TRENDS IN THE QUICK-FROZEN FOOD INDUSTRY*

G. R. SPINKS
Economics Research Officer

1. SUMMARY

The following article is a brief description of the quick-frozen food industry, with particular reference to its development in the United States and in New South Wales, together with some comments on its future in this State. However, the absence of statistical data about production and consumption makes a detailed examination of the industry in New South Wales impossible and as a result the conclusions reached here must be regarded as tentative only.

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Quick-frozen foods have special characteristics which influence consumer purchasing and these must be considered against those of competing products, namely, canned and fresh. Any or all of the following factors may determine consumer buying: price, convenience, flavour, appearance and nutritional levels.

The industry first developed in the United States and its growth in that country has been fairly rapid. The only serious check to its expansion occurred in 1947 when the industry experienced a recession, largely due to the inferior quality of some quick-frozen foods associated with rapid development during and immediately after the war and the fact that canned goods became more readily available at that time.

Since the end of World War II two new groups of products have been developed in the United States; frozen citrus juice concentrates and quick-frozen pre-cooked foods. The output of these has expanded rapidly; the former now accounts for a considerable proportion of the total citrus consumed whilst the latter has opened up a vast new range of products.

However, despite rapid expansion in all types of quick-frozen products, the consumption of quick-frozen fruit and vegetables in the United States is still low relative to total consumption, though the industry's share of the market is steadily increasing each year. However, for certain items such as peas, lima beans and strawberries, the quick-frozen product accounts for a considerable proportion of their total consumption.

The development of the industry in New South Wales can, by and large, be taken as representative of its growth in the other States of the Commonwealth. The first step in its establishment in New South Wales occurred in 1945 when a plant began operating in Sydney. Development has been hindered by two factors: first, the irregular supply of fresh peas for processing, mainly due to climatic adversities; and second, a general shortage of retail storage cabinets. The former is still a major problem but the shortage of retail storage cabinets has now been overcome.

There are a number of factors operating outside the industry to assist its development. The principal among these are the steadily increasing population, with its heavier concentrations in urban areas and the widespread ownership of domestic refrigerators, many with special storage facilities for quick-frozen foods. On the other hand, Australian consumers, unlike those in many parts of the United States, are able to purchase very easily a wide range of fresh vegetables all the year round.

To a very considerable extent the future of the industry will depend upon action initiated by the industry itself. Some form of consumer educational advertising will be necessary to make consumers aware of the special characteristics of this new type of product, but before this is undertaken there are three basic matters which require attention. These are market research, improved retailing and improved reliability of supplies of raw materials, mainly vegetables and fruit.

However, even with effective action to realise the industry's potential in Australia, it seems likely that for a long time and for the bulk of the consumers, quick-frozen foods will be confined to the role of supplementing the fresh product.

2. INTRODUCTION

The problem of coping with periodic shortages and gluts of foodstuffs has always demanded a major portion of man's energies and as a result several techniques of food preservation have been developed throughout the ages, namely, drying, salting, smoking and fermenting. All these techniques are still in use to-day and although considerable research has improved the quality of the final product, the basic principles have not altered.

The first scientific approach to the problem of preserving perishable foodstuffs occurred early in the nineteenth century when, following a plea by Napoleon for the discovery of some method of preserving food for a considerable period of time, canning was evolved by a Frenchman named Appert.

Although freezing has been used as a technique of food preservation for thousands of years, it has been limited by climatic factors. The first step in its development for large scale preservation occurred in 1842 when an Englishman named Benjamin took out a patent for the freezing of food by immersion in an ice and salt brine. Other patents quickly followed in the United States and the United Kingdom for the freezing of fish and meats. However, the extension of frozen foods to the individual consumer was an offshoot of the growth of mechanical refrigeration which allowed the large scale storage of foodstuffs and their transportation.

Although fruit was being frozen in barrels at the beginning of this century it was left to an American, Clarence Birdseye, to develop the idea of marketing frozen foods in packages to suit the individual consumer. It is reported that Birdseye noted during hunting trips in Arctic regions that game and fish quickly frozen in those low temperatures retained their quality and flavour. In the mid-twenties, he commenced marketing small sized packets of quickly frozen fish, and by the early thirties he had extended the system to cover fruit and fresh vegetables.

There is very little agreement as to what constitutes quick-freezing and from the range of definitions it is apparent that the term "quick" is purely relative. It is maintained by some that the process must be defined on the basis of the observed ice formation in the frozen produce, fast frozen being referred to as intracellular freezing (intrafibre for animal products) and slow freezing being the condition where the ice formation is mainly extracellular (extrafibre for animal products). Others define the process as that in which solidification is obtained within 30 minutes or less. There are also definitions in terms of the minimum rate at which the ice zone progresses through the product.

The need for a quick-freezing technique involving a very rapid rate of ice formation appears to vary with the product under consideration and some recent research on different freezing rates on vegetables has suggested little difference in final quality.[1] It is fairly clear, however, that under commercial processing conditions the product must be reduced in temperature as soon as possible after harvesting, in order to prevent deterioration during processing. This is quite apart from the controversial problem of the effect of the rate of freezing on the maintenance of quality after processing.

[1] F. A. Lee, W. A. Gortner and J. Whitcombe, "The Effect of Freezing Rates on Vegetables", *Industrial and Engineering Chemistry,* Industrial Edition, Vol. 38 (March, 1946) pp. 341-346.

A major concern of the quick-freeze processor is the quality of the final product and because initial quality cannot be improved by processing it is essential that only the highest grade raw materials be used. Thus, quality conscious processors of fruit and vegetables view the actual growing of the raw material as part of processing, with quick-freezing as the method of retaining the initial levels of quality. Rapid harvesting, transporation and processing are essential to quality retention and therefore factories are usually located near the centres of production of the raw material. This in turn means that the selection of a site is a major decision for a processor, as the variety of fruit and vegetables for which the area is suitable must be considered. In the processor's endeavour to attain a high quality product, a carefully trained field staff is necssary to determine the best harvest time for the various crops. Once this stage is reached processing must commence as quickly as possible.

The preparation of vegetables for quick-freezing is similar to that used in canning. Actual processing techniques vary to some extent with each type of vegetable but they usually involve washing, blanching or scalding, cooling, inspection and packaging. Although a heat treatment is used, quick-frozen vegetables are not cooked as in the canning process.[2]

The preparation of fruits for freezing is relatively simple. Berry fruits, for example, are washed, sorted and (for strawberries) sliced. They may then be either mixed with a proportion of sugar and placed in containers or covered with a heavy syrup. Peaches, for example, are peeled, halved, sliced and covered with a syrup containing a preservative such as sulphur dioxide or ascorbic acid. Fruits, for the most part, are more difficult to preserve by freezing than vegetables as they tend to brown, lose flavour and collapse in texture. However, the use of sugar, both dry and as syrup, and of anti-oxidants such as ascorbic acid, has enabled a large number of fruits to be successfully frozen.

3. CHARACTERISTICS OF QUICK-FROZEN FOODS

The characteristics of quick-frozen foods, in particular fruit and vegetables, must be assessed by comparison with those of the competing products, the fresh and canned articles. Consumers, when purchasing may consider any or all of the following factors: price, convenience, flavour, appearance and nutritive value. However, although considerable discussion has centred around the nutritional levels of quick-frozen products it is the author's opinion that this aspect is unlikely to be a major factor in influencing consumer purchasing in Australia in the near future.

[2] A brief description of the actual processing of fruit and vegetables is available in S. M. Sykes' "Some Developments in the Freezing of Fruits and Vegetables in Australia", *The Journal of the Australian Institute of Agricultural Science,* Vol. 20, No. 1 (March, 1954), pp. 3-8.

Price

Quick-frozen fruit and vegetables are usually more expensive than the equivalent canned article and, except in certain periods of the year, the fresh product. Therefore the industry relies on the other qualities of quick-frozen foods to offset this price disadvantage—comparative prices for peas in Sydney are shown later in Table IX.

Convenience

Both canned and frozen products are much more convenient than the fresh article as there is no preparation other than warming for the canned and cooking or thawing for the quick-frozen product. The canned product has the additional advantage that it requires no special storage facilities and can be kept in reserve for longer periods, whereas quick-frozen products have a relatively short safe storage period after purchasing, so that some planning in purchasing is necessary.

Flavour

Generally speaking the frozen article retains much more of the natural flavour than the canned product, both in fruit and vegetables. This advantage is particularly marked for those fruits which are normally eaten raw, such as strawberries. However, most fruit frozen with sugar or syrup is less palatable than the corresponding canned article, because the penetration of the sugar is not as complete as with the canned item. Furthermore, in some cases the consumer is already well satisfied with the canned product and may prefer it to either the frozen or even the fresh product; for example, canned clingstone peaches, asparagus, salmon, tuna, etc.

In many instances quick-frozen vegetables surpass in flavour even the "fresh" product as sold in retail stores; this is particularly true of quick-frozen peas.

Appearance

Quick-frozen fruit and vegetables are generally superior in appearance to most varieties of canned products and the majority of fresh products. The colour of any particular variety of fruit differs little from that of the canned item, whilst the colour of quick-frozen vegetables, especially peas and beans, is generally more attractive than its competitive products.

Nutrition

In Australia, this aspect may influence only a small proportion of consumers at present but later may become an important selling point. A recent comprehensive survey in the United States has shown that quick-frozen fruit and vegetables have particularly high nutritional levels,[3] although no clear-cut comparisons with the canned or fresh product are yet available. However, nutritional levels of quick-frozen fruit and vegetables are probably considerably higher than much of the fresh product purchased through the retail market.

[3] "Nutrition Report Opens New Markets for Frozen Foods", *Quick Frozen Foods*, Vol. XVIII, No. 8 (March, 1956), pp. 55-58.

Each of the characteristics discussed will have varying appeal to different classes of purchasers, in relation to such factors as income, age, size and number of working members in the family. For example, the aspect of convenience might appeal more to young married working couples while price would not be a major consideration to those in the higher income groups. The trend towards higher real incomes is likely to favour the quick-frozen product.

4. THE QUICK-FROZEN FOOD INDUSTRY IN THE UNITED STATES

Because the industry developed in the United States it is of considerable interest to examine its growth in that country. This growth is all the more remarkable for three reasons: firstly, the quick-frozen food industry developed in the depression years of the thirties; secondly, it was forced to overcome considerable consumer prejudice against foodstuffs associated with any form of refrigeration; and thirdly, the steadily increasing production until 1939 rested wholly upon passive consumer acceptance, as no large-scale advertising or sales promotion schemes had been conducted.

War-time Development

The industry received its greatest boost during World War II when a general shortage of tin-plate caused the rationing of canned goods. Because of their packaging material, quick-frozen foods were not placed on the ration list and consumers found them an attractive substitute. Furthermore, the reduction in supplies of all consumer goods stimulated the search for substitutes for rationed goods and encouraged much exploratory buying. The large number of working married women also quickly appreciated the advantages of the quick-frozen foods.

TABLE I

United States Production of Commercial Frozen Foods

Year	Fruits	Vegetables	Poultry	Meats	Sea Foods	Prepared Foods	Concentrates	Total
	million lb.							
1938 ...	130	73	12	5	48	...	...	268
1939 ...	180	70	15	10	50	...	...	325
1940 ...	225	92	50	14	50	...	...	431
1941 ...	250	150	75	18	75	...	...	568
1942 ...	275	220	70	12	70	...	...	647
1943 ...	210	300	90	14	90	7	...	711
1944 ...	315	285	90	...	90	10	...	790
1945 ...	445	338	100	...	120	25	...	1,028
1946 ...	519	450	125	12	125	40	...	1,271
1947 ...	344	346	130	15	125	5	...	965
1948 ...	370	446	150	20	150	20	...	1,156
1949 ...	354	563	200	50	165	35	140	1,507
1950 ...	472	587	275	75	225	60	300	1,994
1951 ...	416	770	350	85	300	85	440	2,446
1952 ...	420	896	400	125	350	130	550	2,871
1953 ...	542	1,103	470	170	400	195	678	3,558
1954 ...	523	974	525	200	450	280	783	3,735
1955 ...	660	1,140	575	250	520	400	807	4,352
1956 ..	694	1,533	550	300	560	565	990	5 192

Source: Compiled from *Quick Frozen Foods*, Vol. XIX, No. 6 (January, 1957); *Agricultural Statistics*, USDA, 1955; *The Fruit Situation*, USDA Marketing Service (October, 1957); and *The Vegetable Situation*, USDA Marketing Service (October, 1957).

The war years also encouraged an extension of frozen locker plants; these are community freezing works specialising in the freezing and storage of patrons' surplus foodstuffs. This was mainly a rural development and its patrons were principally from the farming community. For example, in 1946, 73 per cent of the total locker patrons in the United States were farmers—mainly renting lockers for the freezing of meat.[4] Even as late as 1954, the quantity of meat products frozen was just over four times that of fruit and vegetables. The rapid expansion of locker plants during and immediately after the war (see Table II) was not conducive to efficient plant management, and little attention was paid to abnormal war-time and post-war demand or to the location of plants. As foodstuffs became more readily available consumers returned to the normal retail outlets for many of their requirements, while in addition the purchase of home freezer units increased. As a result, the steady increase in locker plant numbers levelled off, and by 1952 had begun to fall. Furthermore, their basic role—that is, the rental of freezing space—changed and many have now become mainly distributing centres for nationally advertised brands of quick-frozen products or are now processing their own products with a view to developing a purely local market. Locker rental, once the main source of income, is now a minor function.

Post-war Development

After the war, the quick-frozen food industry continued to grow and with the rapid expansion of consumer purchasing power in that period a large number of new processors was attracted to the industry. Many of the newcomers had little real understanding of the specialised nature of the quick-frozen product, and made little or no attempt to process a high-quality article or try to gauge market trends for particular items. Furthermore, there was a general shortage of suitable storage cabinets at the retail level. As other foodstuffs, particularly canned goods, became more readily available and consumers become more aware of the generally poor quality of some quick-frozen foods, demand eased and some resistance to the purchasing of quick-frozen foods developed. As a result, many frozen-food brokers were left with large inventories, which precipitated a slump in the industry

TABLE II

Number of Frozen Food Locker Plants in the United States

Year	Number
1938	1,269
1946	8,025
1947	9,529
1948	10,617
1949	11,245
1950	11,506
1951	11,608
1952	11,427
1953	10,954
1954	10,854
1955	10,553
1956	10,344

Source: Compiled from *Agricultural Statistics*, USDA (1955) and *Quick Frozen Foods*, Vol. XIX, No. 6 (January, 1957).

[4] *Agricultural Statistics*, USDA (1948), p. 726.

in 1947. For example, stocks of peaches moved from slightly more than 30 million lb. in 1945 to approximately 68 million lb. in 1946, and were about 61 million lb. in the following year.[5]

The seriousness of this slump is indicated in Table I, while Tables III and IV illustrate its effect upon the production of various types of quick-frozen fruit and vegetables. For example, peaches, apricots and prunes, which constituted about 24 per cent of the total quick-frozen fruit packed in 1946, have never recovered their importance. Except for strawberries, production in the years following the slump declined as brokers attempted to reduce their stocks. Strawberries are by far the most popular frozen fruit and have continually increased their importance in both absolute and percentage terms. The quantity of quick-frozen strawberries constituted only about 15 per cent of total output of all quick-frozen fruit in 1946, but over the last five years for which figures are available (1952 to 1956, inclusive) they make up more than 40 per cent of the total. In absolute terms their output has increased about four times between 1946 and 1956.

The output of almost all quick-frozen vegetables also declined as a result of the slump, but recovery was more rapid than for fruit—see Table IV. Peas continue to be the major vegetables processed, although their importance in percentage terms has decreased from about 31 per cent in 1946 to 24 per cent in 1956.

Many authorities within the quick-freeze industry in the United States contend that this recession taught valuable lessons, as it illustrated the need for marketing only quality products, and it also eliminated a large number of inefficient processors. Furthermore, it suggested that market research would be necessary in guiding the future expansion of the industry.

Since the inception of the quick-feeze industry some important changes have taken place. Table I shows that until 1947 the production of quick-frozen fruit was always greater than that of vegetables, but by 1956 production of quick-frozen vegetables was more than double that of fruit. Quick-frozen fruit and vegetables tend to serve different markets. Fruit (apart from strawberries—see Table V) has nearly always been directed to the institutional trade (hotels, hospitals, restaurants, and industrial use) and is mostly packed in quantities of 10 lb. and over. Vegetables, on the other hand, have been mostly processed for the retail trade, which takes more than 60 per cent of total output (see Table V). Changes have also occurred in the size of packages offered on the retail market. The movement has been away from the 12-ounce to the 10-ounce packet and since 1948 this sized package has made up more than 60 per cent of the total vegetable pack for the retail trade.

New Products

Since the end of World War II two new groups of products have been introduced, frozen citrus juices and pre-cooked foods. Because a considerable proportion of the total per capita consumption of citrus fruits had been in the canned form since the late thirties, the rapid acceptance of quick-frozen citrus juices was to be expected, as this processing technique is an improvement on that used for canning. Table VI shows that there was

[5] *Quick Frozen Foods*, Vol. XIX, No. 6 (January, 1957), p. 253.

TABLE III

United States Frozen Fruit and Berry Production

Fruit	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
	'000 lb										
Apples and Applesauce ...	62,369	28,401	27,551	52,268	48,013	28,772	37,649	42,355	60,094	72,758	86,956
Apricots	43,571	6,006	2,476	2,086	7,801	9,869	4,155	3,962	5,404	12,257	4,594
Blackberries	19,750	14,509	9,745	15,186	8,972	14,574	10,628	17,966	14,156	16,539	12,845
Blueberries	10,240	5,406	7,660	14,035	10,899	13,921	9,848	13,988	20,971	21,020	19,638
Cherries	95,891	67,358	88,461	73,953	105,200	101,533	64,278	116,980	90,334	117,289	93,969
Grapes and Pulps	12,444	20,974	5,510	3,118	15,188	4,799	4,937	10,109	9,411	11,125	14,903
Peaches	65,140	27,034	13,598	23,234	25,790	32,380	35,454	32,170	36,380	50,635	45,481
Prunes	14,106	2,843	2,125	5,297	5,144	6,791	3,588	8,356	4,498	5,754	3,991
Raspberries	29,420	32,516	27,715	31,836	31,377	28,973	27,368	33,869	31,800	33,983	16,935
Strawberries	78,059	109,035	160,077	107,599	192,731	157,729	200,302	225,962	221,446	272,970	312,293
Young, Logan, Boysen and Similar Berries	19,570	18,976	16,929	20,055	13,494	13,369	14,517	15,933	17,822	18,514	22,380
Miscellaneous Fruits and Berries	68,532	10,461	7,875	5,353	7,564	3,235	7,578	20,303	10,674	26,209	60,327
Total Fruits and Berries ...	519,092	343,519	369,722	354,020	472,173	415,945	420,302	541,953	522,990	659,053	694,327

Source: Compiled from *Agricultural Statistics*, USDA, 1955, and *The Fruit Situation*, USDA Marketing Service, January, 1958.

TABLE IV

United States Frozen Vegetables—Production

Vegetables	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
	'000 lb.										
Asparagus	28,316	10,737	18,321	18,422	22,309	23,561	25,460	32,945	25,780	28,669	37,674
Beans—Snap	40,974	30,910	49,583	58,523	65,528	81,650	87,438	114,780	123,253	120,967	137,744
—Lima	50,082	68,194	75,403	87,948	85,987	108,020	113,926	138,594	129,674	117,697	143,538
Broccoli	25,788	9,117	29,126	45,233	41,028	48,768	82,253	89,042	62,004	96,240	118,287
Brussels Sprouts	13,521	4,556	10,525	23,454	22,439	22,476	22,454	40,801	33,418	23,142	43,989
Carrots	9,069	2,904	15,392	12,750	13,338	10,573	22,269	29,331	27,494	34,389	51,010
Cauliflower	13,326	5,353	13,962	21,655	12,338	22,428	33,166	35,709	17,088	44,086	47,159
Corn—Cut	42,426	26,559	20,919	37,076	32,997	44,549	62,684	104,809	78,212	70,041	118,153
Corn-on-Cob	2,295	6,064	10,323	17,563	10,068	8,772	14,196	17,217	16,788	6,932	20,422
Peas	140,602	131,785	118,976	113,273	152,275	195,541	203,726	226,664	206,854	231,216	359,661
Potatoes	.....	.....	.....	.....	.....	.....	.....	70,691	85,256	128,890	189,685
Spinach	38,185	23,279	41,571	62,306	52,805	97,878	91,464	87,927	66,901	110,347	104,511
Pumpkin and Squash	10,008	5,189	5,577	8,336	8,324	12,724	15,068	9,472	13,036	.....	.....
Other Vegetables	35,408	21,561	36,679	56,959	67,665	93,324	121,974	105,288	88,817	127,079	161,205
Total Vegetables	450,000	346,208	446,357	563,498	587,101	770,264	896,078	1,103,270	974,575	1,139,695	1,533,038

Source: Compiled from *Agricultural Statistics*, USDA, 1955, and *The Vegetable Situation*, USDA Marketing Service, October, 1957.

TABLE V

United States Frozen Fruit and Vegetable Pack Retail and Institutional Comparisons for Selected Products

	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
	Per cent									
Vegetables—										
Asparagus—										
Retail	68	72	69	73	74	60	68	75	67	66
Institutional	32	28	31	27	26	40	32	25	33	33
Beans, Snap—										
Retail	54	54	60	64	67	69	68	64	63	63
Institutional	46	46	40	36	33	31	32	36	37	37
Limas—										
Retail	49	57	60	54	62	65	65	61	66	65
Institutional	52	43	41	47	38	35	35	39	35	35
Broccoli—										
Retail	60	68	71	74	74	82	76	81	78	71
Institutional	40	32	29	26	26	18	24	19	22	29
All Vegetables—										
Retail	56	58	64	64	67	68	66	65	64	64
Institutional	44	42	36	36	33	32	34	35	36	36
Fruits—										
Cherries, Red Tart—										
Retail	2	...	3	...	...	1	5	3	6	3
Institutional	98	100	97	99	99	99	95	97	94	97
Blackberries—										
Retail	19	1	7	16	2	2	2	1	1	2
Institutional	81	99	93	84	98	98	98	99	99	98
Raspberries, Red—										
Retail	25	11	22	39	42	34	42	48	44	46
Institutional	75	89	78	61	58	66	58	52	56	54
Strawberries—										
Retail	24	32	36	45	40	43	48	46	40	46
Institutional	76	68	64	55	60	57	52	54	60	54
All Fruits—										
Retail	26	15	20	21	20	22	30	28	23	24
Institutional	74	85	80	79	80	78	70	72	77	76

Source: *Quick-Frozen Foods*, Vol. XIX (January, 1957), No. 6, p. 249.

TABLE VI

United States Citrus Fruits—Per Capita Consumption

Year	Fresh	Canned	Canned Juice	Frozen Juice	Total
	Fresh Fruit Equivalent—lb				
Average 1936–40	50·9	1·2	5·9	.....	58·0
Average 1941–45	61·3	0·8	15·7	.....	77·8
1946	59·1	1·1	34·8	0·3	95·3
1947	62·2	1·5	30·2	0·2	94·1
1948	54·4	2·0	36·2	0·5	93·1
1949	47·8	1·8	26·2	6·6	82·4
1950	41·2	1·5	19·8	10·6	73·1
1951	45·1	1·7	20·8	14·9	82·5
1952	44·4	1·4	17·0	21·2	84·0
1953	43·4	1·8	15·9	24·2	85·3
1954	41·2	1·9	15·8	26·7	85·6
1955	41·9	2·6	16·6	29·9	91·0
1956*	38·3	2·2	16·3	30·6	87·4

* Preliminary.

Source: *The Fruit Situation*, USDA Agricultural Marketing Service, August, 1957, p. 32.

approximately a threefold increase in per capita consumption of frozen citrus juice between 1950 and 1956. This increase has been at the expense of competing citrus products since the total consumption of citrus per head of population has remained fairly stationary.

The development of pre-cooked foods in the industry has also been extremely rapid (see Table I). This section of the industry is in a constant state of flux, as there is a very rapid rate of entry and exit of various dishes. A total of more than 170 items were available in 1955 ranging from appetisers to desserts and from individual items to complete dinners.[6] However, a few items constitute the major proportion of this output, namely French fried potatoes, meat and poultry pies and dessert pies—for potatoes see Table IV. This branch of the quick-frozen food industry is generally regarded as the one with the greatest potentiol in the United States as it opens up a complete new range of products. Its big advantage is that at the present time quick-freezing is the only method whereby complete meals can be processed and presented in the normal manner. Although a limited range of meals is available in canned form, the ingredients are completely mixed, whereas freezing allows them to be adequately separated.

Fairly extensive advertising and sales promotion schemes have been undertaken to educate consumers in the variety of quick-frozen products available, their generally high quality standards and also in the correct preparation of frozen foods in the home with particular emphasis on the problems of home storage, thawing and the dangers of refreezing. Definite attempts have also been made to instil brand consciousness into consumers on a scale very much like that which exists in the canning industry. Furthermore, considerable debate into the merits of marketing second-grade products has occurred with a view to placing the quick-freezing industry on a similar basis to canning, where there is a definite demand for a lower-priced second-grade product.

Another problem facing processors is the role of the super markets and large chain stores, which together control a considerale proportion of the total retail cabinet space. These firms have commenced to market their own brands of frozen foods, and as a result, some of the nationally advertised brands are being forced out of cabinets.

Considerable research has been and is being conducted by both the Federal and State Governments, together with Universities and State Colleges, into various aspects of the industry such as, quality, product standards, processing, storage and distribution. Research into retail marketing has not been particularly extensive, although some interesting studies have been made. One of the main objects has been to discover the principal type of purchaser of quick-frozen foods. A survey was conducted into this problem in three separate areas of New York and an analysis indicated that at the time of the survey "the important market for frozen foods is made up of families with comparatively high incomes".[7] It was found that, although all income groups bought some frozen foods such

[6] Robert B. Reese, *Production of Frozen Prepared Foods* 1954-55, USDA Marketing Research Report, No. 170, p. 3.

[7] R. C. Scott, *An Analysis of Frozen Food Purchases in Three New York Areas* (New York: Cornell University Agricultural Experiment Station, Ithaca) Bulletin 861 (September, 1950) p. 3.

as peas and strawberries, the range of both fruit and vegetables purchased widened considerably as income increased. This study also attempted to consider the effects on buying policy of family size, occupation and the age of the purchaser, although the author points out that his efforts in this field were mainly exploratory and the results were inconclusive. Similar findings were reported in another study which showed that more of the higher income families (those with incomes of more than $3,000 a year) bought frozen foods for each of the 12 frozen items studied.[8] In this latter study, using an unweighted average for the six vegetables examined, 40 per cent of the high-income families purchased quick-frozen vegetables compared with 26 per cent of the lower income groups. For strawberries, representing the main fruit bought at the retail level, the corresponding figures were 53 per cent and 39 per cent. Marked differences between the income groups were also obtained in respect of chicken and fish fillets.

The quick-frozen food industry itself has been active in the field of research. For example, a grant of £250,000 was made by the National Association of Frozen Food Packers to the University of Wisconsin in order to establish the vitamin and mineral content of 30 frozen vegetables, 14 frozen fruits and 7 frozen juices. The findings were evaluated against the Recommended Daily Dietary Allowances (RDDA) of given nutrients as established by the Food and Nutrition Board of the National Research Council which is part of the National Academy of Sciences. For a considerable time, spokesmen for the industry have maintained that the nutritional level of quick-frozen products is extremely high, and in order to prove this important advertising point the above grant was made.[9] The first report of the research panel, released in 1956, substantiated the industry's nutritional claims. This, the first piece of comprehensive research into nutritional levels of frozen foods, has been hailed as opening up a new range of market possibilities. However, the panel has not compared the nutritional levels of quick-frozen foods with canned or fresh products, and at the convention where the first research findings were made available none of the panel "would draw any comparison between fresh, canned or frozen foods in the light of the new findings."[10] However, the trade journal, *Quick Frozen Foods,* made comparison between certain canned and frozen items which were quite misleading and since then the Research Group at the University of Wisconsin has pointed this out.[11] The second stage of the report, already under way, will deal with the retention of nutrients during processing, storage and cooking.

A new process incorporating quick-freezing has been developed in the United States called dehydrofreezing. This could be regarded as a separate process which incidently involves quick-freezing; as the title implies it

[8] H. W. Bitting, *Purchase of Frozen and Canned Foods by Urban Families as Related to Home Refrigeration Facilities,* Marketing Research Report, No. 60. USDA Agricultural Marketing Service (February, 1954) p. 8.

[9] "Nutrition Report Opens New Markets for Frozen Foods". *Quick-Frozen Foods,* Vol. XVII, No. 6 (March, 1956) pp. 55-58. The full report of the panel is to be found in "Vitamin, Mineral and Proximate Composition of Frozen Fruits, Juices and Vegetables", M. Burger, L. W. Hein, L. J. Teply, P. H. Derse and C. H. Kreiger, *Journal of Agricultural and Food Chemistry,* Vol. 45 (May 1956) p. 418. The article has also been reproduced in *Quirk Frozen Foods,* Vol. XIX, No. 6 (January, 1957), pp. 222-232.

[10] *Ibid.,* p. 190.

[11] Editorial "Is Industry Getting Good Mileage out of its Nutritional Survey?" *Quirk Frozen Foods,* Vol. XIX, No. 8 (February, 1957), p. 39.

is a combination of normal dehydration and quick-freezing, the object being to dehydrate to the lowest level without impairing quality.[12] Peas processed in this way have been tested in parts of the United States and the results have been quite favourable. Processing by this method removes about two-thirds of the water content from peas which are then quick-frozen, thus reducing the fresh weight by about half. The direct reductions in both volume and weight result in substantial savings in freezing, packaging, transportation, storage and other handling and distribution costs. It is also claimed that the method had definite quality advantages, particularly for fruits frozen with sugar.

The stage reached by the industry as far as vegetables are concerned in its competition with canned and fresh products is shown in Table VII. The fresh product has declined in importance as a result of the increase in frozen and canned articles. Nevertheless frozen vegetables still account for only about 8 per cent of total consumption. However, with certain items such as peas and lima beans the frozen product accounts for a much greater proportion. The study made by Bitting showed that of the twelve quick-frozen items examined, only three were bought by more than half of the families in the survey. These items were orange juice, peas and strawberries.[13] The per capita consumption in terms of fresh, canned and frozen, for selected vegetables is shown in Table VIII.

A survey of the purchases of about 500 restaurants by the U.S.D.A. showed that the use of frozen foods by restaurants is not as great as normally believed. Only 31 per cent of the vegetables purchased by the survey restaurants were in the frozen form, while 38 per cent were canned and the remaining 31 per cent were fresh. A similar position existed for fruit and berries although more cherries and strawberries are bought frozen.[14]

TABLE VII

*United States per capita Consumption of Vegetables**

Year	Fresh Equivalent					As Percentage of Annual Total			
	Total Fresh and Processed	Fresh	Processed			Fresh	Processed		
			Total	Canned	Frozen		Total	Canned	Frozen
	lb	lb	lb	lb	lb	Per cent	Per cent	Per cent	Per cent
Average, 3 yrs. 1937–39 ...	169·8	114·0	55·8	54·7	1·1	67·1	32·9	32·2	0·7
1952	201·6	111·0	90·6	78·4	12·2	55·1	44·9	38·9	6·0
1953	201·9	108·4	93·5	81·0	12·5	53·7	46·3	40·1	6·2
1954	198·2	106·7	91·5	77·9	13·6	53·8	46·2	39·3	6·9
1955	202·1	104·6	97·5	82·2	15·3	51·8	48·2	40·6	7·6
1956	205·2	104·9	100·3	83·2	17·1	51·1	48·9	40·6	8·3

* Civilian consumption only.

Source: *The Vegetable Situation*, USDA Agricultural Marketing Service, July, 1957, p. 29.

[12] Edward J. McGrath, "Milwaukee Restaurants go for Dehydro Frozen Peas", Agricultural Marketing, Vol. 2, No. 10 (October, 1957), p. 3. The method has been used in Australia, mainly on an experimental basis—see D. McBean, "Dehydrofreezing; A New Method of Preservation", *CSIRO Food Preservation Quarterly*, Vol 16, No. 1 (March, 1956), pp. 16-17.

[13] H. W. Bitting, *op. cit.*, p.1.

[14] Henry T. Badger, "Use of Frozen Foods by Restaurants", *Agricultural Marketing*, USDA Agricultural Marketing Service, Vol. 1, No. 4 (November, 1956), p. 3.

TABLE VIII

*United States per Capita Consumption of Selected Fresh and Processed Vegetables**

Commodity	Average 3 years 1937–39	1952	1953	1954	1955	1956
	lb—Fresh Equivalent Basis					
Asparagus—						
Fresh	1·20	·80	·80	·70	·70	·70
Canned	·70	·87	1·03	·99	·88	1·00
Frozen	·08	·30	·32	·33	·31	·32
Beans, Lima—						
Fresh	·80	·40	·40	·40	·30	·30
Canned	·50	·66	·66	·70	·72	·75
Frozen	·23	1·59	1·62	1·47	1·59	1·64
Beans, Snap—						
Fresh	4·60	3·40	3·50	3·30	3·40	2·80
Canned	1·45	2·51	2·58	2·67	2·93	3·02
Frozen	·06	·67	·72	·81	·84	·91
Peas, Green—						
Fresh	2·23	·50	·40	·40	·40	·30
Canned	8·11	8·63	8·33	8·26	8·07	8·17
Frozen	·48	3·35	3·52	3·92	3·78	4·21
Spinach—						
Fresh	2·67	1·5	1·40	1·1	1·0	1·1
Canned	·83	·93	·91	·68	·83	·94
Frozen	·03	·90	·94	·94	·104	1·01

* Civilian consumption only.

Source: *The Vegetable Situation*, USDA Agricultural Marketing Service, July, 1957, p. 30.

4. QUICK-FROZEN FOODS IN NEW SOUTH WALES

The growth of the quick-frozen food industry in this State can, by and large, be taken as representative of development in the other States of the Commonwealth although certain differences must be recognised resulting from population densities. Compared to the stage reached in the United States, the industry is very much in its infancy. However, in many ways it has developed along similar lines to that in the United States as fresh frozen peas have been and will continue to be the nucleus around which growth will depend. The major problem handicapping any real examination of the quick-frozen food industry in Australia is the complete absence of any statistics covering production or even the number or type of firms engaged in the quick-freezing of foodstuffs.

Development of the Industry

Prior to the outbreak of World War II, some very small quantities of frozen foods were imported into this State from the United States but sales were confined to the luxury food trade. It was not until 1945 that the first step was taken in the establishment of a quick-frozen food processing plant. A Sydney firm, already engaged in food processing, erected a plant, the main outlet for which was the Armed Services, although some production was allocated to the civilian population.

Following this venture, a plant was erected in southern New South Wales for supplying quick-frozen food to the retail market, under a well-known United States firm name. Also, at about this time, a completely new article, pre-cooked foods, appeared in shops, but this initial venture proved a failure, largely due to high prices, generally poor quality and inferior packaging. (Subsequently pre-cooked products have appeared with more success.) The quick-freeze industry had not reached a level where it could support a speciality item such as pre-cooked foods. Since then the industry has maintained a steady but unspectacular growth and its place as an essential part of the Australian food processing industry is assured.

In this State, only three major firms are actually engaged in the quick-freezing of fresh vegetables and fruits. One of these, operating in the northern portion of the State, is mainly concerned with processing peas for the institutional trade. There are also a number of small firms which confine their operations mainly to prepared foods. In some instances the food is prepared, under contract, away from the freezing works, and is then delivered in bulk, where it is packaged and frozen. Obviously such a system results in considerable variation in quality. Others engaged in the preparation of pre-cooked products conduct all processing on their own premises, thus allowing close supervision of quality. Some firms buy the raw material from the wholesale fruit and vegetable markets, preparing and packaging the product on their own premises. This system does not result in a high-quality product as purchasing is mainly governed by ruling market prices and not quality.

Peas are by far the most popular of the quick-frozen vegetables and would constitute more than half of total sales. Other vegetables processed include beans, asparagus, cauliflower, broccoli, sweet corn and brussels sprouts. The bulk of the fruit processed is sold to the catering trade and to processors in large-sized packs ranging from 30 lb. to 50 lb. A considerable proportion of this fruit is exported, but an increasing amount is being further processed locally into jams, preserves and cordials. The most popular of the fruits sold on the retail market are the berry fruits, particularly strawberries.

Present Position

It appears that the development of the frozen food industry in this State has been hindered by two factors, one of which has now largely vanished; firstly, the supply of peas to processors, and secondly, the shortage of adequate storage cabinets at the retail level—this latter factor is no longer a major factor hindering development.

Until very recently this general shortage of cabinets was reflected in the fact that a considerable number of shops, principally in the outer suburbs, were holding frozen foods in ice cream cabinets, although the better-known brands were not included in their stocks. However, continual pressure from retailers without storage cabinets who saw frozen foods as an extra selling line could not be ignored by the refrigeration industry. Frozen food cabinets became readily available as some refrigeration manufacturers offered them on hire-purchase terms or at low rentals.

Although the shortage of retail storage cabinets has abated, there still remains as a limiting factor an inadequate supply of raw materials. In particular, the shortage of fresh green peas for processing has hindered

and may continue to hinder the development of the quick-frozen food industry in New South Wales. The inadequate supplies over the past few years have been mainly due to climatic adversities. Because of the heavy demand for quick-frozen green peas, supplies were imported from overseas, particularly from New Zealand—a country where the industry is well established. For a short time, this proved a profitable venture and in some instances New Zealand processors expanded their plants with a view to the Australian market. However, fairly severe import restrictions accompanied by increased local production soon terminated this development. This, coupled with a good growing season, resulted in over-production of quick-frozen peas and triggered off a price war in the New Zealand quick-frozen food industry.[15]

Because of a general lack of consumer knowledge of quick-frozen foods, their principal role in the past has been as a supplement to the fresh product. For example, very few people are aware that a 12 oz. pack of quick-frozen peas is about equal to 2 lb. of peas in the pod. Over the past few years, quick-frozen peas have retailed at 3s. 6d. for this size pack, which is equivalent to approximately 1s. 9d. per lb. of peas in the pod. From the viewpoint of price alone, and ignoring considerations of quality and convenience, it would only pay to purchase quick-frozen peas when the retail price of the fresh product rose above 1s 9d. per lb. Over the past three years monthly average retail prices for peas in Sydney have exceeded 1s. 9d. in 14 months out of 36, mainly in the winter—see Table IX. However, the quick-frozen article has frequently been in short supply during periods when fresh peas are scarce and dear. Considering price alone, it would pay consumers to use the canned product all the time in preference to quick-frozen peas and most of the time in preference to fresh peas—see Table IX. It is apparent, therefore, that characteristics other than price largely determine consumer purchasing of peas.

Recently there has been a fairly rapid expansion of the prepared food section of the industry and a considerable number of small firms have begun to market a fairly wide range of products, particularly novelty items and national foods, for example, Chinese meals. These lines have allowed cabinets to be reasonably stocked during periods when quick-frozen peas were unobtainable. This section of the industry is relatively easy to enter, as capital investment is not as great as in the processing of fresh fruit and vegetables. The first plant to prepare pre-cooked meals was established in 1947 by Qantas—Australia's overseas airline—and production was and still is used entirely in its planes and at airports. Articles produced by this firm are of the highest possible standard as a result of a policy of rigid quantity control for both the raw material and the processed product. As mentioned earlier, some firms have the food prepared under contract away from their freezing works and as a result considerable difficulty occurs in maintaining quality standards. However, several firms prepare their product on the premises with careful attention to quality. The range of items offered is continually expanding and contracting, new items appearing at a fairly rapid rate and others disappearing. The major selling lines are "national" foods, *e.g.*, Chinese and Italian meals, although there is a movement towards the more conventional English dishes. As yet there does not appear to be any major product which makes up a large proportion of the

[15] *Australian Financial Review*, Sydney, November 14, 1957, p. 3.

TABLE IX

Sydney Retail Prices for Fresh and Processed Peas

A. Fresh Peas—Average Monthly Prices

Month	1955	1956	1957
	Price per lb.		
	s. d.	s. d.	s. d.
January	1 6	1 2	1 8
February	1 7	1 6	1 11
March	1 7	1 10	1 4
April	1 9	2 11	1 3
May	2 9	2 11	1 3
June	2 11	2 7	1 7
July	2 11	2 8	2 5
August	2 3	2 0	2 7
September	1 4	1 8	2 6
October	1 2	1 5	1 6
November	1 4	1 7	1 7
December	1 2	1 3	1 5

Source: As collected by the Division of Marketing and Agricultural Economics.

*B. Quick-frozen Peas**

A 12 oz. packet which is equivalent to about 2 lb. of peas in the pod retails at 3s. 6d. This is equal to 1s. 9d. per lb. for peas in the pod.

*C. Canned Peas**

A 16 oz. can which retails at 2s. 5½d. consists of about 11 oz. of shelled peas. This is equivalent to approximately 29 oz. of peas in the pod and is therefore equal to a price of about 1s. 4d. per lb. for fresh peas.

* Retail prices of quick-frozen and canned goods are for the top brand products; these have remained unchanged over the past three years.

total output as is a feature in the United States. Nevertheless, the role of the prepared foods in the future of the Australian quick-freeze industry needs careful examination, as many people have been turned away from quick-frozen products because of the poor quality of some of these prepared foods. Because these products have a great novelty appeal they encourage exploratory buying and therefore they are often a consumer's first venture into quick-frozen foods. The consumer may tolerate an indifferent pea, but never a poor quality prepared meal.

The availability of quick-frozen products is fairly extensive in this State, as the major processors have set up distributing depots in most of the larger rural centres. However, distributing problems have been not fully understood by many of the smaller processors and until recently considerable quantities of quick-frozen products were despatched without adequate refrigeration protection. However, this practice is decreasing as distributors and processors become aware of the problems associated with rises in temperature during handling.

The quick-freezing of poultry has also expanded fairly rapidly in this State with most of the production moving to the institutional trade, such as hotels, restaurants, hospitals, etc., and although at the moment the price is relatively high and quality control sometimes lax, this branch of the industry seems assured of a good future. Quick-frozen fish is readily available in retail shops, but the bulk is imported; however, some tuna is being quick-frozen in New South Wales.

Perhaps the greatest boom to the industry in this State, as elsewhere in the Commonwealth, has been the entry of the large chain stores into the retailing of quick-frozen foods. Following their normal pattern, these businesses have closely watched the development of the industry and the increase in demand, as they do not retail any artricle until demand for the particular line is established. Their relatively late entry into the sale of quick-frozen foods is partly due to the fact that they must be assured of sufficient retail cabinet space and adequate storage on their premises. These businesses have placed quick-frozen products before a wider group of purchasers.

The growing importance of the quick-frozen food industry in Australia can be gauged from a statement by the Commonwealth Minister for Health, who is reported to have said "special legislation to control the preparation, packaging, handling, storage and transport of frozen foods may be recommended to the States by the Commonwealth".[16] This is an indication that some governmental concern has arisen about the general lack of understanding not only by consumers but by some processors, distributors and retailers of the special problems inherent in this form of food processing.

5. FUTURE DEVELOPMENT IN NEW SOUTH WALES

The future development of the quick-frozen food industry in this State and in the other States of the Commonwealth rests largely in the hands of the industry itself. A major problem facing processors is that of properly appraising market demand, since they are introducing a new product for which wide consumer acceptance has not yet been established. In Australia, at the moment, the retail price of quick-frozen foods is generally higher than that of its competitive products. Compared with the canned article, raw material and processing costs are similar, but quick-frozen products are more expensive to distribute. Special warehousing and transport facilities are necessary; as a result, both wholesale and retail markups are much higher. Similarly, the distribution of the fresh product, largely due to wastage, is more expensive than is that of the canned.

The general lack of adequate data about production, consumption and stocks of quick-frozen foods does not permit any detailed examination of trends within the industry and most discussion of its future must be largely in terms of opinions and impressions. However, it seems probable that increasing demand could result in some price reduction through economies of scale, both in processing and distribution. At the present time, many consumers are unaware of the special characteristics of quick-frozen foods, so that rapid expansion of the industry will depend largely upon intensive advertising and not so much upon price reductions.

[16] *Sydney Morning Herald,* November 22, 1957.

The Australian market for quick-frozen foods has a number of features which must be examined by processors. The most favourable aspects for the industry are, firstly, the steadily increasing population coupled with its heavy concentration in urban areas and, secondly, the extremely widespread ownership of domestic refrigerators, many of which have special storage cabinets for quick-frozen foods—a trend which is increasing.

The main disadvantage of the Australian market from the quick-freezers' point of view is that the climate permits an adequate all-year-round supply of fresh vegetables; this contrasts with the position in the United States, where winter conditions in the north, the most densely-populated region, prevent an adequate supply of the fresh product. Thus consumers, of necessity, have purchased processed articles for many years. Quick-freezers in Australia, therefore, have a more difficult problem in overcoming consumer conservatism against the quick-frozen product.

Basic Requirements for Market Expansion

Before any educational advertising campaign is instituted it would be desirable that three basic matters be given attention. These are: firstly, market research; secondly, improved retailing; and thirdly, improved supplies of raw materials.

Market Research

The first problem facing processors is to discover the type of market for which their product is suited. From the results of studies made in the United States it seems that the quick-frozen product is mainly purchased by the higher-income groups and it is also likely that this will apply in New South Wales, although a number of retailers do not agree with this assumption.

Carefully designed market research could be conducted relatively easily in stores which carry a complete range of products. The stocking of frozen, fresh and canned foods is becoming a common feature in New South Wales stores, including large chain stores, chain groceries and large departmental stores. This characteristic is not widespread in many parts of the United States; for example, a survey in Washington showed that "many stores did not stock several of the fresh vegetables, although they were in season and readily available. Less than one-third of the stores stocked fresh peas, lima beans, spinach or broccoli."[17] Thus the availability of fresh products in the United States does not appear to be as widespread as in Australia.

The results of such store surveys could suggest what sections of the community are the principal purchasers of quick-frozen foods and what are the main consumer motivations and preferences, so that advertising could be mainly directed at that section of the market with the greatest potential.

[17] "Availability and Display of Frozen Foods in Retail Stores in Washington, D.C.", *Marketing Research Report*, No. 73, USDA Agricultural Marketing Service, Washington, D.C. (August, 1954), p. v.

Improved Retailing

Considerable improvement is needed at this level as retailers' knowledge of the specialized characteristics of quick-frozen foods has been largely neglected. Retailing is in many ways the weakest link in the processor-consumer chain. Products may leave the factory at the highest quality standards but reach consumers at much lower levels due to faulty handling.

A recent report provides the following example. A grocer in a Melbourne suburb, in enquiring about temperature control in his cabinet remarked that he had "frequently found temperatures as high as 27° but had not noticed any visible deterioration of the goods". He then went on to say that "a few customers had said they were disappointed with the flavour of products taken from the cabinet".[18] In reply to the query, the CSIRO pointed out that quick-frozen food cabinets in retail stores should be maintained at an air temperature of 0° to plus 5° F. at the trays or baskets within which the frozen food is held. Even for a short period, temperature at any part of the cabinet should not be allowed to rise about 10° F. as general deterioration of the food increases rapidly as the temperature rises about this level.[19] According to the above report, independent surveys have shown that in some districts more than 7 out of 10 quick-freeze cabinets were being operated at temperatures higher than the recommended level.

Although this particular case was in Melbourne, a similar position would probably exist in many stores in Sydney and in country districts of New South Wales. However, one of the main processors in this State conducts regular periodic checks on cabinet temperatures in stores retailing its products, and also attempts to make retailers conscious of the importance of correct temperature control for quality retention. This is in fact an important free service to other processors whose products are displayed in the same cabinets.

The display function of cabinets has been just as neglected as education on their storage function. Cabinets are often overcrowded and packages torn or badly frosted. The results of a survey in the United States showed that the "condition of display (orderliness, price marking, frosted or damaged packages) has the most important effect on frozen foods sales".[20] Because of the heavy capital outlay involved, it is essential that cabinets fully serve both functions and this requires that they be placed in a strategic position in the store. This is particularly important for a new product, where a considerable amount of the purchasing can be classified as "impulse" or "novelty" buying.

Quick-frozen prepared foods can play a very useful role as an introduction to quick-frozen products for many consumers, providing quality standards are maintained at a high level. In Australia these products have considerable novelty appeal and in many instances will be a consumer's

[18] *Refrigeration Annual* (December, 1956), p. 58.

[19] A brief summary of some of the major research findings on the effects of different storage temperatures on quick-farozen foods is available in S. M. Sykes, "The Storage of Frozen Foods in Display Cabinets", *CSIRO Food Preservation Quarterly,* Vol. 17, No. 2 (June, 1957), pp. 22-28.

[20] *Marketing Research Report,* No. 73, op. cit., p. iii.

first venture into quick-frozen products. Unfortunately an appreciable proportion of prepared foods is of dubious quality and the purchasing of such an item could result in consumer prejudice to all frozen products.

Improved Supply of Raw Materials

To date, the lack of continuity of supply of a number of products, particularly peas, has hindered the expansion of the quick-frozen food industry. This has been largely the result of weather adversities. However, the development of irrigation can assist in stabilising supplies. Already a number of processors are operating in Tasmania, where climatic variations are not so marked.

Although very small quantities of frozen citrus juice concentrates are being marketed in New South Wales future prospects are not particularly clear. Besides the heavy capital investment necessary to establish processing plants, there are grave problems of supply of raw materials. Furthermore, Australian consumers have had little experience with processed juices of any type and therefore it is unlikely that frozen concentrates will be accepted as readily as in the United States where expansion of the market for this product was to a large extent based on the earlier popularity of canned citrus juices—see Table VI.

From the growers' point of view, price fluctuations will be limited to some extent by any expansion in the production of quick-frozen fruit and vegetables. The main limit to the stabilising function is that processors cannot, to any great extent, absorb temporary surpluses of fresh products since their processing demands fairly rigid quality and variety requirements. Thus the wastage and low prices associated with gluts will not be directly reduced by the expansion of quick-freezing—a belief held by many in this country.

However, the presence of widely accepted quick-frozen and canned substitutes will have the effect of dampening price rises in the fresh market during a shortage. While the expansion of the quick-frozen food industry will mean that a higher proportion of growers will be enjoying the price stability of the normal contract system associated with production for processors.

6. CONCLUSION

For a number of reasons experience in the United States is not a good guide to the future of the industry in New South Wales or in the remainder of the Commonwealth. Considerable expansion in the industry can be expected but the rate of development is extremely difficult to predict. It will probably be influenced largely by the extent of the efforts made by the industry in the direction of retailer and consumer education and market research. Such expansion as does occur will have some stabilising effect on market prices and producers' income but this effect is generally overrated. It seems likely that for a long time the industry in New South Wales and in the other States will be confined to a very small proportion of the total overall market for vegetables, fruit and other products.