AUSTRALIAN MANUFACTURING INDUSTRY — THIRD TIME LUCKY*

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The title of this paper "Australian Manufacturing Industry — Third Time Lucky?" carries with it the implication that Australia has had two previous attempts at establishing a manufacturing industry in which we failed to achieve the success we desired. We will examine some of the historical and economic reasons for this failure and use this analysis to indicate how we can establish a viable export-oriented manufacturing industry in Austrailia.

Keywords: Australian manufacturing industry, R & D, CSIR, technology, economics

BRIEF DISCUSSION OF AUSTRALIA'S ECONOMIC PERFORMANCE

The last decade has seen a remarkable change in the subjects which are talking points among chemists. It is most unlikely that a group of chemists in the 1950s or 1960s would have talked about restructuring our manufacturing industry to become export-oriented, or about tariff protection and the level of private industry investment in research and development. Yet today these are common topics of converstaion. Figures comparing sources of funds for research and development for various countries expressed as a percentage of gross domestic product are now familiar.

These figures raise some interesting questions about Australia's research and development outlays, especially the relatively low expenditure by business. Similarly familiar are figures (Table 2) which compare the proportion of funds devoted to basic research, applied research and experimental development in Australia with the USA and they show that while we spend a marginally higher precentage of our gross domestic product on basis research and a slightly lower proportion on applied research than either the USA or the OECD

* This paper is based on the second T.G.H. Jones Lecture delivered by Dr. D.H. Solomon at the University of Queensland on Tuesday, 28th November, 1986. Thomas Gilbert Henry Jones was Professor of Chemistry at the University of Queensland from 1940 until his retirement in 1965. He joined the University in 1915, at the age of 20, as a Lecturer in Chemistry. Professor Jones' research work was concerned with the chemistry of Australian native plants.

TABLE 1
Sources of Funds for R & D
(expressed as per cent of GDP)

	Year	Business	Government
Australia	(1981)	0.21	0.77
USA	(1984)	1.32	1.33
Sweden	(1983)	1.50	0.90
Denmark	(1982)	0.57	0.58

Source: OECD, *Reviews of National Science and Technology Policy — Australia,* 1986.

average, we spend a dramatically smaller percentage on experimental development than almost any country.

Recently a new set of figures have been presented.[1] These figures are concerned with trade in selected technology-based products. In Table 3 are listed the ratio of exports to imports and the *per capita* value of exports of technology based products for a number of countries.

TABLE 2
Allocation of R & D Effort
(expressed as per cent of GDP)

	Year	Basic Research	Applied Research	Experimental Development
OECD	1979-84*	0.26	0.50	0.69
Australia	1981	0.33	0.44	0.22
USA	1984	0.32	0.57	1.58

* average based on figures provided by member countries

Source: OECD, *Reviews of National Science and Technology Policy — Australia,* 1986.

TABLE 3
Trade in Selected Technology-based Products

Country	Ratio of exports to imports	*Per capita* exports $US per person
Germany	1.92	1071
Sweden	1.08	1070
United States	0.96	358
Finland	0.63	477
Australia	0.12	65
Iceland	0.01	10

Source: OECD, *Reviews of National Science and Technology Policy — Australia,* 1986.

Only Iceland has a lower ratio of exports to imports than we do.

THE THREE PERIODS

The choice of the title "Third Time Lucky" is a deliberate one because it enables us to go back and look at the first two phases of Australian manufacturing industry, to try to discover why we have ended up with the kind of economic performance illustrated in Table 3. The paper is biased towards the chemical industry but we believe that there are lessons to be learnt from the chemical industry that can be applied generally to manufacturing.

Manufacturing industry in Australia can be divided into three distinct periods. Stage 1 covered the period up to 1939, Stage 2 from 1939 to the early 1970's and Stage 3 from the 1980's onwards.

Period 1

Prior to 1939 the chemical industry was a collection of chemical producer groups each grown up in isolation and having more affinity with its customer industry than with other producers.[2] Most chemical production was concerned with serving the mining and wheat growing industries. The first chemical factory was set up in 1874 by Robert Scott at Deer Park in Victoria to manufacture the explosives used in underground mining. Up to this time supplies of explosives had come from the Nobel factory in Ardeer, Scotland. In this case the 'tyranny of distance' worked in Australia's favour. Incidentally, the Deer Park factory, now owned by ICI, is still producing explosives with a 2 per cent tariff protection. The other major chemical manufacturing was concerned with the manufacture of superphosphate from imported rock phosphate and locally made sulfuric acid. The Mount Lyell Chemical Company soon established factories in New South Wales, Victoria and South Australia. Cumming Smith at Yarraville, Victoria, and Cresco Fertilizers at Geelong were other important producers. The farmers objected strongly enough to the pricing policies of the superphosphate producers for them to be able to form a co-operative company, Pivot Superphosphate, to produce their own requirements. The resulting price fall caused the other producers to increase the efficiency of their operations. Superphosphate is still produced in Australia with a 2 per cent tariff protection.

Consolidated figures for research and development expenditure in that period are not readily available. However, it is clear that there were some major achievements and that it was largely funded by business. The flotation process was developed in this period. Sir Ian Wark's Laboratory, while housed at Melbourne University, was funded by a consortium of mining companies. CSR had a well established research program in the early part of this century and

established a laboratory in Pyrmont in 1923. It is fair to say that during this first period our manufacturing industry was closely related to primary industry, it was not protected by tariff barriers, and it had some highly focussed, business-funded research and development activities.

Period 2

The second stage of development of Australian manufacturing industry can be regarded as having started with the outbreak of World War II in 1939. Professor Jones foresaw some of the opportunities and possible difficulties. In his Presidential Address[3] to the Institute in 1939 he said:

> With the outbreak of war it is obvious that research in the applied field will receive a great stimulus if Australia is to develop those secondary industries which are suggested by the unusual emergency. Not only will existing industries require to be carried on with the greatest possible efficiency but newer ones will create demands for trained chemists which it may not be possible to supply at once. . . . .It cannot be doubted that the unfortunate circumstances of war may prove of some benefit to Australia insofar as the development of secondary industry is concerned.

Even the Government foresaw the opportunity. On 13th March, 1940, Cabinet approved the formation of the CSIR Division of Industrial Chemistry on the following basis:—

> The aims of Division, put generally, were to be:
> (i) to promote greater technical efficiency in established industries;
> (ii) to stimulate the establishment of new industries;
> (iii) to encourage the use of raw materials of Australian origin;
> (iv) to seek substitutes for raw materials at present imported; and
> (v) to find uses for the by-products not now utilized.

Until the late 1930s CSIR's main effort had been research for primary industry.

The chemical industry in Australia grew in a spectacular way in this period. Before the War the chemical industry was not an industrial leader. However after the War it became a definite leader[2] in terms of growth per annum and innovation among secondary industries. The underlying philosophy behind this development was that Australia's manufacturing industry aim at 'import replacement'. That phrase is one which causes us great concern. It is still a prevalent philosophy today and, as we will show later, it carries with it tremendous limitations.

TABLE 4
Growth of chemical industry*
1945-60 (1945-6 = 100)

	Chemicals	All secondary industry
No. of factories	305	181
Persons employed	217	152
Value of materials used	1,656	572
Value of production	1,094	581
Value of output	1,114	579

*excluding pharmaceutical and toilet preparations

Source: A. Hunter and L.R. Webb, "The chemical industry", p.290.

This second period was characterized by quite rapid initial growth as the import replacement policy took effect. Most of the technology used in the expansion was imported under restrictive licensing agreements and the industry was protected by high tariff barriers. It is interesting to look at the progress of research and development in this period. Because of the various restrictive arrangements which were invoked during this period, there was a reduction in the relative amount of business funded research and development. Government and University research became very diverse and of doubtful relevance to manufacturing industry and a large gap developed between the industry and the education sector. However, as the years progressed the industry stagnated and we find ourselves with the economic performance indicated earlier.

LESSONS FROM THE SECOND PERIOD

Before going on to discuss prospects for the third period, we will analyse some of the problems we have created for ourselves in the past 30 years. A number of reasons are commonly given why Australia cannot have a viable export-oriented manufacturing industry. Most of these reasons appeal to our 'common sense' but most are inadequate.

Examples:—

- It costs too much to transport our goods to major markets (i.e., we are too far from major makets). The success of Hong Kong, Japan, Korea and Taiwan and the lack of success of Mexico shows that this is not a true explanation. Note also that our main exports are coal and wheat which are the most bulky commodities in international trade.
- Our wage costs are far too high. The success of West Germany, the United States and Japan indicates that this cannot be the

explanation, although it is true that our non-wage hiring costs are higher than our competitors.
- Our industry is largely foreign-owned and is prevented from doing its own research and development.
- We are a small country and cannot ever hope to produce all of our own technology.

There is some truth in the last two statements. In fact the last statement is obviously true. No country is able to produce all of its own technology and has to import some proportion of the technology it uses in its industry. Australia with less than ½ per cent of the world's population can only expect to produce of the order of 1 per cent of the world's technology. If we produced 2 per cent we would be doing well. So Australia, along with every other country in the world, will always be importing technology. Japan, Korea and Taiwan have been massive importers of technology.

In our second phase, with its limited objective of import replacement, we allowed technology to be imported under highly restrictive agreements. Consider a typical restrictive licensing agreement, usually between a large overseas company and an Australian firm (large or small) or the Australian subsidiary of an overseas company. Normally this would involve an up-front payment and royalties based on production in return for the granting of an exclusive licence to the Australian firm. The overseas company would provide the technical process, training and advice. This exclusive agreement, coupled with tariff protection, usually meant guaranteed profit for the Australian firm. As further protection of this sound commercial position, improvements made by the overseas licensor were available, again on an exclusive basis, to the Australian licensee. However, in return for this the Australian company or subsidiary was required to agree to certain restrictive clauses. Firstly, the product was not to be sold outside Australia and, secondly, under grant-back arrangements any improvement made by the Australian firm to the process or the product automatically became the property of the original licensor. The first restriction, i.e., no export, was of no great concern at the time because our stated objective was import replacement. The second, or grant-back clause, was accepted as the price necessary in order to receive overseas improvements and to maintain the Australian firm's exclusive commercial position.

A further restrictive arrangement of concern was often imposed on our chemical industry by the Australian purchasers of chemical products. In some cases the specification written for a chemical or chemical industry product contained, in addition to the expected performance clause, a specific chemical composition, i.e., they defined the chemical in detail. Examples are of paint systems used on,

for example, refrigerators or motor cars where, in addition to what was required in terms of performance, the detailed polymer specification was spelt out. The composition nominated was often patented, sometimes by a company with similar shareholding to the purchasers, and the net effect was that any Australian chemical firm wishing to supply this material had to go overseas again and take out a licence.

Another method by which some overseas companies restrict the entry of manufactured goods into their countries is by specifying testing far in excess of what is reasonably possible. For example, a company calls tenders for a component of a motor car with a closing date one month hence but requires the product to have been through a three months' testing program.

The subject of restrictive licensing was covered in a recent debate in the Senate.[4] It was revealed that 30 per cent of licensing arrangements involve export restrictions on the product being developed, 45 per cent of licensing arrangements insist that ownership of all improvements in technology be vested in the original overseas licensor, and that 35 per cent of agreements prohibit adaption of the technology locally.

The crucial question for Australia is, under what conditions should we allow technology to be imported? There is an extensive literature on the economic and social aspects of international technology transfer for economies in general[5,6,7] and for Australia in particular.[8,9] We believe that the Government, industry and the research community should be involved in determining the most appropriate policy for Australia. If we are going to develop an internationally competititve export manufacturing industry, then the over-riding consideration must be the development of an industry-funded research and development base.

SOME IDEAS FROM ECONOMICS

The scientific community has a vital interest in the way manufacturing industry is restructured in the next few years. We must, however, be wary of coming up with solutions from the 'top of our heads'. The best way to proceed must come from detailed economic and political considerations. The scientific community must take more interest in these areas if we hope to influence the outcome.

We have been interested recently in the writings of the US economist Mancur Olson, especially his pioneering work.[10] His theory is that the behaviour of groups of individuals and firms in stable societies leads to the formation of dense networks of collusive, cartelistic and lobbying organizatons that make economies less efficient and dynamic. He argues that groups for collective action that comprise a small percentage of the population will lobby for policies

which benefit their members rather than the country as a whole, and that such groups seldom break up and therefore are much more prevalent in static societies. Individuals usually need some incentive (such as the union closed shop) to join a group for collective action, and these incentives take a while to develop effectively. This is another reason why such groups are found in stable societies rather than unstable ones. He also argues from historical evidence that the formation of large free trade areas has led to a period of rapid economic growth and finally that tariff barriers affect the internal economic performance of small to medium economies much more than large economies.

Australia is an ideal country to test his theory. We are a medium-sized stable country with high tariff barriers for our manufacturing industry. We have many groups which have successfully argued for policies which benefit them rather than the country as a whole. One example from the chemical industry concerns commodity polymers. The tariff barrier for the manufacture of PVC and LDPE advantages the manufacturers of these commodities but seriously disadvantages the down-stream manufacturers of plastic products and of course the consumers.

TABLE 5
Prices of Commodity Polymers*

Polymer	Aust.	UK	USA	NZ	Japan
PVC GP (Susp)	1250	820	890	760	840
LDPE	1490	890	1090	980	1250

*$Aus./Tonne/FIS 3rd Qtr. 1984.

Source: Australian Chemical Industry Council.

TABLE 6
Protection and export performance

	Average effective rate of assistance (Mfg) (1976)	Ratio of value of manufactured exports to value of manufactured output (1973)
Australia	28.0	0.08
New Zealand	28.3	0.05
Austria	9.8	0.33
Finland	14.6	0.28
Norway	8.2	0.35
Sweden	6.1	0.38
Canada	7.8	0.20

Source: Olson, 'Australia in the perspective of *The Rise and Decline of Nations.*[11]

Olson's arguments would predict that medium-sized economies with low tariff barriers would perform better than those with high barriers.[11] He took as an indicator of performance the ratio of exports to output of manufactured goods, and as a measure of protection the average effective rate of assistance for manufacturing activities. He analysed 1973 and 1976 information and found that the data supported his theory.

THIRD TIME LUCKY?

A corollary to Olson's thesis is that an economy like Australia's will only restructure if subjected to a large jolt. We suggest that the present economic crisis, which the Prime Minister has likened to a state of war, gives us a great opportunity as a country to overcome the political muscle of the various interest groups and build a viable manufacturing industry. Whatever Olson's insights might mean for the better organization of research *per se,* there is, of course, more hope for research in an outward-looking economy than vice versa.

Our aim must be to have an industry which can be competitive in the international marketplace and is also able to export. This policy objective has a number of clear implications:—

1) Such an industry would not require high protection. The recent IAC Report[12] on the chemicals and plastics industry has advocated the lowering of tariffs on most of the industry's products. Already some powerful lobby groups are trying to force the Government to slow down the implementation of the recommendations or even

TABLE 7

Support for manufacturing related R & D in Australia and comparable OECD countries, 1981

(Per cent of GDP)

	Industry funding in business enterprise	**Government funding for industry related purposes**
Switzerland	1.75	0.08
Sweden	1.26	0.28
Netherlands	0.85	0.14
Belgium	0.92	0.13
Italy	0.49	0.20
Canada	0.47	0.12
Australia	0.18	0.16

Source: OECD, *Reviews of National Science and Technology Policy — Australia,* 1986.

reverse them. Those of us interested in the long-term survival of our industry should urge the Government to resist such pressure.

2) We mentioned earlier that Australia has quite a reasonable level of Government funded research and development but low industry-funded research and development where these figures apply to R & D for all purposes. If we now compare R & D for manufacturing-related purposes, we see that (Table 7) in comparable countries industry spends about five times more on R & D than in Australia.
3) Such an industry may well be quite different from the one we have today. This has an implication for those who train chemists and other future employees of industry. The industry is likely to be more heavily concentrated in high value-added areas rather than in commodities and graduates must have the flexibility to work in such areas.
4) Finally, those of us in the scientific research community will need to take a lot more interest in the economics of industry, market opportunities both local and overseas, and in all of the restrictive practices which have grown up during the easier times.

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