived from locally [illegible], [illegible] acid and acetaldehyde derived [illegible], and ethanol produced [illegible] of [illegible] the industry was [illegible] and commenced production of some [illegible] elsewhere in the world from [illegible]. In addition to the heavy chemicals cited above, [illegible] products, drugs and cosmetics [illegible] products industry was growing [illegible] resins, urea-formaldehyde moulding [illegible], polystyrene and vinyl [illegible] proportion of [illegible] ownership, [illegible], provided the growth.

[illegible] in Australia, the [illegible]. [illegible] result of political [illegible] in the [illegible] the incentives offered [illegible] governments (such as [illegible] of roads, housing, water and [illegible] facilities), [illegible] because of the protective tariff, foreign [illegible] in Australia in the early 1950's, [illegible]. It was not until this period, [illegible] in the form of refinery products [illegible] to Australian manufacturers. [illegible] refineries with a total ca- [illegible] day, equivalent to [illegible].2 million [illegible]. [illegible] capacity is [illegible],000 barrels per [illegible], and [illegible] refineries have facilities for catalytic reforming.

The average size of the Australian refineries is moderate by world standards, around 50,000 barrels per stream day, but the industry has proved able to function profitably without tariff protection, which was removed in 1963. The location of the refineries was determined by the proximity of markets, the existence of deep-water port facilities, and such factors such as the State government incentives mentioned earlier. From the point of view of subsequent petrochemical development, the refineries are reasonably well located, being close to the major city markets, although frequently distant from other raw material sources.

Subsequent to 1960 there has been rapid growth in the Australian chemical industry, particularly in the petrochemical industry, as a result of a greatly increased interest in Australia on the part of U.S. and European companies, many of which were concerned at protecting markets previously served by exports. During the period 1959/60 to 1966/67 the production of chemicals grew at a rate of 15.2% annually, whereas production of all manufacturing industry increased by 6.7% annually. The rate of investment in the industry was equally impressive, being 19.0% annually for the period as compared with 5.4% annually for manufacturing industry, and the total investment by the industry during the period amounted to approximately $A 300 millions, of which 5% was supplied by inflow from overseas. It seems that much of this investment was prompted by concern for gaining or maintaining a position in the Australian market rather than from strict economic considerations, a motivating factor in foreign investment which has been described elsewhere in relation to U.S. direct investment in foreign countries.(4) One of the consequences of this "band-wagon" effect, in the absence of government planning or controls on

* SA1.00-SUS1.1?

(4) See for example: Yair Aharoni, "The Foreign Investment Decision Process" (Division of Research, Harvard Business School, Boston 1966) and for a discussion of the Australian context: D.T. Brash, American Investment in Australian Industry, (Harvard University Press, Cambridge 1966) Ch. III

foreign investment, has been the proliferation of plants of uneconomic size, as described in the next section.

In 1966/67 the output of the industry rose to $A 333 million, the value added being $A 177 million, but profitability has been low by most standards, ranging from 4.4% on shareholders' equity (after tax) in 1964 to 3.6% in 1965. Throughout the period from 1960-65 the chemical industry was subject to intense competition from imports from Japan, Europe and the U.S., and tariff protection and anti-dumping protection were considered to be inadequate. Up to 1964 the Tariff Board, a Federal Government agency, heard submissions by manufacturers and granted tariff protection on an individual chemical basis. The basis of the arguments put forward by the industry included the comparatively small size of the domestic market and the lack of scale economies, the lack of appreciable advantages in raw materials (petroleum, sulphur and rock phosphate were imported), the high cost of internal and coastal transport, and the exposure of the industry to the excess capacity of the large plants overseas which were able to export at less than full cost.

The Tariff Board, in considering individual products, could not allow for the interrelationships between raw materials, products and co-products, and tended to establish a level of tariff aimed at returning approximately 10% before tax on the depreciated value of the investment, provided that it considered that the local producer had suffered injury and was as efficient as could be expected. It was therefore necessary for the producer to suffer losses in order to establish a case, and the protection granted was not considered by the industry to be adequate in view of normal shareholder expectations. In 1963 the government decided that the chemical industry should be encouraged and ordered a comprehensive enquiry to determine the most appropriate form of assistance, and in 1964 heard submissions from a broad group of manufacturers represented by the Australian Chemical Industry Council. As a result of the enquiry, the Board concluded that the industry merited comprehensive assistance and established three levels of tariff: a 25% general duty for 16 chemicals; a 40% general duty for a further 14 chemicals; and a 60% general duty

for 5 products (polyethylene, PVC, synthetic rubber, vinyl acetate and hydrogen peroxide), with preferential rates 10% lower in each case. In addition, to counteract dumping, support prices were established for [illegible], based on normal domestic [illegible] plus freight, [illegible] and landing charges, which were [illegible] reviewed annually. The Board also provided for anticipatory [illegible] for [illegible] products. The Government did not [illegible] assistance or to subsidy [illegible], and the chemical industry remains subject to the same tax [illegible] as other industry in the Commonwealth. Depreciation for tax [illegible] rate faster than for a ten-year life, [illegible] allowance equal to an extra deduction of 20% of new equipment investment has been in effect for several years.

The net effect of the new tariff provisions has not been to increase the profitability of the industry. In fact, although there was a slight improvement in the prices of support value chemicals following the Board's report in 1966, profitability, measured as return on shareholders' equity, continued to fall, and the chemical price index in 196[illegible] is 96.5% of its 196[illegible] level (and only 86% of its 1961 level). The reasons for the continuing decline in profitability, the Council claims, are the reductions in support values following the annual reviews, the continuing price pressure from chemical products dumped on world markets, and the unsatisfactory basis used by the Board in determining funds employed.

In considering the Australian chemical industry's contribution to the external balance of payments, it is claimed by the industry's Council that the net import substitution now achieved amounts to $A 150 million in 1968, after allowing for imported raw materials and tariffs. In addition, the industry has achieved a modest level of exports, amounting to about 5% of sales in 1968, or $A12.5 million. By contrast, imports of chemical products in 1968 were of the order of $A 250 million, (including raw materials for the domestic industry), of which it is estimated 75% are not produced locally. Capital inflow during the period 19[illegible]-1968 included $A 95 million of new funds and $A 123 million in retained earnings, and it is probably

Table I

City	Site	Company	Petrochemical Products
SYDNEY	Botany	ICIANZ	Integrated petrochemical complex: [illegible]
	Kurnell	ICIANZ	[illegible]
	Kurnell	Phillips Imperial Chem.	[illegible]ion, carbon black
	Kurnell	AOR	Refinery
	Clyde	Shell Co.	Refinery; ethylene, [illegible]one
	Rhodes	CSR Chem.	Oxo alcohols, acetates, esters, [illegible]
		CSR-Dow	Polystyrene
		Union Carbide	Chlorine, [illegible], chlorinated hydrocarbons, silicones.
	Silverwater	[illegible]	[illegible]
	Matraville	[illegible]A.	Refinery
	Other		Several products incl. carbon black, polyamides, acrylics etc.
NEWCASTLE		Newcastle Chem.	Phthalic anhydride
		Eastern Nitrogen (ICIANZ, [illegible], [illegible], [illegible])	Ammonia, ammonium nitrate
MELBOURNE	Altona	[illegible]A.	Refinery
		Altona Petrochem.	Ethylene, butadiene
		ASP	Polybutadiene, SBR
		Union Carbide	Polyethylene [illegible] [illegible] (planned)
		CSR-Dow	PVC

Table 1 (cont.)

City	Site	Company	Petrochemical Products
MELBOURNE	Altona	[illegible]	[illegible], styrene
		Australian Synthetic Rubber	Synthetic rubber
		[illegible]	[illegible] (planned)
	West Footscray	[illegible]	Phenol
GEELONG		Shell	Refinery
		Shell [illegible]	[illegible] Petrochemicals (planned)
WESTERN-PORT		B.P.	Refinery
GAL		ICI-[illegible]	[illegible]
BRISBANE	Pinkenba	Amoco	Refinery
	Lytton	Ampol	Refinery
	Gibson Island	Australian Petroleum Refineries Pty Ltd	Ammonia, urea
	Pinkenba	[illegible] Ammonia	Ammonia
ADELAIDE	Hillcrest Road	BOC	Refinery (LPG/Z chlorine-caustic plant, carbonated beverages)
PERTH	Kwinana	B.P.	Refinery
	Kwinana	Kwinana Nitrogen	Ammonia, nitric acid, ammonium nitrate

The above list does not indicate the full range of chemicals and chemical sites, but covers the major petrochemicals.

Raw Material Availability

Until recently, Australia was deficient in petroleum, natural gas, sulphur, phosphate, potash, bromine and fluorspar, but recent discoveries have radically changed the situation. Petroleum discovered to date in the Bass Strait basin will eventually supply most of Australia's needs; reserves are estimated at 1,500 million barrels and further prospecting is in progress. Other small fields, at Moonie and Barrow Island, are in production, and natural gas is being piped to Brisbane from the Moonie field to the Australian Pacific Fertilizers plant, while construction of pipelines and treatment plants is under way for exploitation of the Bass Strait gas finds. Extensive deposits of phosphate in Queensland, and nickel in Western Australia have recently been discovered, and other raw materials for the chemical industry are available, but frequently costly due to transport charges. There is a shortage of naphtha feedstocks due to the orientation of the local refineries towards gasoline, and requirements are imported.

Although the recent oil discoveries will undoubtedly replace imported crudes in Australian refineries, it does not seem likely that there will be any decrease in the cost of petrochemical feedstock, since the price for locally produced oil is set by the government at import parity plus a quality differential of about 10%. It is possible that, if more extensive finds are made, there may be scope for special price arrangements for export-oriented chemical users.

Development since 1960

The first major petrochemical complex to be built in Australia was the Altona complex based on the A.M.A. refinery (formerly Standard-Vacuum, now jointly owned by Mobil, 74% and Esso, 26%). This complex which cost $60 million, commenced operation in 1961, and includes an ethylene plant employing steam cracking of refinery gases and rated at 46,000 long tons* per year, which is to be expanded to use ethane separated from Bass Strait

* All tonnage figures refer to long tons.

gas at the Gela separation plant. The butadiene obtained from the steam cracker is augmented by dehydrogenation of n-butylene to yield 21,500 tons of butadiene per annum. Other plants in the complex are:

Union Carbide's low-density polyethylene plant, with present capacity estimated at 15,000 tons per annum, and with plans for high-density manufacture,

Australian Synthetic Rubber's SBR plant originally rated at 30,000 tons per year, but recently modified to produce polybutadiene.

Dow's ethylene dichloride plant which provides feed for B.F. Goodrich's polyvinyl chloride plant, believed to have a capacity of 7,000 tons per annum (PVC capacity is in excess of 11,000 tons),

Dow's styrene monomer plant (14,000 tons per year), and polystyrene plant (3,500 tons),

CAC's expandable polystyrene plant (added in 1967),

Hoechst Chemicals' high-density polyethylene plant (originally 12,000 tons per year, now recently expanded), established in 1967.

The Altona complex has been referred to, as noted above, and profitability has gradually improved as capacities are more fully utilised. However, neither the ethylene plant nor any of the other units is of a size comparable with plants considered economic in the major industrial nations, although Union Carbide was successful in exporting many tonnages of polyethylene for the SEAFOM and SEAPAC cables. The ethylene supply will shortly be augmented by cracking of ethane supplied from the separation plant at Gela, which will have a capacity of over 100,000 tons per year.

The other main petrochemical development centred around ICI/ANZ at Botany, in Sydney, where prior to 1960 ICI/ANZ had been producing LD polyethylene from dehydrated alcohol, PVC from cracking acetylene, and chlorinated solvents. When Shell constructed its ethylene plant at Clyde, ICI/ANZ agreed to produce ethylene shipped by pipeline to its Botany site for polymerisation manufacture (21,000 tons annually). Shell's

ethylene plant, now 8 years old, is rated at 25,000 tons per year, 15,000 tons of which is extracted from dry gas supplied by BORAL. In 1963 ICIANZ installed a plant to produce carbon tetrachloride and perchlorethylene (10,000 tons) based on propene from the nearby refinery of BORAL, which also supplies residual oil to BORAL's cracking plant. A logical extension of ICIANZ activities to absorb ethylene from the Shell plant was the production of ethylene oxide, glycols and non-ionic surfactants, commenced in 1964, using the Scientific Design air oxidation process. ICIANZ probably entered into manufacturing partly to preempt Union Carbide, for whom ethylene oxide was an expected development, although the market was quite small (10,000 tons).

ICIANZ's PVC production was based originally on calcium carbide produced in Tasmania, but rising PVC demand necessitated imports. The process was costly, and the ethylene route was an obvious alternative. ICIANZ undertook a considerable research effort in developing an oxychlorination process to recover chlorine from byproduct hydrogen chloride, thus avoiding either wastage of chlorine or the need for a mixed ethylene-acetylene feed. The new ethylene dichloride plant, with a capacity of 70,000 tons per year, was the first commercial plant in the world to use the oxychlorination process. Concurrently with the new process for EDC, ICIANZ brought on stream, in 1964, a 70,000 ton per year ethylene plant based on steam cracking of naphtha, and associated with it is a 30,000 ton per year plant jointly owned with Phillips to manufacture SBR, polybutadiene and carbon black.

Also in the Sydney area is a group of plants based on the BORAL refinery mentioned above, which include the BORAL cracking plant which produces dry gas for Shell's ethylene plant and light oil from which aromatics are extracted in a Udex plant. Benzene and a dilute ethylene stream from these plants are converted by Monsanto to styrene monomer using a UOP Alkar process, and the monomer is converted to polystyrene for the NSW market by Monsanto and Dow. Under a reciprocal agreement, styrene produced by Dow in Melbourne is available also to Monsanto, as a means of reducing shipment between cities 500 miles apart.

Another example of the rationalization of production, which has only recently become accepted as desirable by the industry, was the agreement between Union Carbide and Monsanto whereby a new phenol plant was constructed by Monsanto to supply both companies. A plant was originally constructed in Pelicanne in 1964 employing the Scientific Design direct oxidation process, but was subsequently shut down due to operating problems. The process which is now in operation uses the cumene route, drawing propylene from the Altona refinery and benzene from BHP's steel operations. Capacity is believed to be 45,000 tons per annum.

ICI Chemicals completed an 18,000 ton per year plant at Rhodes in 1957 to produce carbonization alcohols (n- and iso-butanol and iso-octanol) to replace oil facilities based on fermentation. Shell completed in 1964 a plant to produce iso-propanol, acetone and methyl ethyl ketone, and BP Chemicals have announced plans for an expansion of their vinyl acetate monomer facilities to 12,000 tons capacity, using the Bayer process, and with production of 5,000 tons per annum of acetaldehyde using the 'Aldehyd BP' process. (BP Aust has a 49.7% interest in OSRC which resulted of an acquisition in 1967).

Great interest has been generated recently in nitrogenous fertilizers, as land farming expansion in Western Australia, NSW and Queensland has switched into areas of fixation in subterranean clover, and there has been a rapid increase in capacity. ICIANZ built a plant in Botany in 1964 rated at 22,000 tons of ammonia per annum, based on the steam reforming of naphtha, and another in 1966 in a joint venture (Queensland Ammonia) at Gladstone in Queensland based on naphtha, with a capacity of 75,000 tons. These plants proved to be inadequate for the growth of the market, and a 175,000 ton per year plant was recently completed at Newcastle by Kooragang Nitrogen, in which ICIANZ has a 50% interest. The associated ammonium nitrate plant will have a capacity of 150,000 tons. Two other plants have been completed this year, bringing the combined capacity for ammonia to 360,000 tons per annum. The other plants are Austral Pacific Fertilizers (mainly Burns and Swift) near Brisbane, based on natural gas from the Roma fields (250,000 tons) and Kwinana Nitrogen (CSR, A.P.) at Kwinana, Western Australia (165,000 tons).

Prior to the announcement of the $80 per ton bounty on nitrogenous fertilizers, the domestic market was estimated at approximately [illegible] tons in 1970 and up to 400,000 tons on the assumption the bounty will stimulate demand, it seems likely that Australian manufacturers will have new export markets for their production, at possibly very low prices, with considerable advantage to the domestic consumer.

[illegible] PROGRAMMING AND POLICY

Table II includes some estimates of future petrochemical capacity and domestic demand in 1975 and 1980. It should be recognized that there is little published data regarding plant capacities in Australia and that the demand projections are approximate, as local capacity in some cases may be greater than indicated. However, it is evident that there is excess capacity in several areas, notably ethylene with a new expansion under way at Altona, [illegible] rubber and polyethylene, ammonia block and ammonia. Average plant size, except for the new ammonia plants, is well below the economic minimum judged by overseas standards. It is unlikely that Australian plants for most petrochemicals will achieve reasonable economic size for many years, if ever.

Several products are not now manufactured in Australia, largely because of the small market. These include polystyrene, Shell and Hoechst have announced plans, coupled to existing plant capacity, for isocyanates (approximately 5,000 tons), synthetic glycerol (about 3,000 tons) and tetra-ethyl lead. Propylene oxide would be the next petrochemical product to be manufactured locally, although the chlorohydrin route would suffer from the high cost of chlorine and the styrene route would produce co-products (e.g. styrene, methyl methacrylate or acrylonitrile) for which the available domestic market is small.

Table II

Estimated Supply, Demand and Plant Size

('000 long tons per year)

Product	1968 Capacity	No. plants	Demand 1970	Demand 1975
[illegible]zene	170,000	4	120,000	200,000
[illegible]ene	[illegible],000	[illegible]	20,000	25,000
[illegible]-xylene-[illegible]	[illegible],000	2	40,000	60,000
-[illegible]	[illegible],000+	1	20,000	30,000
[illegible]ron monomer	45,000+	2	30,000	40,000
[illegible]	35,000+	2	40,000	70,000
[illegible]ene oxide	10,000+	1	11,000	18,000
[illegible]rom black	14,000	3	20,000	25,000
[illegible]mene	360,000	5	150,000+	300,000+
[illegible] [illegible]ber	50,000	2	30,000	45,000
ormaldehyde	35,000+	4	38,000	55,000
[illegible]etaldehyd[illegible]	[illegible],000	1	9,000	12,000
	15,000 (U.C.)	1		
[illegible]nyl acetate	4,000	1	7,000	10,000
	12,000 (U.C.)	1		
[illegible]nol	17,000	1	16,000	25,000

+ Denotes minimum estimate

(U.C.) denotes new facility under construction in 1969

The possibility of large-scale chemical plants aimed at export markets has been proposed as a means of gaining scale economies, and it is worth considering the potential of this line of development. Let us first consider the advantages or disadvantages Australia may have relative to other larger economies in this sphere of activity. The raw material position has been outlined earlier, and it seems that Australia now has local supplies of most of the raw materials needed by the petrochemical industry. If transport costs for raw materials can be reduced, either through direct subsidy or relaxation of restrictive policies, the industry would be competitive with most others in this respect, and would have advantages compared with countries such as Japan which depend largely on imported resources.

With respect to services, the most serious present cost disability of the industry is in electrical power, where in the past chemical manufacturers have paid prices which reflected the costs of the State electrical distribution networks. These prices are in excess of 1.0 cent per KWH, whereas present full generating costs are around 0.3 cents per KWH for the large thermal stations situated close to cheap coal sources. Recently State governments have made concessions to large new users (such as aluminum smelters) and there is scope for further concessions to the chemical industry. With ample reserves of coal and natural uranium, Australia should have advantages in electrical costs from which the petrochemical industry could gain a competitive edge, provided governments can be persuaded to price their product marginally.

Operating maintenance labour are not large components of cost, and Australia's net costs compare favourably with the U.S., but are higher than in Japan or Europe. Managerial and entrepreneurial talent are currently in very short supply, and although this factor is not recognized explicitly in operating costs, it is undoubtedly a limitation to perceiving and grasping opportunities for growth against world competition.

In costs of plant construction, lower Australian productivity (as compare with the U.S.) is offset by lower labour rates. The machinery and fabricating industry is well developed and can provide most items of

equipment. Plant construction costs, as a result, are very close to U.S. costs, being slightly lower where the imported requirement is minimal.

On the basis of considerations outlined above, it is reasonable to conclude that Australian petrochemical plants could compete on world markets if a sufficiently large scale of manufacture could be achieved and if the major part of production could be sold at full cost. These requirements have been met by the chemical industry in recent years, despite the small scale of the domestic market. The difficulty for the chemical industry lies in disposing of its production at prices which cover both variable and fixed costs, and the history of chemical manufacture has demonstrated frequently that manufacturers with access to large domestic markets are prone to dump excess capacity on export markets at prices just above marginal cost to make some contribution towards fixed costs.

Some possibilities which suggest themselves are to charge the domestic economy more for its needs than the export sector by means of subsidy, tariffs or taxation incentives, or to encourage export-only manufacturing zones supported by fiscal incentives, possibly using Australian resources and processing as an off-shore supplement to some other country's industry. In the first proposal, it may be that for some products the costs to the economy of partially subsidizing exports from large scale installations may be no greater than the costs of supporting a fragmented group of small plants through tariff protection, and the benefit to the balance of payments would be greater. However, in the strict economic sense, the solution seeks to impose a greater proportion of fixed costs on the domestic economy in order to supply exports at marginal cost, and should be considered as a device for subsidizing exports. On the other hand, the establishment of industries primarily intended for export requires the allocation of

fixed costs to the export sector, and depends on the existence of a market prepared to accept exports at full cost. It is possible, as has been suggested elsewhere, that such an arrangement could be negotiated between Australia and a nation deficient in resources, such as Japan, with economic benefit to both parties, but substantial political problems remain to be surmounted. In the near future, it seems probable that the Australian petrochemical industry will continue to require support, and that new ventures which capitalize on unique technological advantages and produce further rationalization of production will be more rewarding to the investor.

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