VEGETABLE OILS IN THE AUSTRALIAN ECONOMY.

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SUMMARY.

1. Vegetable oils play an important part in meeting many of our needs; their most important uses in Australia being in the manufacture of paints and varnishes, soaps, margarine and lubricants. To a certain extent various vegetable oils are interchangeable; technical developments such as molecular fractionation tend to make more substitution possible. This trend which is as yet in its infancy may have far-reaching effects in the future

2. Statistics of vegetable oil consumption in Australia are very meagre. According to an estimate made by one of the authors pre-war average annual disappearance of vegetable oils in Australia was approximately 32,500 tons, falling to 31,800 tons during the war years when oil seed and oil imports from many former exporting countries were cut off. Coconut oil and linseed oil together account for more than two-thirds of Australia's vegetable oil consumption. Coconut oil was used in soap and margarine manufacture in approximately equal proportions before the war. Linseed oil is used mainly in the manufacture of paints and varnishes; smaller quantities being used for the production of linoleum and printing inks. Less than one-third of all vegetable oils in Australia are used for edible purposes compared with over two-thirds in Great Britain and United States of America. The relative abundance of animal fats and restrictive legislation against margarine has reduced edible vegetable oil consumption. This is probably the main reason why we have not grown any food oil crops.

3. *Linseed.* Before the war Australia imported from India over 30,000 tons of linseed annually; linseed oil disappearance amounting to approximately 12,500 tons. At the present time imports have been cut severely and are less than one-fifth of the pre-war figure, whilst demand for linseed oil has increased greatly. Many attempts to grow linseed in Australia in past years have failed due to disease and low prices of imported seeds. A new attempt with a rust-resistant variety, Walsh, is at present being made, but substantial quantities for oil-crushing will not be produced until 1949-50. Economic prospects for establishing linseed on a permanent basis as an alternative crop to wheat in certain areas appear very favourable.

4. *Tung.* Tung oil is a drying oil formerly imported from China. Australia used over 1,000 tons of tung oil annually until the war reduced available supplies to a fraction of that quantity. Most of the tung oil is used for paint and varnish manufacture. Although the tung nut tree is extraordinarily well suited for the North Coast of New South Wales, tung production here has made little headway. A number of factors which have retarded the

development of this industry in the past are being rectified but strenuous efforts will be necessary to re-organise this industry which could be of great potential value to Australia.

5. *Perilla* has been tried in New South Wales but economic mechanical harvesting is almost impossible, preventing large-scale production. *Candlenut* is available in large quantities but collection is tedious.

6. *Soybeans.* Australian consumption of soybean oil was about 200 tons pre-war, imported from various countries. In 1946 the Federal Government sent a Mission to America to investigate the Soybean industry. The Mission on its return recommended encouragement of commercial production of soybeans, peanuts, sunflower and an oilseed giving a drying oil. Past attempts to establish soybeans in Australia have failed. A new attempt was commenced in 1946 when 2,200 acres were sown. As far as New South Wales is concerned, this attempt seems likely to fail on adverse seasonal and economic grounds.

7. *Sunflowers* could be produced in Australia with existing equipment and offer the greatest opportunity for development for edible oil production in New South Wales. New dwarf varieties which are easier to harvest, more uniform and better yielders are under trial and seed increase. 3,000 acres of the old Russian Giant variety have been grown in Queensland this season.

8. *Cottonseed* production is confined to Queensland where, in spite of subsidy, cotton production has steadily fallen. Imports of cottonseed stopped in 1943. Before the war annual consumption of cottonseed oil was about 1,200 tons.

9. *Safflower* is more adaptable than linseed, but the oil is inferior in drying power. Commercial development is commencing in South Australia. *Saffron Thistle* is widely distributed and harvested involuntarily with the wheat crop. A small tonnage has just been harvested with which oil tests will be conducted. Australian imports of *sesame,* once extensive, have fallen to less than 50 tons annually. A search for a non-shattering variety has been unsuccessful.

10. *Peanut Oil* consumption in Australia increased from about 1,650 tons in the late thirties to over 2,500 tons during the war; the increased quantity being used in the manufacture of margarine for Allied and Australian armed forces. This increase was made possible by increases of peanut imports from India during the war. In 1945 peanut imports fell and in 1946 India forbade exports on account of the food shortage. Australian production of peanuts is centred around Kingaroy, Queensland. Queensland Peanut Plantings have expanded very rapidly in recent years; the acreage expanding from 14,500 pre-war to 65,000—70,000 this season. Approximately 108,000 acres would be needed to make Australia self-sufficient. Recent expansion has only been possible by an adjustment of prices between peanuts used for edible and those used for oilmilling purposes.

11. *Coconut.* Australia imported more than 20,000 tons of copra annually before the war, but this rose to over 23,000 tons in the war years. Major sources of supply before the war were the Solomon Islands, New Guinea and Papua, whilst in the later period large supplies were obtained from Ceylon and the New Hebrides. Expansion of margarine production consumed the whole of the increase in available supplies of coconut oil.

12. *Rapeseed.* Small quantities, estimated at 500 tons were imported before the war and about 350 tons of Colza oil which is used mainly as a marine engine lubricant. Local production of rapeseed before the war was comparatively small but larger areas were sown in Victoria during the war years.

13. *Olive Oil.* Annual prewar imports were about 1,400 tons, local production, centred in South Australia, about 110 tons. Olive oil was used as a salad oil and also in soap manufacture. Chief deterrents to increased production in the past were the high cost of labour for gathering the fruit and the length of the non-bearing period. Large plantings of olive trees have recently been made in Victoria.

14. *Castor Oil* was imported in small quantities before the war. Castor thrives in New South Wales, local production was commenced this season by farmers under contract to a local firm. Castor is usually seed-shattering, but some dwarf, non-shattering varieties which could possibly be mechanically harvested have been introduced.

15. It seems obvious that Australia has a great opportunity at the present time to introduce oilseed crops and thus reduce the over-specialisation of our agriculture. From an economic point of view prospects for introducing oilseeds which yield drying oils appear better than introducing sources of edibile oils. The crops considered most capable of development are—(*a*) as sources of drying oils: Linseed, Tung, Castor and Safflower. (*b*) as sources of edibile oils: Sunflower and Peanuts.

INTRODUCTION.

Vegetable oils and fats play a very versatile part in meeting our needs in the form of lubricants, paints and varnishes, drugs, food, fuel, linoleum, printers' ink, cosmetics, soap, pharmaceuticals and hydraulic transmission agents In some of these uses vegetable oils are interchangeable with fats and oils of animal or mineral origin; in others they are practically irreplaceable. Vegetable oils of the fixed or non-volatile type (which is the only type concerning us here) can be divided into three groups:—

(*a*) Drying—*e.g.*, linseed and tung oil.

(*b*) Semi-drying—*e.g.*, sunflower and soybean oil.

(*c*) Non-drying—*e.g.*, olive and coconut oil.

The drying properties of a particular fat or oil are determined by the relative proportions of triglycerides of the fatty acids of which the oils consist. The best practical method which has been found of testing the drying capacity of an oil is the Wijs-Hübl iodine value. This consists of treating a sample of the oil with a solution of iodine monochloride, under standardised conditions. In addition to the iodine value, many other tests are used in identification of fats and oils and the determination of their suitability for particular purposes. (*e.g.*, specific gravity, solidifying point, refractive index, viscosity, solubility, saponification value, bromide value, acid value, etc.)

To a certain extent, some oils are interchangeable for specific purposes; thus tung oil could be used to replace linseed and peanut oil could be used as a substitute for olive oil. Furthermore, oils in their natural state can be modified by physical and chemical means to adapt them better for other uses. Hydrogenation, one of the most important of these processes causes progressive and preferential saturation, thus reducing the drying power of the oil. Another method, applicable to some oils only, is dehydration, which consists of the chemical removal of the H_2O group, increasing the iodine value of the oil. Semi-drying oils can be treated by means of molecular fractionation which consists of separating the oil into two parts, making use of the different solubilities of the fractions. Considerable experimental work with molecular fractionation of soybean oil in particular has taken place in United States of America. The purpose of these tests is to obtain two oils from the original soybean oil; one with a higher iodine number, therefore more suitable for paints; the other with a lower iodine number and more suitable for food purposes than the original oil. Transformation of oils from their "natural" state to one which is more suited for the particular purpose in hand is of comparatively recent origin and may be expected to become much more important in the future. This trend is likely to have some far-reaching long-term economic effects. Modifications of the physical and chemical composition of oils in this manner leads to greater facility of substitution between different oils and hence may be expected to produce an even more intense price competition between various oils than in the past. In the long run it seems likely that the cheapest vegetable oils may displace those which are more expensive but possess special characteristics which cannot at present be produced artificially. Generally speaking vegetable oils from tree plantations tend to be cheaper than those from annual crops.

Vegetable Oil Consumption in Australia.

Any attempt to establish detailed statistics concerning imports, production and avenues of consumption of fats and oils in Australia is fraught with great difficulty. An attempt has been made in Table 1 to estimate vegetable oil consumption in Australia before and during World War II but these figures should only be regarded as rough estimates in view of the difficulty which was experienced in checking data and ensuring that they were reliable. However, in spite of these deficiencies certain broad conclusions regarding vegetable oil use in Australia emerge. The two most

important vegetable oils for Australia are coconut oil and linseed oil, which together account for more than two-thirds of Australia's vegetable oil consumption. Coconut oil was used mainly in the soap and margarine industries in approximately equal proportions before the war, but since then consumption for margarine production has increased whilst the amount used for soap manufacture has remained stationary. Linseed oil imports during the war years were on an average equal to those before the war. However, these averages tend to conceal year to year fluctuations which were very considerable during this period. During the first few war years linseed imports were on a much larger scale than before, as increased constructional and industrial activity increased the demand for drying oils. However, during most of the later period of the war seed imports were curtailed and in the case of cottonseed and tung oil, totally cut off. It has not been possible to show actual annual disappearance of various vegetable oils during the war years as figures for stocks were not available. When average consumption is taken for six years it is considered that changes in stocks will not be large enough to make a significant different in the final figures. It is for this reason that it has been necessary to use averages which are not as convenient as annual figures.

TABLE I.

ESTIMATE OF VEGETABLE OIL CONSUMPTION BEFORE AND DURING WORLD WAR II IN AUSTRALIA.

(Annual Domestic Disappearance in Tons.)

	Total.		Soap.		Margarine.		Paints.		Linoleum.	
	Pre-War Average.	War Average.	Pre-War Average.	War Average.	Pre-War Average.	War Average.	Pre-War Average.	War Average.	Pre-War Average.	War Average.
Coconut Oil ...	12,463	14,611	5,979	5,952	6,072	6,395	...	...	...	...
Cottonseed Oil ...	1,204	400*	22	10	598	352	...	...	...	...
Peanut Oil ...	1,664	2,536	...	...	708	1,691	...	...	...	...
Linseed Oil ...	12,423	12,630	...	...	...	...	4,888	6,398	1,260	1,255
Tung Oil	1,033	260	...	...	...	...	900*	242	...	..
Rapeseed Oil ...	634	949	...	...	...	...	...	...	...	...
Olive Oil	1,523	392	535†	1,135†	...	...	...	...	...	...
Other Oilseeds ...	1,718	1,730	...	...	...	...	...	...	...	...
	32,664	31,872	6,536	7,079	7,378	10,438	5,788	6,640	1,260	1,255

* Rough estimate only. † Palm and Olive Oils.

Although it is not possible to calculate exactly from available information what proportion of vegetable oils is used for edible purposes in the form of margarine, cooking, salad oils, etc., the proportion is less than one-third. This compares with a corresponding figure of over two-thirds in the United Kingdom and the United States. As a result of restrictive legislation in favour of butter and also the relatively ample supplies of animal fats available in Australia consumption of vegetable fats in the form of margarine and cooking fats in this country have been almost negligible. Australian consumption of table margarine during 1946-47 was less than ¾ lb. per head compared with approximately 3½ lb. per head in United States of America and an even higher figure for the United Kingdom. This is probably the

main reason why Australia has not grown any food oil crops; as I. A. Butler has already mentioned in a note on vegetable oil crops in "Farm Front" (October, 1947.)

Notes on Individual Oils.

1. Drying Oils.

Linseed. This is easily the most important drying oil used in the paint and varnish industry. Before the war Australia imported most of her linseed from India, expressing the oil in Australia, though a certain amount of linseed oil was imported from the United Kingdom and other countries.

Argentina is the largest exporter of linseed, accounting for 80 per cent. of world exports before the war. The only other large exporters were India and Uruguay. During the war years both Argentina and India reduced linseed acreages and exports fell considerably. In 1947 the harvested acregae of linseed in Argentina was 40 per cent. less than pre-war. In addition, Argentina, in order to foster her own oilcrushing industry discourages, and for some time completely prohibited, the export of linseed to force importers to take linseed oil. This policy has been entirely successful at the present time when all vegetable oils are extremely scarce but whether Argentina can continue such tactics when the world fat shortage ends, remains to be seen. This shortage is expected to last another three to five years.

Indian linseed production fell by 20 per cent. between 1939 and 1946, but the reduction in exports was about 30 per cent. on account of an increase in local consumption. Indian consumption of oils and fats is still at a very low level and it is plausible to assume that the Indian Governments will aim to improve local standards of living which may involve a diversion of linseed acreage to grain or edible oil production. In addition, increased industrial and constructional activity in India would lead to further increases in local consumption of linseed. It is doubtful therefore whether Indian exports of linseed will revert to the pre-war level.

In spite of the decline of linseed production in Argentina and India, the preliminary estimate of world production of linseed in 1947 is 125.6 million bushels which is only 6 per cent. below the pre-war figure and almost 20 per cent. above 1946 production. North American production of linseed increased greatly during the war, partly bridging the gap caused by the decline of Argentinian and Indian production. In the meantime increased industrial and constructional activity in most countries has led to a tremendous increase in demand which cannot be satisfied from existing sources.

This, and the need to conserve dollars, are the main reasons for the great effort now being made in the United Kingdom to expand linseed production. Annual linseed plantings in the United Kingdom during the war years were in the neighbourhood of 20,000 acres, compared with 2,000 pre-war and a further expansion to 150,000 acres in 1948 and 400,000 acres in 1951 is aimed at by means of a generous price guarantee of £55 stg. per ton.

Australia imported more than 30,000 tons of linseed before the war; annual imports during war years being approximately 5½ per cent. more than the pre-war average, with especially large imports in 1939-40, 1941-42, and 1944-45. During 1945-46 imports remained at a fairly high level but in 1946-47 there was a drastic fall to less than one-half of the pre-war level. The Indian quota for 1947-48 is again less than half of the 1946-47 level.

TABLE II.

Australian Imports of Linseed (in tons).

Year.	Seed Imports.	Extraction Rate.	Oil Equivalent.
Pre-War Average	33,564	40 per cent.	13,426
War Average	35,473	.....	14,189
1945–46	37,528	.....	15,011
1946–47	15,934	.....	6,374
1947–48 (Indian quota) ...	6,000	.....	2,400

Prior to the war Australia was a net importer of linseed oil but during the war. substantial quantities of linseed oil were exported to New Zealand. Australian imports of linseed oil ceased completely at one stage of the war, substantial improvements in imports being delayed until 1946-47. Although average annual production of linseed oil in Australia increased by 2,000 tons during the war, the cessation of imports and increase in exports accounted for most of this increase and linseed oil consumption in Australia remained virtually stable. There was a substantial increase in linseed oil production 1945-46; oil crushers probably used part of the record imports of linseed during 1944-45 during this later period.

TABLE III.

Australian Production and Consumption of Linseed Oil (in tons).†

Year.	Imports.	Exports.	Production.	Apparent Consumption.	White Lead, Paints, Varnishes.	Linoleum.
Pre-War Average ...	925	·62	11,727*	12,424*	4,888*	1,260
War Average	72	1,175	13,733	12,630	6,398	1,255
1945–46	...	1,311	17,891	16,580	8,092	n.a.

* Three-year average.

The only users of linseed oil whose consumption of linseed oil is published by the Commonwealth Statistician are the White Lead. Paints and Varnish manufacturers. This group of industries used

†These figures have been extracted from Overseas Trade and Production Bulletins (with the exception of the estimates of linseed oil used in linoleum manufacture) and the figure obtained by "apparent consumption" seems reasonable in the light of seed imports given in Table 2. However, on page 42 of the Report on the Soybean Industry an estimate of pre-war consumption at 4,150,000 gallons is given, which is materially higher than the figure given above. We can find no evidence at all to support this higher figure.

approximately 40 per cent. of all linseed oil, with Linoleum manufacturers accounting for another 10 per cent. The proportion of linseed oil used by the paint trade is almost certainly underestimated as many painters buy linseed oil as a thinning agent and this quantity would not be included in the official figures, which refer only to the quantity of linseed oil used in the actual manufacture of paints, varnishes, etc. No official information is available about the quantity of linseed oil used in the production of printing inks, but it is not believed to be a very large proportion. In the United States only 5½ per cent. of total linseed oil usage is accounted for by printing ink manufacture.

Many attempts to grow linseed in Australia in past years have failed, partly due to disease and insect pests, partly as a result of the relatively low prices of imported Indian and Argentine seeds. In 1935, however, a new trial was commenced with two varieties on which a very successful linseed industry had been built in California under irrigation. These varieties, Punjab and Abyssinian, showed immediate promise when sown at Leeton Experiment Farm on the Murrumbidgee Irrigation Area. After three years' trial, seed distribution had commenced when rust (*Melampsora lini*) appeared in epidemic form and has been present practically every season since. Fortunately, an intensive introduction programme had secured several promising rust-resistant varieties in the meantime, and the best of these, Walsh, is the basis of the present attempt to establish Australian self-sufficiency in linseed, pending further testing of very promising hybrid material.

Stirred by the existing linseed shortage the Federal Government guaranteed New South Wales growers £34 per ton for Walsh linseed in 1944-45. In the following year no guarantee was offered and very little linseed sown. Approximately 32 tons of seed were held in storage by the New South Wales Department of Agriculture during that year. Meggitt Ltd. originated a scheme to purchase this seed from the Commonwealth who insisted, however, that it be divided proportionally between that firm and Harold Meggitt Ltd. Both firms have let contracts to selected farmers guaranteeing £40 per ton or world parity c.i.f. ports, which ever is higher on delivery. Some 1950 acres were sown, mainly in New South Wales, but also in Victoria, Queensland and Tasmania to distribute the risk of failure. Growing conditions were very favourable, but some crops were damaged by rain. Yields of up to 18 bushels per acre are reported. The total crop, when finally harvested and cleaned, is estimated to yield 480 tons, sufficient to sow nearly 40,000 acres during 1948-49. At a conservatively estimated yield of 10 bushels per acre, this should yield a total of 10,000 tons in 1949-50, still short of normal requirements, but providing a substantial quantity for crushing, after deducting 1,250 tons for seed required to sow the 100,000 acres estimated to be necessary to supply all immediate requirements.

A notable record was established in the agricultural history of Australia, when, for the first time, thanks to the enterprise of East-West Airlines, airplanes were used commercially last year

for dusting linseed crops with D.D.T. Complete control of the *Heliothis* moth pest was obtained by this means, and also by power dusting, but with some damage to crops by the machines travelling through them.

Economic prospects for establishing linseed on a permanent basis as an alternative crop to wheat in certain areas appear to be very favourable. At existing prices linseed should be a profitable crop to growers. At the present time it seems likely that the fats and oil shortage will last appreciably longer than the shortage of bread grains; linseed prices might, therefore, be expected to decline at a slower rate or in the more distant future than grain prices. In addition, the shortage of hard currency with which British countries are faced is another factor to be taken into consideration. Before the war the British Empire on balance imported linseed in most years from hard currency areas, especially Argentina. Since then, exports from India, the largest producer in the sterling area, have fallen by 30 per cent., increasing the dependence of the sterling area on Argentinian supplies. As the dollar shortage is likely to remain with us for some years, it may be profitable to develop an export trade in linseed. Numerous additional advantages of introducing this crop can be listed. It will reduce over-specialisation in our agriculture. During the inter-war years there have been many occasions when linseed would have been a more profitable crop than wheat; and with the establishment of linseed somewhat less sluggish adjustments of supply to changes in wheat prices might be expected. The establishment of linseed may also have far-reaching effects on the livestock side of our rural economy by providing a secure and, it is hoped, cheap supply of high protein value feeding stuffs. However, this will depend upon the widespread adoption of better methods of stock feeding so persistently advocated by stock authorities.

Tung.—Tung oil has some very unusual properties, including the highest known specific gravity and refractive index of all oils, conferred largely by a high proportion of the otherwise rare elaeomargaric acid, a stereo-isomeride of linolic acid. China is the world's largest producer of tung oil and has been the only large exporter until now. The Chinese Tung oil industry suffered considerable damage during the Japanese occupation when no new trees were planted and many old trees cut down for firewood. Pre-war (1937) exports of tung oil from China amounted to 89,000 short tons. During 1946 about 40,000 tons were exported. According to American sources last year's production was somewhat larger than in 1946. During the war exports practically ceased. Tung oil production was established in North and South America during the inter-war years. United States production, which is approximately 10 million lbs., is not sufficient to satisfy local demand and the United States of America is the largest importer of tung oil. In Latin America, Argentina is the leading producer. Considerable plantings were made during the war years and when these trees reach bearing age Argentina will have a potential tung oil production of 22,000 tons. Production at present is 2,000 tons; local consumption only 400-500 tons. Brazilian production expanded from 20 short tons in 1942 to 290 short tons in 1946. Exports during 1947 are estimated at 330

short tons. In New Zealand over 5,500 acres of tung nuts were planted by 1936-37, but by 1941-42 only twenty-nine acres remained in production, failure being attributed to poor soil and weather conditions.

Before the war Australia imported most of her supplies of tung oil from China. The beginning of the war led to a considerable curtailment of imports. During the first two years imports were approximately 50 per cent. of the pre-war level but after 1941-42 only a small fraction of normal supplies were available. In terms of pre-war and war average annual disappearance of tung oil fell from an average of 1,033 tons per annum to 260 tons. No information is available regarding the quantity of tung oil used by the paint and varnish trade before the war but from records available for the war years it is evident that over 90 per cent. of all tung oil consumed is used in paint and varnish manufacture. Small quantities are also used in the manufacture of printings inks and linoleum.

TABLE IV.

Australian Imports of Tung Oil.

Year.	Imports of Tung Oil.	Use in Paint Trades.	Year.	Imports of Tung Oil.	Use in Paint Trades.
	gals.	gals.		gals.	gals.
1934–35...	200,150	.....	1940–41...	124,334	122,133
1935–36...	209,739	.....	1941–42...	64,116	60,820
1936–37...	258,081	.....	1942–43...	.....	9,646
1937–38...	327,690	.....	1943–44...	3,994	7,489
1938–39...	236,624	.....	1944–45...	2,768	7,861
1939–40...	168,257	138,621	1945–46...	8,360	.....

The first plantings of tung nuts in New South Wales took place in 1926; 922 acres were recorded as the total New South Wales acreage in 1941-42, but only 100 acres in 1947. Total plantings in Queensland and Western Australia in 1947 were given as thirty-seven acres. Planting statistics for tung are most unreliable but there is no doubt that the industry has been almost stationary since the thirties. Accurate figures for tung nuts collected and used for oil expression are available and have been reproduced below.

TABLE V.

Australia's Tung Nut and Oil Production.

Year.	Crop.	Oil Produced.	Year.	Crop.	Oil Produced.
		lb.			
1938 ...	57,310	8,136	1943 ...	83,573	13,583
1939 ...	68,938	10,136	1944 ...	162,422	21,879
1940 ...	67,936	7,471	1945 ...	98,432	16,932
1941 ...	86,365	13,957	1946 ...	67,325	10,337
1942 ...	85,440	13,306	1947 ...	87,026	13,306

Although the tung nut tree is extraordinarily well suited for the North Coast of New South Wales tung production has made no progress since its establishment. The potential value of the industry is so great that strenuous efforts to reorganise and expand it would be well worth-while. A number of factors have been responsible for retarding this industry in the past. Indiscriminate planting from unselected stock has taken place in many cases. High yielding strains are now available, the most suitable districts and locations can be well defined so that this factor should no longer retard development. Shortage of labour has in the past made the collection of nuts difficult. To overcome this particular difficulty a mechanical picking-up machine designed by the Museum of Technology and Applied Science is now being developed. Two further difficulties which seem to stand in the way of increased activity in the industry are the high cost of transport of small individual lots to Sydney and the fact that there is no buying competition. The one firm on the market does not offer growers very attractive terms. The solution to both these problems seems to be the establishment of an oil mill by a co-operative on the North Coast. This would only be advisable however if tung production were expanded at the same time. In any case an association of growers might be able to obtain more attractive terms from other oil crushing mills which might obviate the necessity to set up a new oil crushing mill. According to pre-war figures there is a demand for at least 1,000 tons of tung oil in Australia annually and this figure is certainly on the conservative side in the light of present demand for drying oils. Furthermore, the market for tung oil would not be restricted to local requirements as the industry seems to be steadily declining in China, the world's largest exporter of tung. As mentioned earlier Argentina seems to be making a determined attempt to expand her exports. The North Coast of New South Wales, where this tree could be best grown, is at present relying on butter production for a large part of its agricultural income. Tung oil could provide a welcome supplementary source of income in this area.

Perilla Oil.

Although sometimes used for edibile purposes in Europe and Asia, Perilla oil is more important for industrial purposes, having excellent drying qualities. In the United States of America, perilla oil is almost as important as tung oil in the manufacture of paints, varnishes, etc. Asia supplies almost all the perilla seed in the world. Manchuria is the largest exporter, followed by China, India and Korea. At the end of the war production was estimated to be down by 20 per cent. No data is available on Australian imports, which are grouped together with other oils and oil seeds in official publications. The plant, which has been tried at Grafton and Wellington, is an annual of indeterminate flowering habit. This makes economic mechanical harvesting almost impossible.

Candlenut.

The Candlenut, a relative of the Tung, is widely distributed throughout the East Indies, Pacific Islands and Northern Queensland. The oil is a reasonably good substitute for linseed, but is more troublesome to extract because of the hard shell. The meal,

like that of tung, is poisonous to stock. Very large quantities are available, but collection is tedious and disorganised at present and shipping facilities for such relatively bulky material very limited.

Two other drying oils which should be mentioned are *hempseed oil* and *oiticica oil.* Hempseed cultivation is forbidden in Australia because the plant is the source of the drug marihuana. Oiticica oil is mainly produced in Brazil and has been used as a substitute for tung recently in the United States.

2. *Semi-drying Oils.*

The line of distinction between drying and semi-drying oils is difficult to define, and varies according to different authorities. Somewhat arbitrarily, it may be taken as an iodine value of 150.

Soybeans.

Soybeans contain about 18 per cent. of oil with an iodine value of 126 to 135. It is a true semi-drying oil with a complete fatty acid group range from stearic to linoleic. In its natural state it is widely used overseas as an edible oil, and to some extent as a drying oil extender, but its fatty acid constitution, and the recent development of a molecular fractionation process render possible splitting it into two fractions with respective enhanced drying and non-drying properties.

World production of soybeans was concentrated in Asia before the war China and Manchuria being the leading producers. During the war United States soybean production expanded at a rapid rate in order to make up for the loss of tropical vegetable oils formerly imported from Japanese-occupied islands in the South Pacific. The United States became the world's largest producer of soybeans during the war and, in spite of the world-wide dollar shortage, is also the largest exporter of soybean oil at the present time. Canadian production has also expanded during the war years. Manchurian and Chinese production during 1947 is reported to have increased since 1946, but is estimated to be 75 per cent. to 80 per cent. of the pre-war (1931-37) level. In view of the upward trend of domestic requirements it is doubtful whether future soybean exports from this area will again return to pre-war levels even with a complete restoration of peace in China.

The acute shortage of vegetable oils in Australia during the last war focused attention on the desirability of establishing a local vegetable oil crop. In view of the spectacular increase of soybean production in the United States of America the Federal Government, on the recommendation of the Australian Agricultural Council, sent a mission to America to investigate the local soybean industry and the possibility of introducing large-scale soybean production in Australia. The mission, headed by the Federal Director-General of Agriculture, Mr. F. W. Bulcock, spent four months investigating the United States and Canadian soybean industries, returning to Australia in November, 1946. In June last year the report of this mission was published. After a detailed description of the uses of soybeans, methods of processing, production and distribution in the U.S.A., the report examines the possibilities of growing soybeans in Australia. The report recognised that: "Of itself the spectacular rise in soybean acreage in the United States of America during the war

is not conclusive evidence that this is the crop upon which Australia should concentrate." The mission recommended promotion by Commonwealth and State Governments of commercial production of a vegetable oil crop capable of producing drying oils and the encouragement of commercial production of soybeans, sunflower and peanuts. In addition the need for further plant breeding and experimental work on vegetable oil plants was recognised and a Commonwealth grant of £10,000 per annum for five years to the States to stimulate such work recommended.

Many attempts have been made in past years in Australia to establish soybeans as a crop, which would be of undoubted value in many respects. A further major attempt was made in 1946, when 2,200 acres of soybeans were sown in Australia, including 1,000 acres in New South Wales. As far as this State is concerned it seems that this attempt will fail on adverse seasonal and economic grounds. An intensive introduction, variety testing and selection programme over the past thirty years has failed to reveal a variety which will yield consistently under our erratic climatic conditions. A South African selection, Potchefstroom 169, appears to be the best yet found in this respect, although some of the newer varieties showed promise last season. In the Northern Tableland, where a large part of the New South Wales crop was grown, returns seem to be smaller than those from competing crops such as navy beans. Last season's crop still remained unsold in February, 1948, at the price of 35s. a bushel demanded by growers.* This season's recorded area was only 200 acres in New South Wales, half on the coast, where wet weather and weeds severely damaged the crop. Mechanical harvesting becomes extremely difficult in erratic weather conditions, It has been suggested that other States, notably Queensland, are better suited for this crop.

Soybean oil was imported in small quantities before the war for use in pickles, sauces, etc., average annual imports being approximately 200 tons. Soybean meal is also used in the plywood glue industry in Queensland, but in spite of these imports of soybeans and their derivatives into Australia, most manufacturers and oil processors are not familiar with the product.

Sunflower.

Sunflowers are grown for seed on a vast scale in Russia and Argentina. Before the war the Soviet Union produced 80 per cent. of the world output which was entirely consumed locally. Sunflower production made spectacular strides during the war years in Argentina, in one year surpassing linseed production. Argentina is the only large exporter of sunflower oil.

The cold-pressed oil is used as an edible oil in the manufacture of margarine or as a salad or cooking oil (replacing olive oil). The hot-pressed oil is used in the manufacture of soap, lubricants, paints and for treating wool. It can also be used as an illuminant and substitute for kerosene. The iodine value of sunflower oil varies between 120 and 136.

* It has since been sold for 30s. 6d. a bushel; the meal will be used in the plywood industry which can pay a higher price than the stock feed market could. The quantities that can be disposed of in this manner are, however, limited.

Sunflowers could be produced in Australia with existing equipment and offer by far the greatest opportunities for development for edible oil production, at least in New South Wales. Queensland is the principal producer in the Commonwealth, and the current crop to be harvested is expected to yield 1,000 tons of seed from 3,000 acres. The crop consists mainly of the Russian Giant variety which can only be harvested mechanically with difficulty. Trade objections to the crop as a source of oil in normal times are that the oil is inferior in drying power to linseed, that the seed requires decortication before pressing if a good oil yield is to be obtained and, lastly, that the press-cake is unknown to a stock-food market accustomed to linseed and copra cakes.

A fair average yield is ½-ton of seed per acre. However, new dwarf varieties are under trial and seed increase, which are not only much easier to harvest with a wheat header, but also are more uniform in maturity and better yielders than the old tall varieties.

Cottonseed.

Cottonseed contains about 20 per cent. of oil with an iodine value of 105 to 112. The press-cake is a valuable stock-food. Egypt, British East Africa, the Sudan, Brazil and China were the largest cottonseed exporters before the war. At the present time the total quantity of cottonseed oil entering world trade is less than one-fourth of the pre-war volume. As cottonseed is only a by-product, future production of this oil depends entirely on the production and utilisation of cotton. Cottonseed in Australia is produced in Queensland by the Queensland Cotton Board, which operates ginning plants and an oilmill. Cottonseed is also imported, mainly from British East Africa, Ninety per cent. of all imports go to Queensland and are processed by the oilmill operated by the Cotton Board. Since 1943 there have been no imports of cottonseed.

TABLE VI.

Australian Imports of Cottonseed and Cottonseed Oil (in short tons).

Year.	Cottonseed.		Cottonseed Oil.	
	Imports.	Exports.	Imports.	Exports.
1934–35	0·4	1	111	11
1935–36	1·0	5	1	11
1936–37	4,527	2	173	0·2
1937–38	842	...	28	0·3
1938–39	4,014	...	37	...
1939–40	1,629	...	23	19
1940–41	2,052	...	0·1	0·2
1941–42	1,334	...	0·1	...
1942–43	552	...	4	...
1943–44	...	...	...	0·2
1944–45	...	...	...	...
1945–46	...	...	...	0·4
1946–47	...	n.a.	...	n.a.

Although statistical information on Australian production and utilisation of cottonseed oil is meagre, it seems that pre-war annual domestic disappearance of cottonseed oil was approximately 1,200 long tons per annum. Approximately one-half of this quantity was used in the manufacture of margarine and the remainder partly as salad oil and partly for soap manufacture. The press-cake is a valuable stock food. During the war, available supplies fell to a fraction of the pre-war figure. The quantity of cottonseed oil extracted annually by the Queensland Cotton Marketing Board, which produces more than 90 per cent. of Australian cottonseed oil production, shows a great decline since 1940.

Cotton production in Australia has up to now been confined to Queensland, where it is decreasing in spite of subsidies. Mechanical picking, which has been achieved in America, together with defoliation of the plants with a cyanamid compound, may open the way for increased Australian production. Very successful experimental crops have been grown in New South Wales at Emmaville, Wellington, Hay and Yanco.

TABLE VII.

Cottonseed Oil Production by the Queensland Cotton Board.

Year.	Short Tons Crushed.	Short Tons Oil Produced.	Year.	Short Tons Crushed.	Short Tons Oil Produced.
1934 ...	8,622	1,078·1	1941 ...	6,893	906·5
1935 ...	7,652	956·7	1942 ...	4,108	531·3
1936 ...	8,884	1,142·6	1943 ...	2,951	368.8
1937 ...	5,318	697·6	1944 ...	3,328	416.0
1938 ...	5,939	774·7	1945 ...	489	61.1
1939 ...	6,401	853·9	1946 ...	779	97·3
1940 ...	8,097	1,056·7	1947 ...	498	62.2

Safflower.

Safflower is a hardy annual, suited to wheat districts, and more adaptable in its requirements than linseed. It yields about the same crop (bushel per acre) as wheat and is even more productive under irrigation. Its seed has a hard shell, necessitating decortication before oil extraction. Local tests have given oil yields of 17 to 28 per cent. according to variety and growing conditions, with an iodine value of 140 to 149. Commercial development is taking place in South Australia, which introduced 10 tons of seed, unfortunately too late for planting last autumn.

The two main disadvantages of safflower are that decortication adds to processing expenses and may therefore reduce the value or the seed in order to compete with, *e.g.*, linseed, and also that the oil is inferior in drying power, and is best used as an extender of linseed. However, it can be grown in areas where linseed could not.

Saffron Thistle.

This plant is closely related to safflower, and is very widely distributed. Large quantities of this seed are harvested involuntarily in most seasons with the wheat crop in which it occurs. In a good season many thousands of acres carry a dense crop of saffron thistle. Typical analyses show about 18 per cent. of oil similar to safflower oil in physical characteristics. A small tonnage has just been harvested with which oil tests will be conducted on a small commercial scale.

Sesame.

Sesame oil has an iodine value of 103 to 110. Sesame is an important food and source of edible oil in Asia and most tropical countries. China produces one-half the world's sesame seed and India one-third. Most of the sesame oil is consumed in the countries of origin, less than 10 per cent. entering world trade. A once extensive export trade from India has suffered severely from competition by peanut, palm and copra oils.

Australian imports of sesame, once fairly important, have also declined considerably and were less than 50 tons annually in the last five pre-war years. Some sixty varieties of sesame have been tried at Grafton and Leeton Experiment Farms. Good yields have been obtained from some varieties, but harvesting is a problem because of shattering. A search for non-shattering varieties has been unsuccessful to date.

Maize.

Maize contains about 12 per cent. of oil with an iodine value of 115 to 125. The germs, separated during the process of starch manufacture, yield about 40 per cent. of oil. Increased production of maize for oil alone is obviously impracticable.

3. Non-Drying Oils.

An iodine value of 100 is taken here, arbitrarily again, as a convenient separating mark between the semi-drying and non-drying oils.

Peanuts.

Peanuts yield from 42 to 46 per cent. of a valuable edible oil rich in the oleic group of fatty acids. Peanuts are extensively cultivated in practically all tropical and semi-tropical areas of the world, but India, China, United States of America and West Africa account for 82 per cent. of the world's output. Production in French West Africa and Nigeria declined sharply during the war but has almost completely recovered. India, West Africa and China were the leading peanut exporters before the war. Since then exports have fallen by more than 60 per cent. due to increased consumption in exporting countries where peanut oil is used as a substitute for coconut oil, but world production is almost as high to-day as during 1935-39. The oil-crushing industry was concentrated in the industrial countries of Europe and America. As a contribution to the relief of the critical world fat shortage the British Government in February, 1947, approved a plan for the

production of peanuts in East Africa on an extensive scale. Two and a half to three million acres of peanuts will be planted and production is expected to reach 600,000 tons by 1950-51. Progress up to now is believed to have fallen short of expectations, largely on account of shortage of machinery. The British Food Mission which recently toured Australia inspected large tracts of undeveloped country in Queensland with the object of increasing local peanut production. Whilst it appears possible that peanut production on a large scale will be undertaken in Queensland in the near future no detailed information on any such projects is as yet available.

The energetic steps undertaken by the British Government to expand peanut production are probably partly based on a belief that India, Britain's previous main supplier, will be unable to resume exports at the pre-war level (933,000 tons per annum) in the future. During the 1946 food shortage India prohibited the export of peanuts.

Peanuts require a long, warm, growing season, an ample and well-distributed rainfall, and a relatively dry autumn. These conditions are found mainly in Queensland and the Northern Territory. Production on the North Coast of New South Wales has been small and erratic. Australian production has centred around Kingaroy, Queensland, but a small area is usually devoted to peanuts in the Northern Territory. Practically all peanuts grown in Australia prior to 1946 were grown for direct human consumption. Before 1946 only those peanuts considered by the Queensland Peanut Board unsuitable for edible purposes were put into the oilcrushing mills. In 1946 production was expanded and 20 per cent. of the crop was put into the oilmills for oil extraction purposes. In 1947 25 per cent. of the crop was used in this manner. This arrangement was only made possible due to adjustment of prices between edible and oilmilling quality peanuts. According to the Queensland Peanut Board it would not be economical to produce peanuts solely for oilmilling purposes.

Peanut plantings in Queensland have expanded very rapidly in recent years. The average acreage pre-war was 14,500, but in 1945 32,000 acres were planted and an estimated 52,800 acres in 1946. During the current planting season, 65,000-70,000 acres were planted and this would give a crop of 35,000 tons in shell under normal circumstances. It is estimated that an acreage of 108,000 acres would be required to make Australia self-sufficient.

Peanut oil is used for the preparation of salad oils and cooking fats and the production of margarine. The Commonwealth Statistician only supplies figures of the quantity of peanut oil used in margarine manufacture, which was less than half of total peanut oil use pre-war, but has increased considerably since then. Australian production of peanut oil increased by over 50 per cent. during the war years.

TABLE VIII.

Australian Production and Consumption of Peanut Oil.
(Long tons).

year.	Imports.	Exports.	Pro-duction.	Apparent Con-sumption.	Margarine.
Pre-War Average	50	2	1,616*	1,664	708
War Average ...	26	...	2,510†	2,536	1,691
1945–46	2	173	2,804	2,631	1,690
1946–47	80	...	...	...	...

* Two-year average (1936–38). † Four-year average.

This increase in oil production was only made possible by a large increase in our peanut imports from India during the war years. In 1945-46 peanut imports from India fell to a fraction of previous imports on account of India's food shortage and in 1946-47 imports ceased altogether.

TABLE IX.

Australian Imports of Peanuts (000 *lbs.*)

1934-35—2,482
1935-36—3,397
1936-37—2,817
1937-38—1,221
1938-39—5,084
1939-40—7,775
1940-41—14,341
1941-42—16,756
1942-43—14,711
1943-44—9,787
1944-45—24,689
1945-46—1,712
1946-47—no imports.

Coconut.

Copra, the source of coconut oil, is produced chiefly in tropical Pacific islands. Before the war Asia exported 85 per cent. of all copra and coconut oil which entered international trade. The Philippines, Netherlands East Indies, Malaya, Ceylon, New Guinea were the main exporters. In 1945 exports of copra and coconut oil were less than 50 per cent. of pre-war, but by 1947 supplies were estimated to be 75 per cent. of pre-war levels. There has been a very great expansion of copra production in the Philippines, but in Netherlands East Indies, Malaya and New Guinea many plantations were ruined during the war, and labour and shipping difficulties are hindering rehabilitation of the industry, which may require years to return to pre-war levels.

Australia obtained most of her supplies of copra from the Solomon Islands, New Guinea, Papua and Fiji before the war. During the war large quantities were imported from Ceylon and New Hebrides. New South Wales is the most important importing State, usually taking over 90 per cent. of all Australian copra imports.

TABLE X.

Net Australian Imports of Copra (long tons).

Year.	Copra Imports.	Extraction Rate.	Year.	Oil Equivalent.
1935–39 (average)	20,278	63%	Pre-War	12,775
1939–45 (average)	23,818	...	War	15,005
1945–46	13,682	...	1945–46	8,620
1946–47	10,124	...	1946–47	6,378

Australian exports of copra are small and irregular. Since 1934-35 exports have exceeded 1,000 tons only in four years. Before the war Australia exported a certain amount of coconut oil to New Zealand but since 1937-38 these exports have declined considerably. Since 1939-40 Australia has been a net importer of coconut oil. This may have been due to the shortage of coconut oil but the decline in exports to New Zealand in the last two pre-war years cannot be attributed to such causes.

Coconut oil is used in the soap and margarine industries. Before the war coconut oil consumption in these two industries was approximately equal and amounted to over 95 per cent. of estimated annual consumption of coconut oil. During the war the amount of coconut oil used for soap production remained stable whilst the quantity used for margarine manufacture increased by one-third. Since 1945 margarine production has dropped, although it was still above pre-war level last year. Imports of copra have been sharply reduced since 1945 and although consumption has been reduced since 1945, appreciable stocks of coconut oil have apparently been drawn on.

TABLE XI.

Australian Production and Consumption of Coconut Oil.
(Long tons.)

Year.	Imports.	Exports.	Production.	Apparent Consumption.	Consumption in Soap Industry.	Consumption in Margarine Industry.
Pre-War Average ...	1·0	33·3	* 999·7 12,795·5	12,463	5,979	6,072
War Average ...	956·6	141·3	1,924·2 11,872·2	14,611	5,952	8,395
1945–46	1,450	8	237·0 7,923·0	...	4,339	6,782

* The upper figure represents refined coconut oil and the lower figure unrefined coconut oil.

Rapeseed.

Rapeseed oil, also called colza, is produced in large quantities in the temperate regions of Europe, Asia and America. India, Rumania, China, and Argentina were the largest exporters of rapeseed and Japan of colza oil. During the war European

production of rapeseed increased from 290,000 tons to 1,200,000 tons. Since the end of the war European production has declined heavily.

Rapeseed has an oil content of 30 to 45 per cent. Its iodine value is 100. Colza oil has a high viscosity and is non-gumming. These two characteristics fit it eminently as a marine engine lubricant, which is its most important use in the United States of America and Australia. In China and India it is used as an illuminant and for edible purposes. In Europe during the war years it was also used as an edible oil.

Before the war average annual net imports of colza oil were 346 tons, chiefly from Japan, Manchuria, Holland and India. Rapeseed imports are grouped with imports of hempseed by the Commonwealth Statistician. These imports amounted to 800 tons pre-war; expanding to 2,600 tons during the war years. It has been estimated that 500 tons out of 800 before the war were rapeseed imports.

Local production of rapeseed before the war was comparatively small, but larger areas were sown in Victoria during the war years. No information on the quantity of rapeseed oil expressed from locally grown seed could be obtained. Rape has been produced very successfully in New South Wales, yields of more than ½-ton of seed per acre being obtained. Aphis have been a limiting factor in production, but are now readily controllable with D.D.T.

Olive Oil.

Tunisia, Italy, France and Greece were the largest exporters of olive oil. World trade in olive oil has declined to less than one-seventh of pre-war on account of the general shortage of vegetable oils and animal fats, which forces producing countries to use their own produce for lack of those imported oils formerly available.

In the three years before the war Australia imported on an average 1,413 tons of olive oil annually. Local production, chiefly from South Australia, was only 110 tons, making average annual disappearance 1,523 tons. Information on the quantity of oil used by various industries, especially as salad oil and in soap manufacture, is not available. In the case of soap manufacture the quantity used is coupled with palm oil by the Commonwealth Statistician, so that little can be inferred from this information. 535 tons of olive and palm oil were used annually for this purpose in pre-war years and 1,135 tons during the war.

Although olive trees will flourish in many parts of Australia, the chief deterrents to increased production are the high cost of labour to collect the fruit and the time taken for the tree to commence profitable cropping. Large plantings of olive trees have recently been made in Victoria.

Castor.

Castor seed contains 46 to 52 per cent. of oil. The oil is characterised by the presence of a very high proportion of an hydroxylated acid, ricinoleic, which confers high specific gravity, viscosity and optical rotation. Castor oil is extremely versatile. It is an almost ideal motor lubricant, having high viscosity and being insoluble in petrol it is a source of sebacic acid and capryl

alcohol-important plastic materials; in addition, it has a well-known medicinal use. By chemical dehydration of castor oil an oil resembling tung in its properties can be produced, the iodine value having increased from about 88 to 160.

Castor beans are grown in many countries which do not publish full statistics so that world production figures are difficult to obtain. Brazil, India and Manchuria were the largest exporters before the war. Brazilian exports have increased since then, whilst Indian exports fell slightly. Castor also became an emergency wartime crop in America. In 1946 India forbade the export of castor beans. Whilst every country was engaged in war or war industry the consumption of castor oil increased in unprecedented proportions.

Before the war approximately 22,000 gallons (*i.e.*, 100 tons) of castor oil were imported annually, chiefly by New South Wales, from India, and 14,000 gallons were exported, chiefly by Victoria to New Zealand. Castor seed was imported from India before the war, but no information on the quantity is available, being grouped with other oilseeds. During the war castor oil imports fell to approximately 20 tons annually.

Castor thrives in many parts of New South Wales, often occurring in dense natural stands, the exploitation of which was commenced by a local firm this season. Castor can be cultivated readily, but usually tall growth and shattering of the seed spike render it quite unamenable to economic harvesting. Some dwarf, non-shattering varieties have, however, been introduced, and together with some local selection are under trial both at various experiment farms, and with farmers under contract to the firm mentioned.

Castor became an emergency wartime crop in America. If the experiments at present in progress here can solve the various inherent difficulties, we should acquire a valuable new farm crop. Incidentally, the castor plant is the fastest known producer of cellulose, is the source of an insecticide, and of a fat-splitting enzyme.

The family *Euphorbiaceae,* of which castor and tung are members, commends itself to the seeker of extraordinary oils. Another member is *Croton,* which yields a violently purgative oil rich in valeric acid, and still another is *Sapium sebiferum,* the Chinese Tallow Tree, which provides a vegetable fat.

Wild Rape, Turnip, Mustard.

Several Cruciferous plants commonly occur as weeds in wheat crops and, like Saffron Thistle, are harvested involuntarily. In good seasons, dense natural stands of wild mustard occur which should readily repay harvesting. The fixed oil approximates rapeseed oil in characteristics, but is very pungent due to the presence of essential oil of mustard.

Conclusion.

The present world shortage of vegetable oils and fats presents Australia with a great opportunity to introduce oilseed crops on a permanent basis. The advantages of this would be manifold and

have been mentioned already by other writers. It would, firstly, give Australia a secure supply of vegetable oils and high-protein concentrates. The last few years should have convinced everyone of the importance of such a secure supply. Secondly, it would add diversity to our over-specialised agriculture. Also, it may make a contribution to our dollar resources by reducing the dependence of the sterling area on vegetable oil imports from hard currency countries such as Argentina and the United States. Thirdly, it may have far-reaching effects on our livestock industries due to the ample supply of high protein value feeding-stuffs. But this will depend on the adoption of better methods of stock-feeding which have been advocated so long without avail. The fact is that, in normal pre-war times, very large quantities of copra oilcake were burnt under boilers because no immediate market was offering and storing was uneconomic. It may be found desirable in future to store large quantities of oilcake for long periods as reserve against drought.

As mentioned in an earlier article in this Review (December, 1947), the present world shortage of vegetable oilseeds has been aggravated for importing countries by the attempts which are currently being made by some exporting countries to build up oil-crushing industries. In view of these developments, importing countries like Australia may be forced to purchase oil instead of oilseeds unless they can supply their own oilseeds. Whether this movement towards industrialisation in the oilseed-exporting countries like Argentina, India and the Philippines will be pushed to such limits that no seed is sold at all, it is, of course, impossible to say, but there can be little doubt about the present trend in this direction.

In spite of the determined efforts being made by many governments, it seems likely that the oil and fat shortage will be one of the most difficult to overcome. However, in the long run, Australian production of oil crops will have to compete with oilseeds from other countries and it is, therefore, essential that we should concentrate our attention on those oils which can be produced here most efficiently. From the point of view of probable future competition those oil crops or trees producing drying oils are more likely to withstand competition from abroad than edible oil crops. The main reason for this is that most edible oil crops compete with such tree products as coconut oil which, in the absence of tariff protection, tends to supply the bulk of edible oil requirements. Also, estimated production costs for peanuts in the African groundnut scheme seem lower than anything likely to be achieved in Australia. Actually, from the point of view of Australian requirements, the provision of a drying oil is very much more important than the provision of an edible oil.

At the present stage of development it seems that linseed and tung are the most promising sources of drying oil, with possible alternative or complementary sources in Castor and Safflower. The edible oil crops, the development of which would seem to be the most profitable, are sunflower and peanut.