



**WORKING PAPER**

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Industrialisation the case of  
oil seeds in Madras upto the depress.

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THE GENESIS OF CHEMICAL - BASED INDUSTRIALISATION  
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Introduction

It is by now well recognised that the Industrial Revolution in Britain in the late 18th century was only the first in a series of transformations of the industrial structure that evolving economies undergo. In its most simplified form, historians of technology recognise at least two more successive landmarks, the chemical or more broadly speaking, continuous processing, revolution of the late 19th century, and the information revolution of the post Second World War Period.

The location of technologies in terms of the era in which they originated is important in assessing the degrees to which the older industrial economies have successfully transformed their industrial structure. They are also useful in terms of analysing the processes of industrial development, such as they were, in countries like India during the colonial period. It is possible, then, to distinguish between the growth of industry in the sense of the relocation of old established industry from the

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then industrialised world to India, and the growth of Indian industry of a nature similar to that currently evolving in the industrial centres.

In this paper, the focus is on the major raw material base, oil seeds, and on the several varieties of constraints and problems that concretely influenced the prospects for the chemical based industries in Madras Presidency in the period leading upto the depression of the 1930s.

Oilseeds present an important case study for many reasons. From an economic point of view, they were one of the major commercial crops and items of export for the Presidency. In the absence of any significant mineral deposits they were also the major base on which chemical technology could potentially be based. Secondly, the extraction of the raw material, oil, from the seeds was a mechanical process, with a pre-existing base in the form of the widely dispersed village ghanis or chekkus, and their derivatives.

Although castor, gingelly and cotton seeds were all available in the Presidency, and the first two grown on a commercial basis (the cotton seeds were a by-product of cotton cultivated for the textile-industry), it was groundnuts and copra made from coconuts which were the prominent oil seeds investigated for industrial applications in Madras. This paper will concentrate on these two seeds, and will cover the period from the formation of the Chemical Industries Committee in 1909,

to the beginnings of the depression in 1927. The subsequent period involves economic and political influences of a quite different nature and is the subject of another enquiry.

## I

## The Constraints on Oilseed-based Chemical Industrialisation

Following its introduction into Madras Presidency in the middle of the 19th century, cultivation of groundnut had spread over an area of about 75000 acres by the early 1880s. However, it was at the turn of the century that its importance as a commercial crop really came to be recognised. Growing initially in place of indigo and partially in place of gingelly, groundnut cultivation was boosted by the new variety of Mauritian nut which led to its introduction on small holdings. By the first decade of the 20th century, it had spread to Malabar, taking the area under groundnut cultivation in the Presidency as a whole to almost 9 lakh acres, double the figure for 1901-02. By the beginning of the First World War, the cultivated area had grown to 16 lakh acres. The following year, its growth was noticed in the Deccan districts <sup>3</sup>. It was this tremendous growth, essentially for the export market, that led to a catastrophic collapse, with the closure of continental markets, and scarce and expensive shipping space during the war.

The bulk of the export trade was in the hands of European agencies but Indian merchant-shippers had a substantial role both <sup>4</sup> as intermediaries and as exporters. There was, therefore,

Table 1  
Groundnuts: Area, Production and Sea-borne exports

Year	Area sown in acres	Estima- ted pro- duction in '000 tons	Price index 1883- 84=100	Exports to foreign countries from Presidency Ports Average of 1898- 89 to 1900-01 =100	qty. in tons	Value Rs. lakhs	Foreign exports of all seeds Qty. in tons	Foreign exports including those from Pondicherry Qty. in tons	Coast-wise exports Qty. in tons	Value Rs. lakhs
1900-01	-	93			10134	14.15	36.18	-	5110	6.61
1901-02	410000	137			49354	71.05	111.63	-	1495	1.79
1902-03	410000	171				67.69	136.53		1407	1.65
1903-04	471000	156	122.90		91362			-		
1904-05	440000	152	119.74		78372	107.57	174.87		816	0.91
1905-06	491359	175	128.45		55852	89.92	149.00		739	0.87
1906-07	634514	189	153.29		67505	68.74	121.59	110674	4576	6.25
1907-08	837275	202	185.11	118.35	60905	99.14	159.69	96762	2646	4.08
1908-09	930750	247	162.12	118.21	74344	96.35	197.80	128754	24598	41.64
1909-10	896428	222	160.83	115.20	132401	115.47	204.13	222267	33393	61.66
1910-11	934135	254	169.81	121.71	129917	204.02	323.29	238735	10762	17.93
1911-12	1299118	306		122.67	141765	211.36	339.83	235690	4907	7.69
1912-13	1455852	341		121.40	180173	232.49	406.50	290678	43604	69.04
1913-14	1605009	411		130.61	197318	332.34	463.30	283827	33840	54.61
1914-15	1866360	560			115157	344.48	532.90		7739	12.16
1915-16	1136142	633			151236	187.75	329.73		49908	71.07
1916-17	1796413	825		122.31		214.36				
1917-18	1415239	680		96.16						
1918-19	1000776	442		105.09						
1919-20	1144071	569		256.59	70430	241.47	301.21	99527	19023	53.69
1920-21	1599739	740		201.35	86166	231.86	252.05	93792	7242	18.75
1921-22	1459122	678			208927	649.55	684.94	246708	7669	15.85
1922-23	1754334	823		211.77	224629	635.67	756.98		1264	4.76
1923-24	1807353	744		208.37	224433	625.10	730.82		463	1.30
1924-25	1904119	948		210.93	329980	938.77	1090.36		3287	8.33
1925-26	2598609	1264		199.32	370617	965.86	1054.69	422750	1592	3.47
1926-27	2680156	1207		196.09	317780	832.92	919.77	384280	5064	13.00

Note: (1) Estimates of weight based on nuts in shell. There is about 25 per cent loss of weight after shelling.

Sources: Season and Crop Reports for column 2.

Annual Volume of the Sea Borne Trade and Navigation of the Madras Presidency for columns 5, 6 and 8.

Review of the Sea Borne Trade of the Madras Presidency for columns 4 and 7.

Appendix 5 to the Report on the Marketing of Groundnuts in India and Burma for column 3.

Table 2  
Groundnut oil:Exports

Year	Exports to Foreign countries		Coastwise Exports	
	qty. in gallons	Value (Rs.lakhs)	qty. in million gallons	Value (Rs.lakhs)
1900-01	9643	0.13	1.44	21.18
1901-02	12221	0.16	1.90	26.70
1902-03	15290	0.22	1.56	21.28
1903-04	17992	0.22	1.74	21.18
1904-05	27696	0.23	1.44	16.97
1905-06	2867	0.03	2.43	29.74
1906-07	1741	0.03	2.74	36.09
1907-08	44985	0.78	3.32	55.03
1908-09	57190	0.87	2.83	42.53
1909-10	75313	1.08	1.30	18.91
1910-11	146227	2.23	1.93	29.26
1911-12	173229	2.72	3.29	49.53
1912-13	218119	3.30	2.67	39.76
1913-14	279895	4.34	0.94	14.06
1914-15	203091	3.07	0.67	9.13
1915-16				
1916-17				
1917-18	626242			
1918-19				
1919-20	22730	0.71		
1920-21	52851	1.39		
1921-22	24738	0.57	1.82	49.62
1922-23	35847	0.78	2.30	59.27
1923-24	28993	0.70	1.27	35.83
1924-25	21522	0.52	0.41	11.53
1925-26	27886	0.67	0.64	18.93
1926-27	22752			

Source: Annual Volume of the Sea Borne Trade and Navigation of the Madras Presidency.  
Review of the Sea Borne Trade of the Madras Presidency  
Handbook of Commercial Information for India, 1919.

pressure from these quarters on the Government to devise ways of helping the market towards recovery, quite apart from any consideration of the consequences of the acute distress amongst groundnut cultivators, affected doubly by the increase in foodgrain prices, and decline in the groundnut price.

In examining the responses of the Government, which takes place later in this paper, one conclusion stands out, and that is that there seemed to be greater interest in being seen to do something to tide over the immediate situation, rather than any attempt to utilise the opportunity to develop an alternative market for groundnuts within the country itself. This was because such an "export substituting" industrialisation strategy would have faced a number of problems. At the most general, was the fact of India's colonial status, with its concomitant, its role in balancing Britain's import surpluses from outside the sterling area, with its own exports to the non-sterling areas. Groundnut alone accounted for some 5 per cent of India's total exports of which the large majority went from ports in the Madras Presidency. Again, of the total Indian groundnut exports, Italy, Germany, the Netherlands and France accounted for 64% of the total as late as 1937. In 1913-14 France alone took 90 per cent of Madras's exports in groundnuts.

Any Government in Madras under the colonial dispensation would treat an export commodity such as groundnut as a major asset and would not wish to substitute export earnings for a doubtful gain in terms of retaining the value added, through processing the groundnut, within the country.

The emphasis on exports of primary products was not, of course, dependent merely on the desire of officialdom to meet the requirements of the imperial fiscal system. Actual exports took place through the agency of private firms on private account. In the case of groundnuts, there were four or five European firms which had invested substantially in building up a network of suppliers, and also developed funds of good will amongst these. Breaking this chain at any point would have involved repercussions which no individual would normally risk incurring unless it took place at a time of crisis for the entire trade. The First World War and the depression were two such instances, and it was at these junctures that businessmen were prepared for careful experimentation, and the government emboldened to experiment.

The third factor was the market question. As the accompanying chart shows, while the food industry was the ultimate sink for the series of processes that constitute the oil-seeds industry, there were a large number of by-products of critical industrial importance in themselves. Many of these could be developed only in the course of an integrated programme of industrial development. This approach had expressly been banned by the Secretary of State, even while he had agreed to a relaxation of the restrictions on government intervention in industrial matters in the case of specific industries.

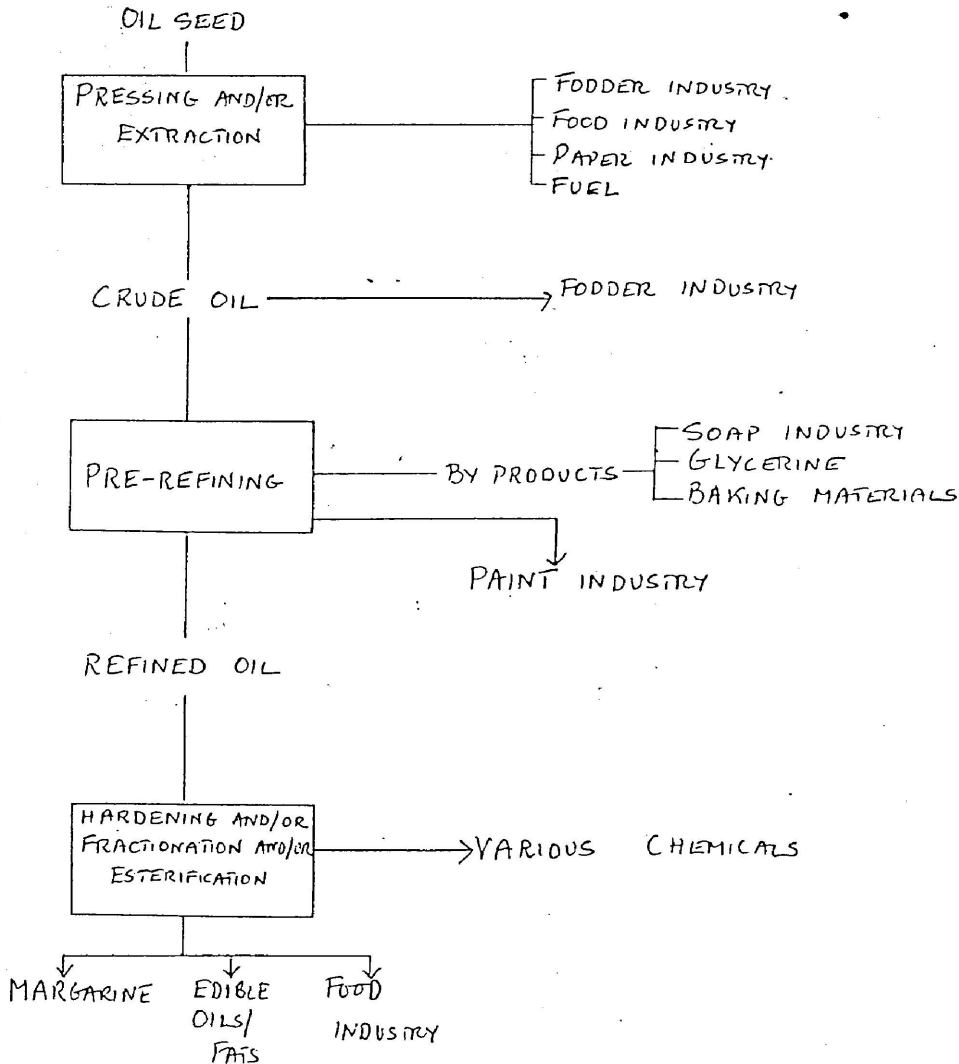
Even if the complex issues of developing the supporting industries is ignored, the problem still remained of identifying an adequate market of final consumers in edible oils and margarine. Here the problem was no less than that of altering the dietary pattern of the bulk of the population who, due to their precariously unstable and small incomes, had little or no access to edible oils or fats.

Finally there was the question of the technology that would be used in the oilseeds industry. While a large integrated complex, even in the absence of indigenous machine building capacity, could be based on the replication of technologies developed elsewhere, interventions on a smaller scale required the development of specific-use machinery or at least considerable adaptation of currently available machinery. This raised questions of work in applied chemistry, in chemical and mechanical engineering, and of the resources required to undertake this.

One of Alfred Chatterton's lesser known contributions to India's industrialisation lay in the formation, in 1909, of the Chemical Industries Committee. The establishment of the Committee, inspite of the opposition to the Government's industrial development efforts voiced at the Ootacamund Industrial Conference of 1908, shows that there were no apprehensions at the time that the Secretary of State would intervene, as he did in 1910, to forestall measures that the Government might have contemplated. The Committee, in which the



Following page 7  
The oilseeds based chemical industry



Source: A. van de Kruijs Relocation in the vegetable oils and fats industry: A Sectoral Analysis. Occasional Paper no 18,  
Development Research Institute, Tilburg, 1983

Director and other members of the Indian Institute of Science in Bangalore were involved, covered a very wide range of industries which involved processing based on a consciously applied knowledge of chemistry .

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Chatterton, himself, was well aware of the need for an industrial chemist in the Department of Industries, if chemical industries were to be successfully developed under its auspices. Tressler, however, inspite of being Secretary to the Chemical Industries Committee, and who became Director of Industries in 1914, seems to have had an inadequate appreciation of the necessary mix of both applied scientific knowledge, and of technological knowledge (in the sense of understanding of working plants and machinery). He also seems to have had difficulty appreciating the complexities of negotiating a path through the more general constraints mentioned earlier. It is therefore quite remarkable that an industrial chemist was at all appointed in the Department of Industries and chemical technology at all developed under its auspices. These developments themselves reflect all the constraints on industrial development of the time.

## II

The response: (i) Induction of an Applied-Chemistry knowledge base

Although the Industrial Conference held at Ootacamund in 1908 had seen vocal opposition to the Madras Government's then policy of active promotion of industry, fisheries had been a subject that was explicitly excluded from the prohibited list

where Government should not involve themselves. It was within this space that Frederick Nicholson, the Honorary Director of Fisheries, proposed to establish an experimental canning, fish-oil and guano plant at Cannanore on the West Coast of the Presidency. A great advantage of this initiative, he pointed out, would be the impetus given to subsidiary industries of which edible oils for canning, vinegar for pickling, and barrel-making were mentioned. The edible oil proposed to be used was groundnut oil, available from the Parry's installation at South Arcot. Barrels could be made in Cochin or, at all events, imported from Burma, while stoneware jars were made by the Basel Mission Potteries, also on the West Coast. The proposal was repeatedly insistent on the point that the experimental station would develop technologies within the financial and managerial capabilities of small capitalists.<sup>11</sup>

The proposal was accepted by the Government and the experimental plant established. Quite soon, it showed astonishing signs of success. Within five years, the number of plants manufacturing fish oil and guano (a dried product made from boiled fish used as manure) had grown to 211 in the districts of Malabar and South Canara, with two-thirds concentrated in the latter. The oil, in fact, was a direct gain to the producers from the new method used and was largely exported, half the amount going to Germany. The major point, however, of the new method of curing the fish was that the older indigenous method was not able to cope with the sudden, large,

quantities of fish which arrived. It was difficult to convert all this into a food which was both safe and nutritious.

Nicholson argued that the new technology should not be seen to be a way by which the food available for local consumption was reduced. Reduction of fatty fish to guano and oil, and lean fish to ordinary manure, could actually lead to increased cereal production if the products were used as manure locally.<sup>12</sup>

It was in the context of the successful functioning of the fish products plant that the question of the appointment of Kesava Menon, a Government of India Technical Scholarship holder arose. This scholar had been trained in England in the Chemistry of Soap manufacture, and on his return, approached the Government of Madras for a suitable job. It may be noted, for it is significant in the context of later developments, that the choice of soap chemistry had been suggested by Best and Co. and the Madras Trades Association, neither of which were fervent supporters of indigenous industrial development, in 1909.<sup>13</sup>

At the time when Menon's appointment was being considered the Department of Industries had not yet been formally reconstituted. In these circumstances, the proposal that Menon should work in the Fisheries Department under Nicholson seemed to be a solution to several problems.<sup>14</sup>

A subsidiary establishment and a building for Menon's experimental work were sanctioned, and extended into a second year, on the basis of the progress that had been made in the

preparation of soaps from the fish-oil already produced at Cannanore.<sup>15</sup> This found a commercial application as an insecticide for spraying on the plantations. Menon was also invited to use the scientific facilities at the Indian Institute of Science at Bangalore.<sup>16</sup>

### III

The response:(ii) Improvements in mechanical processing

Concurrently, with the anticipated reestablishment of the Department of Industries, Tressler, the officer in charge of the Pumping and Boring Department had been asked in 1912 to prepare a budget with items of a non-recurring nature. These would be items for testing and for demonstration purposes only, and Tressler suggested amongst others, the acquisition of an Anderson Oil Expeller, to remove the oil from the seed. Tressler noted that the traditional bullock driven village oil ghani had been adapted to operate on mechanical power. This was both a response to, and an encouragement for, concentration in the oil pressing trade. This concentration had not yet reached the stage where hydraulic oil presses would be in demand, for while a typical battery of three power driven ghanis could produce 600 lbs. of oil an hour, an expeller could produce about 1800 lbs. and the hydraulic mill about 5000.<sup>17</sup>

At the time that these investigations were in progress, groundnut cultivation covered about 15 lakh acres in the Presidency, with the traditional chekku overwhelmingly in use for oil pressing. Table 3 based on estimates by collectors, is indicative of their distribution over the groundnut growing areas.

TABLE 3

Traditional Village Chekkus used for groundnut oil in Madras, 1917

District	Area under groundnut in acres (1917-18)	Number of Chekkus	Remarks
Anantapur	2 99 903	297	
Bellary	80 118	138	Used for other seeds too
Chingleput	27 516	600	Used for other seeds too
Chittoor	23 943	1000	
Coimbatore	90 262	1560	
Cuddappah	2 01 633	350	
Ganjam	17 526	900	Number of presses in Groundnut growing area
Kurnool	1 70 928	295	
Madura	50 554	700	
N.Arcot	1 84 577	2000	
Ramnad	24 955	453	Number of presses in groundnut growing area
S.Arcot	3 55 854	3000	Groundnut and gingelly
Salem	62 953	869	Used for other seeds too
Tanjore	74 727	490	
Trichy	92 822	1258	
Vizagapatnam	29 302	405	460 gingelly presses used for groundnut 50 presses in Vizianagaram taluk.
Total in districts	17 87 573	14315	
Total in Presidency	17 96 418		

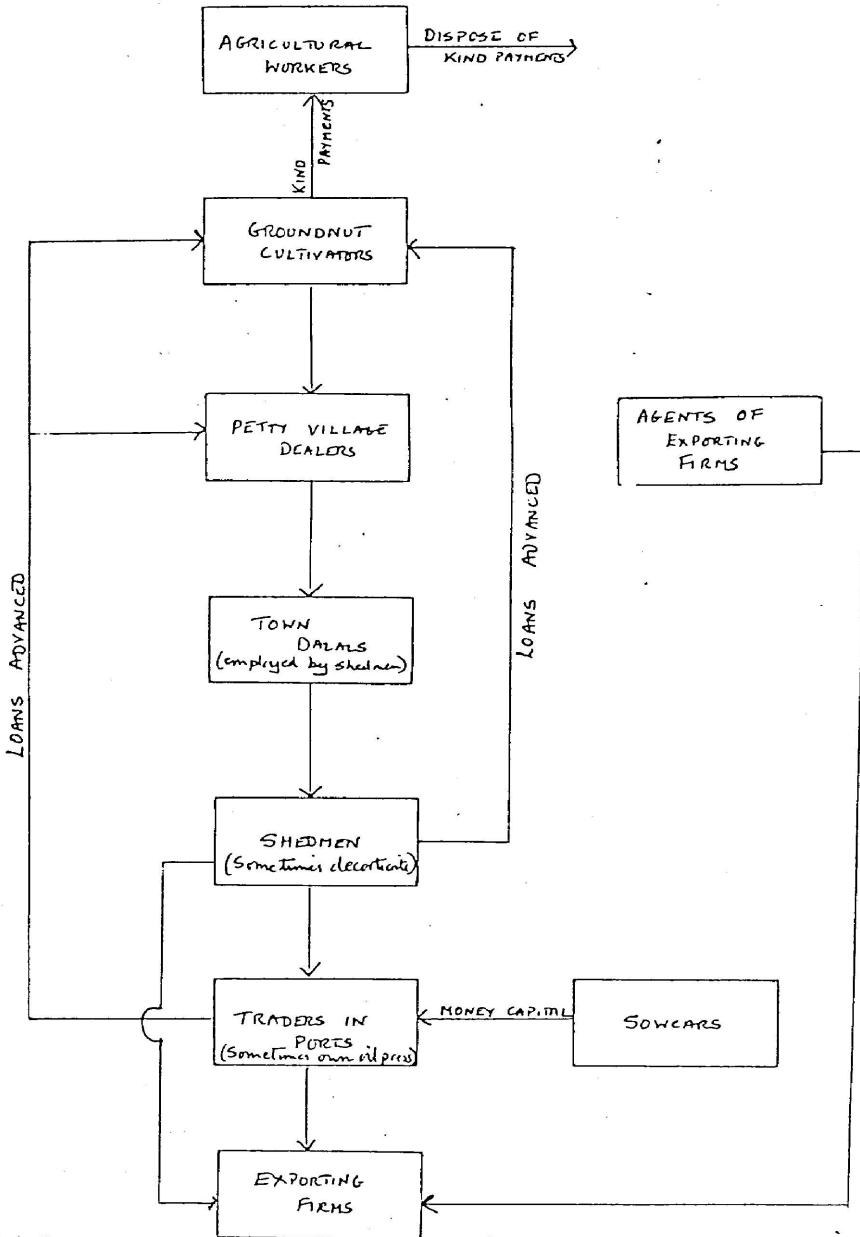
- Note: (i) All Collectors except those of Chittoor and Ganjam, refer to "Country-oil presses". In Chittoor they are called "mills" and in Ganjam ordinary oil presses".
- (ii) All figures are stated to be estimates or the figures given approximately except in Anantapur, Kurnool, Trichy, and Vizagapatnam.
- (iii) In Trichy, taluk-wise breakdown was given; Trichy 245; Kulithalai 305; Musiri 177; Perambalur 131; Udayarpalayam 21; Karur 124; Namakkal 62.

Source: Revenue GO 188 15.1.1918

As far as groundnuts were concerned, decortication was a critical process which affected the quality of the oil which was produced. With the outbreak of the war and the dislocation of foreign markets, attention was drawn to the defects in the traditional method of decortication. The America Consul in Marseilles was reported to have said that the indigenous method -- of wetting and beating with sticks -- ruined the reputation of Madras nuts. The Department of Industries was, in fact, experimenting with improved methods.<sup>18</sup> The problem seemed to be that mechanical methods were not able to cope with nuts of different sizes, and experience showed that either the bigger nuts broke, or the smaller ones were not satisfactorily shelled,<sup>19</sup> when the machinery was adjusted for one or the other size.

Decortication, although a relatively simple process technologically was critical to the oilseeds industry not merely because of technical reasons. Particularly in Southern India, the owners of decortivating units were the wholesale merchants in groundnuts.<sup>20</sup> These would either buy nuts in the shell from the producers outright, or receive them for commission sale, or simply decorticate nuts brought to them.<sup>21</sup> The establishments run by these merchants were important assembly points not only for groundnuts but also for cotton processing (ginning and pressing), oil crushing and for rice milling. In such conditions, the value of the groundnut shell as fuel for the common engine used for all these types of processing often implied that decortivating charges were waived in lieu of

Following page 14  
The Groundnut marketing network



Source: B.V. Narayanaswamy Naidu and S. Harikrishna Groundnut: Marketing and other Allied Problems. Annamalai University Economic Series - No 7 (Annamalai, 1942)



Table 4

Decortivating machinery in use in Madras Presidency in 1918

i) "Sangli" made by Messrs. Dandekar Bros in Sangli was the most popular.

Size	Prewar price (Rs.)	Horse power required	Capacity (in bags of 164 lbs of unshelled nuts per 10 hour day)
A	200	3	67
B	250	4	84
C	300	5	100

The tests by the Agriculture Department had shown that the machinery were satisfactory on the whole and the actual output was well above that claimed.

ii) Messrs. Dakes and Co., Madras made a practically similar machine.

iii) Messrs. Best and Co., made the Gaudart patent machine used in South Arcot in three sizes.

Size	Prewar price (Rs.)	Horse power required	Capacity (in bags of 164 lbs of unshelled nuts per 10 hour day)
A	350	2 1/2	110
B	650	4-5	250-300
C	1150	8-9	500

Trials with one machine in 1916 had shown that the capacity was not achieved. There had also been engine trouble but the machines had since been improved.

iv) Gaebele patent machine used in Pondicherry cost Rs.600, used 5 horse power and did 250 bags in 10 hours.

Source: Home (Educ) GO 355 18.3.1918

retention of the shell, or a small payment even made when the price of coal was high <sup>22</sup>. As controllers of substantial capital, the merchants and commission agents were a critical potential <sup>23</sup> source of manufacturing entrepreneurs.

The oil pressing stage of the oilseeds industry was, as Nicholson pointed out, essentially a mechanical industry requiring little scientific knowledge except that to prevent the oil becoming rancid. Oil refining was also a routine matter and <sup>24</sup> could be effectively supervised by foremen. In other words, introduction of alternative forms of oil-pressing machinery was not, in itself, going to add to the technological base of the industrial sector, or to lead to "industrial development". It is significant that the work undertaken by the Department of Industries, under Tressler between 1914 and 1916 consisted solely of experiments on various kinds of oil presses.

#### IV

The response:(iii) investigation of cost-effective oil pressing technology

There were six kinds of oil presses which could be used, in combination, or alone. <sup>25</sup> The most widespread was the traditional village chekku or ghani, worked by bullock power. It consisted of a fixed wooden mortar with a revolving wooden pestle bearing against the side of the mortar. Pressure was applied by attaching a wooden lever to the pestle. The traditional ghani

cost Rs.40-50 in 1915, and could deal with 50lbs of coconut per hour and between 25 and 35 lbs of other seeds.

The screw press consisted of a horizontal frame supporting a number of loose vertical plates. The seeds were placed in gunny bags packed between the plates which were pressed together by a horizontal screw attached to one end of the frame. Oil flowed out of the sides of the plates, while heating was done by an open fire adjacent to the frame. The screw press cost about Rs.450 and had a capacity of 2 cwt of kernels per hour.

A development of the traditional chekku was made of steel and differed also in that the pestle was stationary while the mortars revolved. It was usual to establish several units in serial order. It gained popularity particularly on the West Coast although there was an objection that the steel working faces powdered rather than crushed the seed, so that the oil was not as pure as that obtained from the traditional chekku. A single unit using a 3 hp motor had a capacity of 60 lbs of coconut per hour and 30 - 40 lbs of other seeds. It cost Rs.280, and a battery of three units with a 10 hp engine and shafting cost Rs.3000. The minimum output for commercial operation was 200 lbs per hour.

Whether for the home or the foreign market, the question posed was that of increasing the efficiency of oil seed pressing

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itself. Oil seeds were said to be of two kinds, one requiring a single pressing, and the others two. In the latter case, the first pressing produced edible oils, the second, oils suitable for soaps and other non-edible purposes. The Anglo-American system was suitable for the first, and the Cage system for the

second. Both of these worked economically on a capacity of 20 tons of raw seeds in a 22 hour day. For smaller demands, the Anderson Expeller could work on 3-4 tons per day. As the demands were becoming increasingly specialised, the smaller plants were unable to compete, as the products had a lower value, and the depreciation was greater. The lower value of the products was due to the fact that while in the larger presses, double pressing was possible, in the smaller ones the output was a mixture. The price this fetched was even lower than that of the second (inedible oil) pressing of the larger presses.

In the case of small mechanised plants, three systems were possible -- the Anglo-American, the Cage, and the expeller<sup>27</sup>. None of these had been thoroughly tested, and it was believed that the Cage was not in use in South India at all at the time. Each system dealt with about 3 - 4 cwt/s per hour and cost about Rs.12000 for the first two, and Rs.12500 for the expeller. To this was to be added storage tanks (Rs.250), filters (Rs.1250 each), and preparatory machinery such as a decorticator (Rs.350), a crusher (Rs.250), edge stones (Rs.750) and so on.

In large mechanised plants, the Cage, Anglo American and extraction process could be used. The Cage, as its name suggested, consisted of a pair of concentric steel cylinders made of bars clamped by hoops. The seed which had been crushed, cooked, or otherwise treated was fed into the cage and the top closed when the charge was complete. A hydraulic ram rising from

the bottom of the cylinder compressed the meal, forcing the oil out of the bars. The ram was driven by steam which was also required for cooking the seed. A typical double unit with a capacity of 1 ton per hour or 18-20 tons per day used an 80 hp motor, and with engine and shafting, cost Rs.65000. Preparatory machinery cost Rs.8000 and a special building cost Rs.15-20000.

The Anglo-American system consisted of a frame through which a hydraulic ram passed. The seed, previously prepared, was packed in flat bags and laid on loose shelves between the ram and the top plate of the press. When the ram was in operation, the oil flowed out of the bag. The cost of five presses, equivalent in capacity to the Cage, was Rs.50000 with engine and shafting. The preparatory machinery and buildings cost the same as in the case of the Cage system. While this latter system was more expensive and difficult to work, the Anglo-American had higher operational costs because of the requirements of bags.

In the extraction process the solvent, benzene or trichlorethylene, dissolved practically all the oil when the seed was cooked in it. The solvent was then separated by steaming. The oil extraction by this process was nearly complete - there was a loss of less than 2 per cent - but a skilled chemist was required to recover the solvent. The solvent cost Rs.450 - 500 per ton and the cost of processing was Rs.13 per ton of seed if skill was used. No preparatory machinery was required in this case, a system of two extraction units with boiler costing Rs.25000.

The expeller system was the only one to be tested by the Department, and the results were sufficiently controversial, apparently, to require the bulletin describing them to be marked "confidential" for over ten years, by which time it became outdated<sup>28</sup>. In the expeller the seed was first treated. In the case of groundnuts, this included decortication, shelling and crushing. If cooking was required, apparatus for tempering was also available. The expeller itself consisted of steel bars in a cylindrical form with a slight clearance between them. The bars were held together by steel rims on the outside. A hopper for loading was fitted at one end. Within the cylinder, one end was blocked by a tapering steel cone which blocked the end almost completely. The annular space between the face of the cone and the cylinder could be adjusted by moving the cone in or out. When the expeller was in operation, the oil was forced through the space in the steel bars forming the cylinder.

The Department of industries had done fairly detailed analysis on comparative costs of various kinds of oil pressing machinery which showed the fall in processing costs as the output increased as shown in Table 5. This analysis showed that for capacities greater than 1 chekku and upto the equivalent of 3 chekkus, a battery of power driven chekkus was the most productive. For capacities between 4 and 6 or 7 chekku equivalents, the expeller was the optimum technology, while for an output of 10 or, preferably, 15 tons per day the hydraulic press came into its own. A three battery power chekku installation required a 10 h.p. motor and cost Rs.3100; an

Table 5

Cost per ton with maximum possible output per chekku

	cost for output equivalent to using																	
	1		2		3		4		5		6		7		8		9	
Techno- logy	chekku		chekkus		chekkus		chekkus		chekkus		chekkus		chekkus		chekkus		chekkus	
	Rs	As	Rs	As	Rs	As	Rs	As	Rs	As	Rs	As	Rs	As	Rs	As	Rs	As
Country chekku	15	0																
Power chekku	17	12	11	12	9	12												
Expeller					12	10	10	13	8	8	6	13						
Press											15	8	8	12	6	8	5	14

Source: Rev.GO 347 3.2.1914

expeller required 15 h.p. and cost Rs.15000; while a hydraulic press used a 45 h.p. motor and cost Rs.45000. All these costs excluded the cost of a suitable building.

In the view of the Department, concentration of oil crushing had reached the stage where an expeller could profitably be used. Detailed calculations were made of the fixed and working expenses for various levels of output. Assuming a 10 hour working day and an output of 5 cwt. per hour, or 2 1/2 tons per day, the power requirements were 150 units costing Rs.4 at the rate of 5 pies per unit. 6 workers to be paid at 8 annas a day cost a further Rs.3. A 10 year life for the machine meant that depreciation and interest would amount to Rs.15000 per year, a salaried manager Rs.240 per year and a driver and foreman an equivalent amount. With a miscellaneous item of Rs.20, the fixed charges totalled Rs.2000 per year. The working expenses for the expeller were then as in Table 6. Unfortunately, these calculations seemed to be based on the manufacturers claims and the Department's own tests showed noticeably lower performance as shown in Table 7.

With these results, the comparison worked out rather differently as shown in Table 8. For equivalent output, the capital costs were now estimated at Rs.16000 for the expeller, Rs.3000 for 15 bullock ghanis, Rs.15000 for 5 rotary mills and 14 h.p. engine, and Rs.500 for a screw press. It was also noticed that the expeller could not work on the kernels alone as the seeds were then compressed so much that the oil did not escape. On the other hand, mixing with husk reduced the value of the residual cake for manurial purposes and made it unsuitable for cattle feed.



Table 6

Average Quantity dealt with in tons		100	150	200	250	350	500
Working expenses	Rs.	280	420	560	700	980	1400
Fixed expenses	Rs.	2000	2000	2000	2000	2000	2000
Total expenses	Rs.	2280	2420	2560	2700	2980	3400
Cost per ton	Rs.	22.8	16.2	12.10	10.13	8.8	6.13

Source: Rev GO 347 3.2.1914

Table 7

Oilseed	Makers Estimates (lbs/hour)	Actual Results (lbs/hour)
Groundnut	600 - 800	225
Gingelly	500	145
Castor	400 - 600	200
Cotton seed	400	133

Source: Home (Educ) GO 960 12.9.1916

Table 8

Technology	Capacity per hour with			Charges per ton with		
	Groundnut % extrac lbs	Gingelly % extra lbs	Castor % extra lbs	Groundnut (Rs.)	Gingelly	Castor
Expeller	225 36-37	145 39.5 - 40.5	---	70	83	83
Bullock cherkku	23 36-37	23 39 - 40	---	45-50	100	
Rotary Mill	60 34-36	60 39 - 40	---	45	65-70	
Screw Press	225 38-39	-----	200 36	40-45	---	32-35

Notes (1) Without cost of jaggery

(2) Includes cost of jaggery

Source: Home (Educ) GO 960 12.9.1916

v

The controversy over the form of response : Chemical Engineering  
Vs Mechanical Engineering

The stage was set, therefore, for a conflict between the Department of Fisheries and the re-established Department of Industries, over the jurisdiction of oil seed development activities, particularly as the commencement of the First World War led to a crisis in several of the export markets to which Madras products were sent.

The war crisis affected not only the supply of manufactured goods imported to the Presidency, but also the export of commercial agricultural products. The chief amongst these were oilseeds, and of oilseeds, groundnuts. The problem lay in the fact that the world centre of the oilseeds industry lay in Marseilles and the disruption in shipping and the general uncertainty of the time drastically affected the prices of groundnuts on the international market. A large number of the merchants in the oil seed exporting business were Indians, even if the actual exporters were Europeans, and during the war period there was a great deal of pressure in the legislative council for effective government steps to deal with the problem of falling demand for oilseeds .

The Government had accepted Tressler's suggestion of buying an Anderson expeller, and also agreed to the proposal that the machine should be leased to an Indian firm on the basis of

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payment per ton of filtered oil . In the meantime, it had suggested that as far as the groundnut trade was concerned demonstrations with improved presses was enough. What might be more significant was the development of purified oils for culinary purpose, a project far more ambitious in scope. Kesava Menon was the individual suggested for this work and Tressler was asked to examine the proposal.

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Kesava Menon, however, was fully occupied with his work in the experimental fishery station. The controversy between the Industries and Fisheries Department arose essentially over the solution to the problem of the dormant market for oilseeds. Tressler of the Industries Department favoured technological improvements to the traditional methods of oil crushing, to improve the supply of oil for indigenous consumption, and a large scale experiment to produce oil for the export market taking advantage of the breakdown of the existing source of supply at Marseilles.

The problem here lay in the fact that in most overseas markets, there was a high duty levied on oil imports, while oilseeds were allowed in at a low or even nil rate of duty.

The second problem lay in the fact that Indian oil would have needed to establish itself on the international market, which was a slow process and could well be interrupted by the re-entry of the old-established oil producing centres. The third problem was that while the export of oilseeds was easy and shipping rates low, barrels for the export of oil were not indigenously available and the shipping rates high.

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33

Nicholson argued that the large scale oil press would be "in the air" unless there was a regular organisation for seed collection and for disposal of the produce, including the low grade oils which could not be economically transported to any great distance<sup>34</sup>. In addition, it would take a year to set up a single hydraulic press, by which time the immediate cause for action (the glut in the oil seeds market) could have disappeared. In any case, even 12 presses would be unable to cope with the groundnut production alone which was estimated at 3,60,000 tons in 1913. In other words, the answer did not lie in replacing the export of oilseeds by the export of oil, even if the hurdles enumerated earlier could be overcome.

Nicholson proposed, instead, "a group of small linked but contiguous factories for the whole of the oil and fat industries". This would be a complex similar to that at Marseilles and was to include an oil press and a solvent extraction plant; a refining plant; a soap factory for using low grade oils and "foots" which formed 15-20% of the output; a stearic acid plant for candle making; a glycerine plant, a sweet edible vegetable fats and butter-substitutes plant; a paint and lubricant factory and a hydrogenation plant for hardening oils which bleached or deodorised the oil, producing a white lard or tallow-like fat.

The immediate problem with Nicholson's proposal was that it would have to be implemented by the Industries Department, whose principal officer saw the problem very differently. The larger

problem lay, however, in the fact that it considerably exceeded the bounds that the Secretary of State had laid down for the work of the Department of Industries, while permitting the Madras Government to restart its activities<sup>35</sup>. There was also some doubt about the size of the internal market for edible oils and for ghee substitutes made from vegetable oils<sup>36</sup>. Of course, it was fully part of Nicholson's conception that the "vegetable butter" produced would form a critical supplement to the diet of those who presently subsisted on rice and coarse grains and had no access to meat or to ghee. But this was a conception that linked industrial development to changes in dietary patterns which required, at the very least, a substantial increase in the incomes of the bulk of the people. When put in this form it was clear that the problem lay not only in the constraints that the Secretary of State may have laid down, let alone at the level of the persuasion of the small section of actual or potential ghee consumers to switch to vegetable fats. To be successful, the proposal required a thorough reordering of the income distribution of Indian rural society. Whatever the nature and level of objections voiced to the suggestion, this was something that was quite beyond the bounds of the feasible.

Tressler pressed his scheme for more ambitious oil pressing demonstrations. He suggested the acquisition of two more Anderson Expellers, for Parry's at Cuddalore and for the Raja of Bobilli, both of 5 cwt. capacity. Best and Co. were to be leased an 18 cwt. Premier Mill of hydraulic design, there was to be another 8 cwt. capacity "Colonial" mill, and a refining and

cooling plant at Madras. All items in this proposal were accepted by the Government except for the Colonial Mill, which was disallowed on financial considerations<sup>37</sup>. In the event, as will be seen, the entire series of experiments and the expenditure proved to be infructuous.

The plan was to locate the hydraulic oil mill on government land at Tondiarpet in the north of Madras. Seeds were to be provided by Best and Co. though it was made clear that no concession would be provided on the cost of the land in the event of the eventual sale of the mill to them<sup>38</sup>. However, all this was looking very far ahead. The requisition of the manufacturing capacity of the firm supplying the oil mill machinery in the course of the war meant that the equipment was not received in a complete form. The Government tried to persuade the Indian Institute of Science to experiment with the mill but the proposal did not work out<sup>39</sup>. Finally, Best and Co., gave up their option to the machinery and it was sold to the Premier Oil Mills in Kanpur who were said to have the backing of a London financier<sup>40</sup>. Significantly for the future development of the oil seeds industry, this arrangement seemed also to imply that Premier Mills would not develop the edible oil industry in Madras in deference to Best and Co.'s existing interests in the trade<sup>41</sup>.

The silence and lack of visible progress on the development of the oil seeds industry, brought criticism both in the nationalist press and in the Legislative Council<sup>42</sup>. The Director

of Industries had to admit that the Anderson Expellers were not suitable for decorticated groundnuts, while the shells contained sand and caused unacceptable wear and tear to the machinery. The debate seemed to be sufficiently grave to require a defensive noting by the secretariat that Frederick Nicholson himself had suggested experiments on groundnut, for the expellers were already in use for coconut oil on the West Coast. <sup>43</sup>

Here too, the Indian Institute of Science was asked if they would experiment with the expellers and the oil plant. This they were more inclined to do, as the other provincial governments had not shown themselves keen to finance large scale and ambitious experiments. However, in the meantime, the Mysore Government made an outright offer for the expellers and they were thankfully and quickly dispatched. <sup>44</sup> Again an opportunity seems to have been lost, for the proposal to the Institute was based on Nicholson's scheme, suitably scaled down, to develop an integrated complex based on oilseeds, and experiments with an integrated project of this kind would have had a far wider impact <sup>45</sup> than would attempts in the narrow field of oil milling alone.

Some time later a less ambitious proposal was suggested by which the oil milling stage could itself be made more profitable. This was to develop alternative uses for the oilcake, a product of the oilpressing stage which at that time could be used only as cattle feed or as manure. <sup>46</sup> This was a theme which to arise more insistently later on but it received little attention at the time.

## VI

## Problems of the transition

The noticeable feature of this entire period is the lack of any sustained interest amongst the capitalists involved in the oil trade, in the development of a vertically integrated oil complex which would provide opportunities for the manufacture of higher value added items. Though, with the outbreak of war, the market for oilseed had been severely dislocated, by June 1915, the price of groundnut in Marseilles was almost at the pre-war figure. However the price in India had fallen to about Rs.28 a candy (529 lbs) from Rs.40 a candy as compared to cultivation costs of Rs.16 a candy. This fall in the margin was due to increased costs of shipping and insurance due to war risks.<sup>47</sup> Markets which were found in North America offered prices even lower than at Marseilles and though there was an improvement in the price with the establishment of a groundnut oil plant at Singapore this was not enough to satisfy growers and traders. In any case, the Singapore offtake was risky, as the oil was re-exported to Hong Kong, possibly for transmission to China.<sup>48</sup> But these were markets gained at the expense of dislocated channels of supply from elsewhere and could not serve as a solution to the dependence on the Marseilles market.<sup>49</sup>

In fact, within a few months of the outbreak of the war, a petition argued in favour of an export duty on groundnut, and the establishment of soap and candle industries to absorb the oil which was milled in the country. It pointed out that there was



no need to experiment on improved methods of oil milling (which the Government had taken up or, at least, invested in with some vigour, as described earlier) because the traditional chekkus were effective and produced oil which sold at a higher price than mill expelled oil.<sup>50</sup> This was, in fact, support to the line of argument proposed by Frederick Nicholson. Unfortunately it came at a time when the Secretary of State's restrictive terms of reference for the Industries Department were still in operation and was not pressed when the export prices recovered later.

Another problem stemmed from the fact that attempts were made to retrieve the situation while not disturbing Marseilles' monopsonistic position. It was argued that earlier the British Government had made representations to the French Government on the latter's ban on the re-export of oil-cake. This had effectively limited the market for oil cake to France alone and had, in turn, reduced the demand for groundnuts. Under these circumstances, it was felt that it would be difficult at that stage for the Government of India itself to levy an export duty to control the supply of groundnut to Marseilles.<sup>51</sup>

While the demand for copra (or sun-dried coconut) came from France and Germany for use in the manufacture of margarine, there was also a demand for coconut oil from the United States and Germany for the soap and candle industries. However, with improvements in the oil extraction process on the continent, there was a movement of demand away from Indian oil to copra in the years preceeding the First World War. Hydrogenation and other processes expanded the use of the oil beyond soap making to edible purposes, and even for industrial applications.<sup>52</sup>

Table 9  
Coconut: Exports

Year	Area sown in acres	Foreign	Coastwise		Average value		
		qty. in tons	Value (Rs. lakhs)	Qty. in tons	Value (Rs. laksh)	1873-74 =100	Average of 1898-99 to 1900-01= 100
1900-01		3760	7.61	11528	24.04		
1901-02		1991	4.83	5590	15.24		
1902-03		7055	18.14	9893	22.65		
1903-04		17458	41.65	7038	15.55	121.46	
1904-05		7622	18.09	6201	15.09	120.85	
1905-06		8714	21.66	6727	17.31	126.52	
1906-07		6256	18.76	4158	14.38	152.68	
1907-08		5900	21.27	3846	12.71	186.33	174.93
1908-09		19450	52.02	7565	20.74	136.46	129.76
1909-10		26609	74.19	5656	18.71	141.96	135.27
1910-11		22294	78.26	5003	19.50	178.74	170.29
1911-12		31618	113.16	8093	29.89		173.63
1912-13		34236	128.39	6627	26.09		181.91
1913-14		38086	155.46	5713	25.31		198.00
1914-15		31736	122.97	6087	22.95		
1915-16		15603	57.04				
1916-17		25315	94.26				181.29
1917-18	557384	5469	19.20				174.12
1918-19	538525						180.50
1919-20	546136	7344	31.39				207.27
1920-21	544747	2582	13.56				254.70
1921-22	559404	2762	10.83	16855	73.51		
1922-23	543263	13856	49.94	17666	70.79		
1923-24	547000	3906	16.02	14836	64.62		
1924-25	525445	292	1.16	13594	65.40		
1925-26	555465	1		12805	63.10		
1926-27	552815	2034	7.55	19390	87.46		

Note: Data explicitly include foreign exports originating in Travancore for some years. These were valued at Rs.2.17 lakhs, Rs.0.7 lakhs, Rs.3.48 lakhs and Rs.3.99 lakhs in 1907-08, 1908-09, 1910-11 and 1911-12 respectively.

Data on values for the years 1915-16 to 1918-19 given in Sterling. These have been converted at the rate of Rs.15 per pound sterling.

Sources: Season and Crop Reports

Annual Volume of the Sea - Borne Trade and Navigation of the Madras Presidency.

Review of the Sea-Borne Trade of the Madras Presidency.

Indian Munitions Board Handbook, 1919

Table 10

## Coconut Oil

Year	Seaborne Trade				Average Value of		Railborne Trade with destinations				
	Exports to foreign countries		Coastwise exports		sea borne exports		Ports in Presidency including Pondichery	Inland within Presidency		Outside Presidency	
	qty. in million gallons	Value (Rs. lakhs)	qty. in million gallons	Value (Rs. lakhs)	1883-84 =100	Average of 1898-99 to 1900-01 =100		qty. in million gallons	Value (Rs. lakhs)	qty. in million gallons	Value (Rs. lakhs)
1900-01	1.36	16.66	4.26	46.95			0.60	0.14	4.36	0.10	1.54
1901-02	0.82	12.29	3.82	49.83			0.18	0.30	5.33	0.12	2.15
1902-03	1.99	28.55	4.60	58.16	122.29		0.75	0.28	4.84	0.13	2.17
1903-04	3.34	48.15	4.62	48.86	122.12		0.50	0.34	5.31	0.11	1.73
1904-05	1.99	28.70	4.68	56.73	124.75		1.02	0.31	4.83	0.19	3.03
1905-06	1.47	21.72	4.89	62.30	124.49		0.44	0.44	7.34	0.19	3.14
1906-07	0.94	13.86	4.08	66.70	122.89		0.45	0.42	8.70	0.47	9.62
1907-08	1.14	16.50	4.33	73.21	119.57	117.69	0.46	0.51	10.97	0.21	4.49
1908-09	2.81	39.71	5.49	69.61	125.76	114.53					
1909-10	2.50	37.09	4.92	73.62	152.20	87.99					
1910-11	1.89	33.95	4.28	78.25		145.78	2.03	0.44	10.61	0.37	8.94
1911-12	2.12	39.66	4.13	70.58		151.78	1.81	0.60	14.99	0.36	9.15
1912-13	0.93	18.43	3.92	71.70		160.87	2.00	0.48	12.54	0.37	9.52
1913-14	1.06	22.48	3.39	71.24		172.16	2.70	0.45		0.31	8.68
1914-15	1.78	35.96	3.37	57.12			2.80	0.55		0.77	18.40
1915-16	2.02	38.87	2.73	42.81							
1916-17	2.02	42.53	2.40	44.40		175.81					
1917-18	2.49	46.40	2.79	40.92		151.38	0.98	1.15		2.55	66.82
1918-19	3.89	69.70	3.09	58.92		145.34	1.39	1.50		1.36	40.74
1919-20	3.01	85.95	2.76	73.67		231.71					
1920-21	1.79	59.19	3.00	89.21		268.30					
1921-22	0.96	25.58	5.46	128.27							
1922-23	0.81	19.40	5.08	107.48		195.29					
1923-24	0.15	3.72	4.78	112.45		197.24					
1924-25	0.11	2.72	4.10	102.97		197.07					
1925-26	0.12	2.97	3.51	89.23		205.35					
1926-27	0.19	4.47	4.70	101.77		194.48					

Note: Data explicitly include foreign exports originating in Travancore State for some years. These were valued at Rs.0.77 lakhs and Rs.0.25 lakhs for the years 1908-09 and 1909-10 respectively.

Source: Annual Volume of the Sea Borne Trade of the Madras Presidency  
 Review of the Sea Borne Trade of the Madras Presidency  
 Review and Returns of the Rail borne Trade of the Madras Presidency  
 Handbook of Commercial Information for India, 1919.

In the case of Coconut Oil, the situation was, therefore, rather different to that of groundnut. Nicholson had pointed out in 1914, that on the Malabar Coast, where there was the largest concentration of coconuts grown, the oil pressing industry was well established. <sup>53</sup> In fact, at a time when the Government was thinking of demonstrating the use of expellers and hydraulic presses these were already in use on the West Coast for coconut oil.

The oil-millers (who were said to be from Bombay) had moved on from the first generation of hydraulic press, of the open type, to the cylindrical cage type, inspite of the fact that the latter were far more expensive. This was because of the laborious process of feeding the charge into the open press, where the seed had to be wrapped in press cloths and individually placed between steel plates. After the pressing was over, the reverse process was undergone. Each press cloth cost Rs.3 and lasted for a fortnight, which made the operating expenses high due to both the cost of the cloth, and for the manual work involved in loading and unloading the press. In addition, there were other problems with the use of the open press, when dealing with a substance as full of oil as copra. In the cage press, much more durable press mats were used, between the 12-14 sub-charges that made up each charge or loading of the machine. As a consequence 12-14 distinct oil cakes were obtained by this process.

In any case, as Nicholson pointed out, the oil millers were well aware of the developments in oil-pressing. Even more

importantly, they were also aware of the frailty of such relatively complex technology within the then prevailing context. Most of them ran complexes of iron rotary mills alongside the hydraulic presses. These were developments of the traditional village chekkus run by mechanical as opposed to bullock power. Sometimes lined with manganese steel, their reliability was of a much higher order. This was because under the pressure of 2-3 tons per square inch, the cylinder of the hydraulic press could split, causing both a delay and requiring the replacement of an expensive component. Even in the open press, the hydraulic pump and leathers were a potential source of trouble in addition to the replacement cost of the cloths, already mentioned, and the laborious process of loading and unloading. Hydraulic presses also required the attendance of a highly paid engineer, in addition to their high initial cost. In the case of a complex of 30 rotary presses, a fault in any one would merely require its disconnection from the driving shaft, and the remaining 29 would continue in operation.

A battery of 20 rotary presses, equivalent in capacity to a hydraulic press, together with engine, boiler, shafting and accessories, but without a building would cost Rs.15000. The cost of an equivalent press was Rs.25000. In a 14 hour day, the rotary complex would press 25 candies (of 700 lbs.each) or approximately 8 tons of copra. The cost of the oil excluding interest and depreciation was about Rs.3 for 35 lb of oil.

The oil content of the copra was about 70% and of this, the rotary mill extracted 62.5 to 65 per cent. With the hydraulic press, almost the entire oil content, 65 to 70 per cent, was extracted. However, the rotary oil-cake with 5-6% of oil sold as cattle food, while the press cake could be used only as manure and was largely exported to Ceylon. The oil from both kinds of press was of the same quality.

Nicholson pointed to an interesting instance of comparative advantage. Due to the high temperature in Cochin of about 90<sup>o</sup> f, the coconut oil was fluid and in one unheated pressing, the entire quantity could be removed. In European conditions, with ambient temperatures around 60<sup>o</sup> f, the copra was subjected to two pressings, one cold and the subsequent one, hot. Even then, the residue contained oil which justified the use of the extraction process. According to Nicholson, as the pressing in India was done entirely cold, the oil was of the highest quality. As already noted, Tressler, the Director of Industries, had pointed out in another context that increasingly specialised requirements of oil implied that oil produced by a single pressing which necessarily contained different grades, fetched a lower price than oil separated into grades by multiple pressings. 54

### VIII

The outcome: (i) TOMCO and the internal market

Still, the coconut oil pressing industry appeared to be well adapted to the prevailing demand and supply position. This became apparent with the initial problems, at least, faced by the

Tata Oil Mills factory (TOMCO) set up at Ernakulam in Cochin State. Set up at an expenditure of Rs.65 lakhs, the unit was operational shortly after the war ended, although there had been discussion on it since at least 1916.<sup>55</sup> The mill used Anderson Expellers for cold pressing and hydraulic presses for the second or hot pressing, both run on electricity. The basic problem seemed to be that of getting adequate supplies of copra which would keep the mill's large capacity fully occupied. It was alleged that this capacity was greater than that of the annual export of copra from the Malabar Coast. In any case Tata's had not reckoned with the opposition of "vested interests" as a later Director of Industries was to put it.<sup>56</sup>

Apart from the fact that the machinery that Tatas had installed gave only 3 per cent more oil than the power driven chekku, as local opinion held, there were in fact various layers of "vested" interests. Supplies of coconut came from the Malabar district of Madras Presidency, from Travancore and from Cochin itself. Tenant cultivators in Malabar sold coconuts to local merchants, who bulked supplies, made copra and supplied this to other merchants in port towns. In turn, these merchants supplied exporters with the copra on short period contracts at fixed rates. The precarious nature of occupancy rights of the cultivators, and the local laws prevented any effective enforcement of the contract by the buying firms. It was also not possible to bind the merchants or the cultivators to a sliding rate depending on the current market value for a limited number of years.<sup>57</sup> In other words, the monopsony desired by the

exporter firms could not be achieved precisely because of the unstable nature of the cultivator's existence. On the other hand, supplies from Travancore, where the land tenure system was certainly more favourable to the cultivator, declined after the  
58  
imposition of an export tax.

Even for the copra which was available for local crushing there was severe competition, for as has earlier been noted, this industry was relatively well developed. As the supplies of coconut oil made available by the old established units was exported by European firms, TOMCO were in direct competition with these. Given the capacity of their mill, and their intention to supply the Indian market, this intervention threatened to  
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dislocate both the production and distribution channels.

Technologically, however, TOMCO were far in advance in that they had equipment for the hydrogenation (or hardening) of  
60  
oils. This was a process that Nicholson had been advocating since 1914 and had, in fact, started negotiations with the originators of the process until the outbreak of the war prevented further progress. Apart from hardening the oil, hydrogenation also deodorised and bleached, and enabled lower  
61  
grade oils to be used for edible purposes.

The economic use of lower grade oils was an important issue if advanced technological processes which enabled different grades to be extracted from oilseeds were to fully utilised. This question had arisen in an early controversy over the wisdom



of using coconut oil for the manufacture of soap, as had been advocated by Nicholson. One opinion held that soap required low grade oils and the use of coconut oil for this purpose would be a waste.<sup>62</sup> To this the obvious response was that at the Marseilles oil complex, coconut oil was used for manufacture of soap. In fact, tropical oils such as copra had replaced the use there of locally available olive oil.<sup>63</sup> Nicholson confirmed this view, and pointed out that soap was normally made from the oil of the second or third pressings. In fact, glycerine which was a valuable by-product of the "spent" soap lyes could also be obtained directly by splitting the oil and using the remaining fatty acids for soap. In this way, coconut oil which contained 13-14% glycerine (as compared to 9-10% for other oils) was often used even for making candles as the principal product was glycerine.<sup>64</sup>

## IX

### The outcome: (ii) Soap from Coconut Oil

Although there were problems in large scale manufacture of edible oils for internal consumption, Nicholson and Kesava Menon continued to innovate and to find commercial markets for different kinds of soap.<sup>65</sup> Moving on from the manufacture of fish oil soap for insecticidal purposes and a harness soap for the military authorities, the latter using stearine, they had also made a high quality "genuine" soap using a locally fabricated handstirred plant.<sup>66</sup> Nicholson's "unusual enthusiasm" was noted in the Secretariat and when he put forward a modified proposal to establish a soap manufacturing unit, it was agreed to

even though this was recognised to be a "commercial" venture,  
 then prohibited by the Secretary of State. <sup>67</sup> Kesava Menon had  
 managed to sell 10 tons of the insecticidal soap to planters and  
 the proposal was to expand into the area of high quality soaps  
 made from vegetable oils and tallow, once perfumes were  
 available. Nicholson recognised that there would be opposition  
 from British firms but argued that this would have to be faced  
 and overcome. <sup>68</sup> It was an unusual arrangement for the government  
 to permit soap to be made in the Fisheries Department, but as the  
 Education Secretary noted (he was now in charge of industrial  
 activities) it would be a pity "to show want of sufficient  
 consideration to Sir Fr  derick." <sup>69</sup> The Governor evidently  
 agreed, and Nicholson was asked to submit a definite proposal. In  
 the meanwhile, it was clear that Menon's work had aroused some  
 antipathy, for the Government of India chose to pick on his  
 activity alone when they asked for a report of his work. They  
 were informed that at the end of that year (1915) a full report  
 had been asked for and a copy would be sent to them. <sup>70</sup>

By the decision to entrust Nicholson and the Fisheries  
 Department with experimental soap manufacture, the Government had  
 ensured the future of the Indian soap industry on the West Coast  
 of the Presidency. However, the arrangement was irregular and  
 the Director of Industries, Tressler, remained sulky. When  
 Nicholson sent in his proposals which required an expenditure of  
 Rs.36000 and Tressler was asked if he could spare it, naturally  
 he refused to part with money budgetted for other industrial  
 experiments and the Government were only able to find Rs.6000

extra for the soap plant. Nicholson's suggestion that for competitive soap manufacture, glycerine recovery was essential could not be agreed to with the funds at hand.<sup>71</sup> In fact, when a legislative council question asked for the establishment of a soap factory on the West Coast, the Government explained that only small scale experiments were under way because of the shortage of money.<sup>72</sup>

So Nicholson's scheme was held in abeyance. However, one important result of the debate was a reference to the Secretary of State of the implications of a British Government decision to aid the dye industry in Britain actively. Brought to the notice of the Madras Government by Nicholson, an official statement had mentioned that due to the war time dislocation of the supply of German dyes, the Government proposed to form an association of British firms to develop the dye industry, supported if necessary by financial assistance. If the British Government had been forced by circumstances to change its position on direct aid to industry, it was argued that a similar change on the part of the Government of India should be permitted, given the Indian economy's precariously dependent position on imports of manufactured goods.<sup>73</sup>

In 1916, the situation had eased. The establishment of the Indian Industrial Commission was itself one sign of this process, but even before the Commission's report was prepared, the Secretary of State in a telegram to the Viceroy announced that Provincial Governments would now be free to help in the

development of specific industries. This decision would need to be approved by the Viceroy and subject to financial considerations, but the Governments need not feel unduly restricted by previous rulings (i.e., those ordering the closure of the Department of Industries in 1910 and its re-establishment in 1912). As usual, in cases of doubt, the Secretary of State was willing to consider "recommendations". This telegram had been sent in response to a dispatch from the Viceroy and may well have been a result, amongst others, of the precedent of the British Government's aid to the dyeing industry, which Nicholson had brought to the notice of the Madras Government.

It was in this context that when Nicholson resubmitted the proposal for a soap plant, with a glycerine recovery unit attached, at the end of 1915, it was accepted. The Government was under some pressure from nationalist opinion which had reportedly been very sarcastic about the denial of funds in the current year for an experiment in industrial development which had shown more progress than any other. It was also felt that Kesava Menon should be given a Government job, and at the least be paid more than his current salary of Rs.250 (expatriate industrial advisors were then paid between Rs.750 and Rs.1000).<sup>75</sup>

Although Menon's salary was raised, the Government continued to have doubts about entry into the edible oils industry and deferred any decision on that matter. The fact that the soap plant was a "commercial" establishment seems to have been a deterrent, in itself, to further industrial adventures in the climate of uncertainty then prevailing. The Government however

were in the process all the time, of being pushed towards taking a major decision by the inexorable and astonishing progress made by the soap factory. Kesava Menon discovered an indigenous oil which had been used as an illuminant until the advent of kerosene when it had been discarded. This was available cheaply and formed the basis for a cheap but good toilet soap. This was manufactured in a plant made laboriously in India while a modern plant had been ordered from England. Similarly, although a vacuum glycerine plant was not likely to be available for some time, a locally made evaporation plant for glycerine had been installed.<sup>76</sup>

The progress at the soap factory attracted the attention of capitalists and would-be capitalists, both British and Indian. Tatas asked Nicholson whether Kesava Menon would be available to them. There were reports that Lever Brothers were to start a soap factory at Feroke on the West Coast. Altogether it seemed as if the soap industry was finally going to develop substantially and provide an internal market for the oil seeds of the Presidency. These successes generated a view in the Secretariat that the war provided a breathing space to the industry, which would be strangled if it was not set on its feet by the end of the war.<sup>77</sup> Nationalist pressure also played an indirect role. The Finance Member, noting that a "dangerous political agitation" had recently (mid 1917) been repressed, asked for suggestions for a "constructive programme".<sup>78</sup> Although the Director of Industries had then treated this as a rhetorical request, when later in the year he suggested that Menon should

certainly be given a permanent government position and the soap factory made permanent, this proposal was seen as a prototypical element of the constructive programme, and accepted by the Government.<sup>79</sup>

The permanent establishment of the factory was likely to increase the opposition of established soap manufacturing interests. To gain some grounds for manoeuvre, an attempt was made to meet the demands of the Indian Munitions Board for glycerine, and for this purpose a survey was made of the traditional village ghanis as a possible source of groundnut oil.<sup>80</sup>

The Director of Industry felt that groundnut oil could be a suitable source for glycerine, but that it would also be necessary to use the fatty acids for making soap and candles. Here again, the presumption was that there was no need for innovation at the oil pressing stage. The Board of Revenue had, in the closing stages of the previous century estimated that there were 18000 chekkus in use, and it was presumed that these could form the base for any further increase in oil supply required.<sup>81</sup>

However, the proposal did not move any further as the Munitions Board decided against locating the glycerine plant in Madras.<sup>82</sup>

Nicholson also suggested an alternative technology by which glycerine could be manufactured, with soap as a by-product, without the use of caustic soda which was unavailable during the war.<sup>83</sup> This required a "priority certificate" for a glycerine plant but it was (regretfully) noted that the proposal did not

lie within the domain of official priorities.<sup>84</sup> An attempt was made to get caustic soda itself from the Munitions Board but the attempt failed, supposedly at the instance of Brunner Mond, a constituent of Imperial Chemical Industries.<sup>85</sup> Nicholson then suggested the expansion of the soap plant to meet the requirements of munitions and at this stage was actually warned in writing by the Director of Industries that the Gossage Crossfield Soap combine was watching developments closely. The manager of the combine had gone to the extent of saying that they would not "sit still and watch India [develop] its own soap industries". However, the expansion proposal was not accepted by the Munitions Board.<sup>86</sup>

The experimental work at the plant continued and seems to have justified the appointment of an assistant to Menon, to whom the more routine duties were delegated, leaving Menon free for experiments.<sup>87</sup> With the successful operation of the plant, administrative responsibility was transformed to the Industries Department from Fisheries, where it had incubated under Nicholson's direction so successfully.<sup>88</sup> Nicholson continued to be directly in charge of the factory and did a final act of service to the indigenous soap industry by providing a rationale<sup>89</sup> for continuing government support to the factory. He argued that unlike the situation as far as some other industries were concerned, the purpose of the soap works was to train persons in soap making, under commercial conditions, so that a soap industry and not merely a factory was established.

This approach helped to gain the support of Indian members of the Legislative Council, who had grown accustomed to the transfer to European hands of any Government concern which had shown itself technologically and commercially viable. Thus when a resolution was introduced asking the Government to establish a technical training institute rather than a soap factory on the West Coast, the Legislative Council was informed that the factory would train small entrepreneurs.<sup>90</sup> Conversely when an Indian member asked whether the plant would be sold to private capitalists (he was in favour of its sale to Indians) he was informed that that was not the intention.<sup>91</sup> Later on, the concept underlying the factory was to serve further to ensure the continuance of the concern against the recommendations of the Retrenchment Committee and European opposition in the 1920s. However, the opposition of the Madras Chamber of Commerce, and the legal advisor to the India Office, to the use of the word "Sarkar", and the broad arrow as the emblem forced the Government to change both in 1920. It was felt that the use of the government's "prestige" in the brand name implied unfair competition with the private sector, and the trade mark could not be registered in England.<sup>92</sup>



X

The outcome: (iii) Effects of the restoration of the groundnut export market.

In the absence of concrete plans to develop a market for large scale supplies of oil in India, it was obvious that proposals to control the export of oil seeds would meet with opposition from both British and Indian exporter-suppliers.<sup>93</sup>

The postwar shortage of kerosene led to the reintroduction of groundnut and castor oil for lighting purposes, and it was suggested that the export of seeds should be banned. In fact at the time castor seed exports were prohibited, castor seed oil could be sent only to Britain, while groundnut oil was permitted to be exported only to Britain and its colonial possessions.<sup>94</sup>

The problem of an adequate price support mechanism for the growers, if exports were ended, was again the reason why no long term measures were recommended by the Madras Government.

With the end of the war, the shortage of food and consequent increase in foodgrains prices, the question of oil milling received another impulse, this time from the angle of the necessity of oil cakes as a form of manure necessary to increase food and commercial crop production.<sup>95</sup> As early as 1919, the All India Board of Agriculture which met at Pusa suggested an export tax on oil cakes in order to develop an internal market.<sup>96</sup> That this was a reflection of policy concerns was demonstrated by a discussion in Madras on the need to increase food production,

given the twin constraints of an absolute limit to arable land and the fact that large portions of it were already devoted to commercial crop production. The Department of Agriculture was asked to suggest ways in which the use of fertilizers could be increased.  
97

The Director of Agriculture responded by pointing out that it was the high price of bone and fish guano manure and oilcakes that prevented the use of manures on any larger scale. To bring down the prices it was necessary to ban exports as suggested by the Board of Agriculture, but it was unlikely that the Government of India would act as there was likely to be opposition from the Finance and Commerce Departments.  
98 Some evidence of this was provided by an indication from the Government of India that the Board of Agriculture's recommendations were still under consideration at the end of 1920, a year after the recommendations were made.  
99 The further passage of a year led to a question in the Legislative Council on whether steps to prevent exports of manures were intended, but there was no clear indication in the answer.  
100

With the end of the war and the return of the export trade to roughly the pre-war situation there was a complete eclipse of the interest in developing the oil milling industry as such, both within the Government and amongst interested members of the oil-traders.  
101 The only initiative came in 1922 from Kesava Menon of the Kerala Soap Institute who, after a visit to Europe,

suggested that experiments should be made using a Domag oil mill, either manually or mechanically operated which could press 200 to 500 lbs per day without power, and upwards of 500 lbs per day with power.<sup>102</sup> This was in comparison with the traditional chekku or ghani's capacity of 45-50 lbs per day.

In 1922, the question of the development of the oil seeds industry was for the first time correctly posed as the twin problem of the disposal of the oil and oil cake.<sup>103</sup> In fact, it was argued that the major problem was the oil cake, and that no mill could be profitable sale of the cake. The export demand for oil seeds also limited favourable prospects by raising their price relative to the price of oil and, of course, curtailing supply. The possible uses of oil cakes of various kinds were set out as below:

<u>Type of cake</u>	<u>Use</u>
Castor	Used for sugarcane but castor generally preferred. Groundnut used for rice, plantains, turmeric. Castor not used as cattle food as it was poisonous.
Coconut poonac Gingelly	Both expensive as manure and used as cattle food.
Cotton seed	Seed used directly as cattle food.

The conclusion was that more extensive use of manure did depend on lowering its price which, in turn, depended on more widespread and localised seed crushing and lower transport costs.

Although the glycerine plant ordered in 1917 did arrive in 1921, it could not be installed under a new building for the

Kerala Soap Institute was complete. <sup>104</sup> This Institute continued to have a precarious existence with its operations sanctioned on a year to year basis. <sup>105</sup> The attitude was summed up by the Director of Industry's categorical assertion that there was little justification or necessity to pioneer the vegetable oil industry. <sup>106</sup> Until the depression in the late 1920s provided the next great impetus, there was no noticeable development in the chemical industry in Madras. <sup>107</sup> However, some kind of base had been laid on which further developments could later be expected.

## XI

### Conclusions

Although the distinctive trends in the behaviour of the groundnut and copra based economies have not delineated themselves fully by the end of the period under consideration, certain broad features are apparent. As Tables 1 and 2 show, the foreign exports of groundnut and groundnut oil would seem to have stabilised, although at levels distinct to the prewar period. However, both Tables 9 and 10 show that coconut oil exports had a tendency to decline, atleast as far as foreign exports are concerned.

This paper has attempted to show the factors underlying the two trajectories. The overseas groundnut oil market appeared to be one that was difficult to supplant. The interests of Indian suppliers, British exporters and the Government of India's fiscal requirements all militated against the replacement of groundnut export by groundnut oil exports to Europe (the bulk of

oil exports were to the plantation workers in Ceylon and Mauritius). The use of groundnut derived products in India faced the additional handicap of the low incomes of the bulk of the Indian people.

Coconut oil exports seem to have faced a different set of circumstances. Initially, the climate on the Malabar Coast which allowed oil pressing in a single cold pressing seems to have encouraged the development of a competitive oil pressing industry on the coast. However the two significant developments described in this paper, the experiments on coconut-oil based soap, and the establishment of the Tata Oil Mills Factory in princely Cochin were decisive in reorienting the destination of copra products. While Tatas had set themselves the task of breaking into the metropolitan Indian markets for coconut oil, the Kerala Soap Factory generated a demand for soap leading to a derived demand for coconut oil. What also seems to have been significant was the location of the Soap Factory on the Malabar Coast, and the concentration of technological experiments on the most easily available oilseed, copra.

It would seem, then, that a combination of the right natural environment, the presence of a firm backed by substantial Indian capital and the entrepreneurship exhibited by Frederick Nicholson and Kesava Menon led to the progress observed in the development of the copra based industry. Similar features were not present in the case of groundnut.

## Notes

All references to Government Orders (GO) are to records of the Madras Presidency held in the Tamil Nadu Archives, Madras.

1. See, for instance, S.A. Heinman Scientific and Industrial Revolution: Economic Aspects (Progress, Moscow: 1981). Surendra J. Patel is one of the most active writers in this field. See "Technology Strategy and Technology Policy and Research Management, Beijing, October 1983, reprinted in Mainstream November 12, 1983.
2. Govt. of India, Indian Munitions Handbook, 1919 (Delhi, 1919) p.60 Fredrick Nicholson, "Lecture on Soap" in The Book of the Madras Exhibition 1915-1916 (Govt. Press, Madras: 1916).
3. Season and Crop Reports for various years.
4. Government of India, Agricultural Marketing Advisor, Report on the Marketing of Groundnuts in India and Burma (Manager of Publications, Delhi: 1941).
5. A.K. Bagchi Private Investment in India 1900-1939 (University Press, Cambridge: 1972) pp 47-50.
6. B.V. Narayanaswamy Naidu and S. Hariharan Groundnut (Marketing and Other Allied Problems) (Annamalai University, 1941) p.89, p.93. Government of Madras Handbook of Commercial Information: Madras (Supd. Govt. Press, Madras: 1916).
7. In 1913-14, exports of groundnuts and groundnut oil accounted for 69% of the production of groundnuts in Madras. Government of India Handbook of Commercial Information for India 2nd Ed. (Supd. Govt. Printing, Calcutta: 1924) p.175. In that year oilseeds as a whole accounted for 17% of the total export trade of Madras Merchandise.
8. Report on the Marketing of Groundnuts in India and Burma.
9. In replying to the Government of India's dispatch no.51 of 26.11.1915, the Secretary of State's telegram relaxing the restriction is in Educ. GO 843 (confdl.) 5.8.1916. For the history of the Madras Government's earlier attempts, see A.K. Bagchi Op.cit., pp 50-51; S.P. Sen Studies in Economic Policy and Development in India (1848-1939) (Progressive Publishers, Calcutta: 1972) pp 84-87; and Padmini Swaminathan, "State Intervention in Industrial Development: A Case Study of Madras Presidency" Paper presented to the Seminar on South Indian Economy and Society c1914-c1945, Centre for Development Studies, Trivandrum, April 1988.
10. The formation of the Committee was based on a resolution of the Industrial Conference (number 47). See Rev. GO 203 26.1.1909 and Rev. GO 1404 20.5.1909. The Report of the Committee is in Rev. GO 3427 14.12.1909.

11. Letter number 294 of 30.11.1909 to the Revenue Secretary in Rev.GO 3488 18.12.1909.
12. Report of the Department of Fisheries for 1913-14 in Rev GO 2337 13.8.1914.
13. Educ. GO 480 27.5.1913
14. Rev. GO 3553 3.12.1913; Rev. GO 3755 20.12.1913.
15. Rev. GO 3111 30.10.1914; Rev. GO 190 20.1.1914.
16. Rev. GO 384 6.2.1914; Rev. GO 2666 15.9.1914.
17. Rev. GO 347 3.22.1914.
18. Rev. GO 2996 23.12.1916.
19. Rev.(Spec) GO 1676 18.9.1920.
20. Report on the Marketing of Groundnuts in India and Burma, p.134.
21. Ibid. pp. 127-28.
22. Ibid. p.126.
23. Cf. R.K.Ray "The bazaar: Changing Structural Characteristics of the Indigenous Section of the Indian Economy before and after the Great Depression" Indian Economic and Social History Review 25, 3 (1988) pp 310-316.
24. Educ. GO 522 16.1.1915.
25. Government of Madras, Department of Industries, Oil Pressing: Bulletin No.12 (Supd. Govt. Press c.1915).
26. Letter from Director of Industries 6.11.1914 in Educ. GO 52 16.1.1915.
27. Oil Pressing: Bulletin No.12
28. Anderson Expeller: Bulletin No.16
29. Rev.GO 3562 (confdl.) 5.12.1914; Educ. GO 385 10.4.1915; Educ. GO 642 14.6.1915; Educ. GO 13191 10.12.1915; Home (Educ) GO 255 24.2.1917.
30. Rev. GO 2802 26.9.1914; Rev. GO 931 26.3.1914; Educ. GO 255 8.3.1915.
31. Noting by H.Stuart, Member (Finance) of the Governor's Council on 21.11.1914 in Rev. GO 3468 30.11.1914.

32. Letter from Director of Industries 6.11.1914 in Educ. GO 52 16.1.1915.
33. Appendix A of the Madras Commercial Directory (fn.6) gives the duties levied in 1914.
34. Letter No.519 of 13.10.1914 to Rev. Secretary in Educ. GO 52 16.1.1915.
35. Noting by A.G.Cardew, Member (Revenue) on 7.12.1914 in Educ. GO 52 16.1.1915.
36. See Cardew's noting mentioned in fn.35. Also Stuart's response dated 21.12.1914 and Nicholson's letter No.30 of 20.12.1914 addressed to Cardew. Educ. GO 52 16.1.1915. See also Rev. GO 2159 21.9.1916 for the Government's view on the feasibility of developing the edible oil industry.
37. Educ. GO 158 13.2.1915.
38. Educ. GO 943 27.8.1915; Educ. GO 704 27.6.1916; Educ. GO 1137 30.10.1916.
39. Home (Educ.) GO 1334 11.12.1916; Home (Educ) GO 62 15.1.1917.
40. Home (Educ.) GO 187 16.2.1917; Home (Educ)GO 106 31.1.1918; Home (Educ.) GO 370 16.3.1917.
41. Letter from Director of Industries No. GC 307 25.10.1917 in Home (Educ.) GO 1468 19.11.1917.
42. Home (Educ.) GO 515 23.4.1917; Home (Educ) GO 789 14.6.1917; Noting by Education Secretary on 22.12.1915 in Educ. GO 37 10.1.1916.
43. Letter from Director of Industries K-107 of 4.1.1916. The Secretariat noting is dated 18.8.1916 in Home (Educ). GO 960 12.9.1916.
44. Home (Educ.) GO 320 8.3.1917; Home (Educ) GO 439 4.4.1917.
45. Home (Educ.) GO 1334 11.12.1916.
46. Home (Educ.) GO 255 24.2.1917.
47. Director of Industries letter No.90 24.6.1915 in Educ. GO 844 5.8.1915.
48. Rev. GO 292 22.1.1918; Petition by V.T Doraiswami Aiyer, groundnut dealer, in Educ GO 278 1.3.1915.
49. Madras Chamber of Commerce note in Educ. GO 385 10.4.1915.



50. Petition by V.T.Doraiswami Aiyer, groundnut dealer, see fn. 48.
51. Noting by Revenue Department in Educ GO 278 12.3.1915.
52. Review of the Sea borne trade of the Madras Presidency for 1902-03, 1907-08, 1908-09, 1909-10, 1911-12 and 1912-13.
53. This and the following paragraphs are based on Nicholson's important letter No.519 13.10.1914 in Educ. GO 52 16.1.1915.
54. Letter dated 6.11.1914 in GO mentioned above.
55. Home (Educ.) GO 255 24.2.1917.
56. Letter No.251-A 18.9.1922 in Dev. GO 1119 6.8.1923.
57. Letter from A.Subba Rao 12.6.1921 in Dev. GO 1744 30.11.1923.
58. Ibid
59. Letter from Tata Sons Ltd G 577 24.6.1919 in Rev. (Spec) GO 39 6.1.1920.
60. Letter from Director of Industries 20.4.1923 in Dev. GO 1744 30.11.1923.
61. Rev. GO 3562 (Confdl) 5.12.1914; Rev. GO 465 19.2.1915.
62. Noting by Cardew Revenue Member 7.12.1914 in Educ GO 52 16.1.1915.
63. Noting by Stuart, Finance Member, 21.12.1914.
64. Nicholson's letter to Cardew No. 30 20.12.1914.
65. In deferring, yet again, a decision on A.K. Menon's permanent appointment, the Government mentioned, as a reason, that it considered the development of the edible fats industry "problematical". Rev. GO 2159 21.9.1916.
66. Report of the Department of Fisheries 1914-15 Rev GO 1857 9.8.1915 Rev (Spec) GO 371 13.9.1918.
67. Nicholson's letter 8.2.1915; Secretariat note 17.2.1915 in Educ. GO 354 26.3.1915. See also noting by Cardew, Revenue Member, that the soap factory was a commercial enterprise 19.9.1916 in Rev GO 2159 21.9.1916.
68. Nicholson's letter 8.2.1915 in GO 354 26.3.1915.
69. Noting dated 18.3.1915 in the same GO.
70. Rev GO 752 26.3.1915.

71. Rev GO 735 5.7.1915 ; Rev GO 2241 5.10.1915.
72. Educ. GO 1393 10.12.1915.
73. Educ. GO 52 16.1.1915, p.21.
74. Educ. GO 843 (Confdl) 5.8.1916; The Report of the Department of Industries 1919-20 has a concise account of its fortunes. Rev (Spec) GO 4 3.1.1921.
75. Education Secretary's noting 22.12.1915; Secretariat noting 4.1.1916 both in Educ GO 37 10.1.1916; Rev GO 798 16.3.1917; Rev GO 2754 5.12.1916.
76. Report of the Department of Fisheries 1915-16 Rev GO 2764 5.12.1916.
77. Nicholson's letter No.132 29.3.1917; Director of Industries letter D.Dis 260 26.5.1917; Revenue Deputy Secretary's note 4.11.1917 in Home (Educ) GO 1468 19.11.1917.
78. Noting by Cardew, Revenue Member, 3.7.1917 in Home (Educ) GO 149 9.2.1918.
79. Letter GO 307 25.10.1917 in Home (Educ) GO 1468 19.11.1917; Home (Educ) GO 257 22.2.1918.
80. Rev GO 188 15.1.1918.
81. Rev GO 329 25.1.1918.
82. Rev GO 356 28.1.1918.
83. Rev GO 897 2.3.1918.
84. Rev GO 344 28.1.1918; Priority Committee guidelines are in Rev GO 2429 (Confdl) 8.8.1917.
85. Home (Educ) GO 766 12.6.1918.
86. Rev (Spec) GO 394 18.9.1918.
87. Rev GO 1420 16.4.1918.
88. Rev GO 3461 17.10.1918; Home (Educ) GO 949 17.7.1918.
89. Home (Educ) GO 743 8.6.1918; Rev (Spec) GO 464 1.10.1918. There was a debate in the Legislative Council on the Soap question on 22.11.1918 Rev (Spec) GO 1647 28.8.1919.
90. Home (Educ) GO 754 11.6.1918. The Question had arisen as early as 1915 Educ GO 1363 9.12.1915; See also Home (Educ) GO 439 20.4.1916.
91. Rev (Spec) GO 361 13.9.1918.

92. Educ GO 1052 4.10.1916; Rev (Spec) mGO 690 1.4.1920.
93. Legislative Council resolution in Rev (Spec) GO 1130 6.6.1919.
94. Rev (Spec) GO 686 11.4.1919.
95. Rev GO 1063 7.3.1920.
96. Rev (Spec) GO 848 1.5.1920.
97. As in fn 95
98. Rev (Spec) GO 41 8.1.1921.
99. Rev (Spec) GO 1604 4.9.1920.
100. Dev GO 1735 16.9.1921; Another questioner was referred to official statistics. Dev GO 1368 25.7.1921.
101. While two questions in the Legislative Council got routine answers, the Government actually abolished the post of Industrial Chemist. Rev GO 761 22.2.1918; Dev GO 1910 12.10.1921; Dev GO 857 2.5.1924.
102. Dev GO 1546 6.11.1922. This suggestion was based on his study tour in Europe. Dev GO 1827 28.9.1921 and Dev GO 131 26.1.1922.
103. Letter from Director of Industries No.251-A 18.9.1922 in Dev GO 1119 6.8.1923.
104. Report of the Department of Industries, Madras for the year ended 31.3.1921. (Madras, 1922).
105. A dreary picture is provided by the annual reports for succeeding years. Export markets in Singapore and Penang were explored but the chances were not favourable Dev GO 434 26.3.1925. There was also concern expressed in the Legislative Council on the Institute's financial performance. Dev GO 846 9.6.1925.
106. See reference in fn.103.
107. See references in fn. 101. An attempt by the Deputy Director of Industries to get travelling allowance so that he could visit advanced centres of vegetable oil extraction while on home leave failed because the Government took so long to respond that his leave had expired. Dev GO 1148 31.8.1922.