THE USES OF COTTON SEED*

MUCH has been written in recent years about the close connection between the price of cotton and the tendency of the growers throughout the world, especially in America, to reduce or increase the area under cotton according to the actual cash return they receive for the crop. In such calculations, however, it must be remembered that the price received for the cotton seed is also a factor in the economic yield of the crop, and sometimes a more important factor than is generally realized. In America a waggon load of 1,500 lb. of seed cotton produces approximately a 500-lb. bale of cotton lint and 1,000 lb. of cotton seed, but it will be seen from the following table that the proportions of the total cash return to the planter which come from the lint and the seed respectively have, to take only recent years, varied very greatly.

TABLE I

ESTIMATED PRICES RECEIVED BY GROWERS FOR COTTON LINT AND SEED

	Prices		Total Prices Received. (Based on a yield of 200 lb. of lint per acre and 400 lb. of seed)			
	Cotton (Cts. per lb.)	Seed ($ per ton)	Cotton ($)	Seed ($)	Total ($)	Seed per cent. of total
May 15, 1930 ..	14·5	30·61	29·00	6·12	35·12	17·4
Do 1931 ..	8·8	22·32	17·60	4·46	22·06	20·2
Do 1932 ..	5·2	9·66	10·40	1·93	12·33	15·7
Do 1933 ..	8·2	12·00	16·40	2·40	18·80	12·8
Do 1934 ..	11·0	22·23	22·00	4·45	26·45	16·8
Do 1935 ..	12·0	39·36	24·00	7·87	31·87	24·7

Thus in the 1934-35 season the drought in America produced a great shortage, not only in the cotton crop, but also in the supply of hogs (depending on the corn crop, which suffered even worse than cotton) and therefore of lard as well as in other vegetable oil seeds, with the result that the price of cotton seed shot up to levels that have not been seen for many years.

The reason why the prices of cotton and cotton seed move almost entirely independently of each other lies in the fact that the uses of cotton seed bring it into a world market in which cotton seed plays a relatively small part, and its price therefore affected largely by the supply of all the other commodities

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which enter into that market. It should therefore be of interest to cotton growers to have some idea of what these other commodities are and how they compete with cotton seed.

The development of the cottonseed trade, with the extraordinary variety of uses to which is now put, is one of the romances of modern industry. At first the seed was regarded in many countries almost as a nuisance which cost money to get rid of, unless it could be used as manure or sometimes as fuel. Before the War it had become one of the stock illustrations of the utilization of by-products ; now it is an industry in itself, with a turnover worth probably £50,000,000* per annum, and its products are the raw material of a hundred trades, from cattle-rearing to soap-making, edible oils and artificial silk.

The general outline of the processes of manufacture must first be described. Its nature depends in the first place on the character of the seed. American Upland seed and other similar varieties are what are known as " white " or " fuzzy," owing to the short lint or fuzz which with the whole seed is coated, and which is not removed by the process of ginning. Egyptian and Sea Island seeds, on the other hand, are "black" or "clean" seeds, having no short lint or fuzz except occasionally a small tuft of short green lint on the pointed end of the seed. In America, therefore, it has always been customary to put the seed through what practically amounts to a second ginning process called " delinting " and the short lint thus obtained is what is known as " linters." These used to be regarded as of comparatively small commercial value, being fit only for such purposes as gun-cotton or blotting-paper, or for mixing with waste cotton in spinning low-count yarns ; but they constitute quite a considerable proportion of the American crop—say 1,000,000 bales—and it is a curious fact that the amount of linters crop does not vary in proportion to the lint crop. On the average of the last ten years, however, the linters crop was about 7½ per cent. of the whole crop. A similar process has for many years been applied to Indian cotton seed or Bombay seed, as it is generally called in European markets, as well as to Chinese, Russian, Brazilian and African cotton seed. Even after delinting, however, the greater part of the short fuzz still remains on the seed. Since the War an important new use for linters has been as the raw material of artificial silk, though this use has not yet been fully developed in England owing to the high cost of securing the necessary cleanliness or cellulose purity of the product. The best linters are now worth rather more than half the price of American Middling cotton, but lower grades go to much lower prices.

The next process in the case of American seed is decortication, which consists practically of cutting or cracking the seed so as to separate the kernel from the husk, with the fuzz which still adheres to it. In Egypt and in Europe (except where seeds of the Americantype are handled) the whole seed is crushed without separating husk and kernel, and Bombay seed is treated in the same way as Egyptian. In China, where cottonseed crushing began only about

*The world's cotton crops now amount to about 25 million bales of 500 lb. Every bale of cotton lint represents roughly 1,000 lb. of seed, so that the total cottonseed crop must be about 12 million tons, with an average value of, say, £4 per ton. The value of the finished products is of course much larger.

1910, the American methods are followed, and the same applies generally to the Russian crop, most of which is now of the American type of seed.

The meal or crushed kernel, or the whole seed crushed, as the case may be, is then heated by steam in an enormous kettle, after which it is put into bags or wrapped in clothes in an oblong shape ; it is then pressed in hydraulic presses of great power, thus extracting the oil and at the same time giving to the remainder the peculiar form in which it is so well known as cake for cattle-feeding purposes. There is now an alternative method, known as the Expeller process, of extracting the oil from the crushed seed by forcing it through a tapered cylinder by the action of a heavy rotating screw. In this machine the residue or cake is thrown out in a broken condition, and is known as expeller cake.

The crude oil from the presses is refined by various processes, chiefly based on the use of caustic soda, and is used either as edible oil or for soap-making, according to its quality. In the case of Egyptian oils made from undecorticated seed, a small quantity of dark resinous matter exudes from the husk in the crushing process, which darkens the colour of the oil and gives it a peculiar flavour. To remedy this it is necessary to use stronger chemicals in refining the oil, but until the discovery of the deodorization process about 1910 it was never possible to eliminate the peculiar flavour entirely, and this seriously handicapped the use of these oils for edible purposes.

The black grease or refuse of the oil-refining process goes through various further processes, by which still other by-products, such as glycerine and white candle grease, are taken from it. The residue is at last reduced to the consistency of pitch, and in this form it is spread upon brown paper with a thin layer of coarse cotton fibre on its surface, thus forming the familiar, waterproofed wrapping paper in which many forms of textile and other goods are packed, especially for export. This pitch is now also used for insulating covered electric wires. There is also another refining process by which a cheap form of soap (useful for textile purposes) is produced directly.

In view of the predominance of the American crop in the world's cotton supply, American cottonseed still supplies the bulk of the cottonseed oil trade. It is chiefly manufactured in the United States, and is largely consumed in that country, as well as being exported to all parts of the world in normal seasons. A considerable quantity of cottonseed meal is also exported, but the cake is mostly consumed in the United States. The Egyptian crop is partly crushed in Egypt, though the greater proportion of it is exported in the form of seed to European ports. Some of the Bombay crop is also exported chiefly to the United Kingdom. France and Germany used to take a considerable share of the Egyptian crop, but since the War England has taken the lion's share, and since 1931 the Continent's share has been very small.

The English cottonseed industry is centred in Hull, Liverpool and London, with a considerable trade also in Glasgow, Leith and Bristol. It used to be confined practically to Egyptian and Bombay seed, Egyptian being more than half of the total, but in recent years increasing quantities of Empire seed from East and West Africa and also of Brazilian white seed have been coming to the United Kingdom. Egyptian black seed, however, still forms the bulk of the U.K. trade. The finished products must, of course, face the competition of those of the American industry.

In discussing the relative value of different oil seeds it is necessary to keep in view the two main products of the seed—namely, oil and cake. Thus, as regards the quality of the oil produced, the American method was superior for the production of high-class oils ; the removal of the husk or shell by decortication and the use of the crushed kernels alone for the production of oil produced a finer quality of oil than could be obtained by crushing the whole seed. Accordingly, the standard grade of American sweet oil, known as " Prime Summer Yellow," used to represent the highest quality among the world's cottonseed oils, while the Egyptian came next and Bombay last. The application of the American method of decortication to other varieties of white seed in England has, however, produced oils quite equal to the American.

The market for cottonseed oil is highly complex or composite, alike from the side of supply and of demand. Cottonseed oil enters into two formerly distinct markets which may be generalized as edible oils and soap fats, and in each of these fields it had competitors innumerable. Thus, as edible oil, it had to find its place in a long list containing all the animal fats, lard and even butter itself, as well as all the other edible vegetable oils, especially olive oil. In this branch of the market American cottonseed oil, until before the War, stood almost alone. Egyptian oil, owing to the peculiar flavour above referred to, was so far behind the American as to be hardly a competitor at all, while Bombay cottonseed oil was not regarded as possible for edible purposes. Bombay oil, along with a number of other vegetable oils such as those obtained from linseed, maize, soya beans, rubber seed, copra, coconut, palm oil, sunflower and many others, the very names of which are hardly known to the average layman, had their places at various points in the supply of vegetable oils ; they were mainly used in the soap and candle trades and other manufactures, where also until then Egyptian cottonseed oil found its chief demand. In this trade the vegetable oils had to compete with tallow, whale oil, and other low-grade animal fats, the better qualities of which came into the more profitable market for edible products. Linseed oil had, of course, its own special market for paint mixing, and in this it had practically no competitor, though latterly soya bean oil had been tried for this purpose with some success. Mineral oils such as petroleum are, of course, an entirely separate branch of the oil trade.

Conditions, however, have altered very materially since about 1910 in all trades into which cottonseed oil enters, and the relative position of the different products has been entirely changed. It is impossible to enter into these changes here in detail, but on the whole they have been in the direction of improved methods of dealing with what were formerly the lower-grade oils from the edible point of view, such as Egyptian and Bombay. In 1910, owing to the failure of the usual supply of edible oils and fats, such as olive oil, American cotton seed and American hog lard, a great deal of attention was devoted to discovering improved methods of handling these crops, especially the Egyptian, so as to improve the quality of the product from the edible point of view. It must be remembered that the chief use of oil for culinary purposes in England is not as oil—butter, the most expensive form of animal fat, has always taken in England the place filled by oil in Europe—but in some

composite or made-up form, such as lard, margarine, etc. Until 1910 the makers of these goods preferred either animal fats or the finer American sweet oil. But in 1909 there was an extraordinary combination of disastrous shortages in almost every branch of the supply of edible oils and fats, with the result that the consumers were forced to turn their attention to other sources of supply, and particularly to Egyptian oil. The result was a marked change in the position of cottonseed oil in the English markets. It was no longer merely a soap fat, but also an edible oil (as it had always been in Egypt) and therefore able to command a higher price, which was still further augmented by the general high level of prices of all edible oils. In 1911, however, the enormous American crop entirely reversed the conditions, and the value of Egyptian oil returned to something like its former relative position, while the lower price of American oil again made it available for soap-making.

In the same way, but to a more marked degree, Bombay oil had before the War been looked upon in England as quite impossible for edible purposes, but in modern industry it is not safe to say that anything is impossible, and by about 1910 oil refiners had succeeded in producing quite satisfactory edible oils from Bombay seed.

Many other oils have passed through a similar phase. Thus, copra and palmkernel oil were found adaptable (under pressure of unusual demand) for certain edible purposes, especially margarine, and even soya bean oil, which at first was classed as only fit for soap-making, soon proved a useful substitute for linseed oil, and was then, by still further refining, made into good salad oil.

Again, about 1912 a new process of deodorizing oils produced almost a revolution in the supply both of soap fats and edible oils. This process, first introduced in America, consisted in blowing super-heated steam through the oil, thus removing all objectionable flavours and making it possible to extend enormously the possible sources of supply of edible oil.

Again, a new hardening process was still more of a revolution. The original patent was taken out early in the century, but it was not until about 1911 that it became possible to apply the new method commercially. Broadly, the whole group of oils or fats used to be divided into two sections—soft or liquid oils, and hard or solid oils. Linseed, cotton, rape, whale oil, etc., belonged to the first group ; coconut and palm oil, etc., to the second group. There was formerly a difference of nearly £10 per ton between the soft oils and the hard oils in favour of the latter, owing to the fact that a certain proportion of hard oil had to be used in the manufacture of margarine and soap in order to produce a firm product. The new invention was based on the discovery that by the removal of certain constituents soft oils could be converted into a hard stearine. Thus, linseed oil, whale oil and cottonseed oil, when treated by this new process, became harder and more solid than even tallow. The cost of the process is now about £5 per ton. The result was to draw the two groups closer together in value, because of the readiness with which the one could now be substituted for the other. The effect of such a revolution as this was not to increase the available quantity of fats and oils for the world's consumption, but rather to change the course of markets from one industry

to another. As far as cottonseed oil is concerned, the result was that the whole output became available for edible purposes in the form of hard fat, but a further supply of that or some other material was needed to meet the requirements of the soap trade.

Another important development in the last ten years is the large increase in the world's production of whale oil, which in one year (1931) reached the enormous total of 3,689,631 barrels (of which six go to a ton) as gainst about 750,000 barrels before the War. This was, of course, entirely excluded from use as edible oil until the development of the new processes above referred to, but these have completely altered its position. The fact is that the distinctions between edible oils and soap fats and between soft oils and hard fats now hardly exist, and almost any oil or fat can be made available for almost any purpose.

Table II. summarizes the world's production of the various oils, animal and vegetable, and indicates the relative importance of each source.

TABLE II

WORLD'S PRODUCTION OF VEGETABLE OILS AND FATS

(From Messrs Frank Fehr and Company's Annual Review)

	1929	1930	1931	1932	1933	1934
	Tons	Tons	Tons	Tons	Tons	Tons
Olive Oil ..	1,007,000	500,000	739,000	810,000	751,000	813,000
Coconut Oil ..	925,561	827,749	757,744	696,035	793,650	805,169
Cottonseed Oil	802,466	767,320	775,242	822,643	767,638	748,257
Groundnut Oil	698,802	697,888	708,339	480,134	576,860	601,004
Linseed Oil ..	686,719	570,805	629,885	628,083	533,793	492,271
Soya Oil	365,924	320,519	327,556	370,131	344,252	350,888
Sunflower Oil ..	250,957	301,419	303,228	255,400	279,962	230,117
Palm Oil ..	230,933	273,746	252,204	272,290	330,949	348,000
Palmkernel Oil	211,638	211,229	190,645	228,296	185,682	203,560
Castor Oil ..	65,076	54,320	54,352	45,591	51,206	47,407
Wood Oil ..	63,000	70,000	50,000	47,220	72,611	65,000
Rapeseed Oil ..	52,395	34,872	31,923	49,265	34,287	22,445
Sesame Oil ..	40,188	46,800	27,224	21,020	21,976	16,517
Margarine* ..	1,312,500	1,148,000	1,087,658	1,010,567	910,138	893,366
Butter ..	1,291,887	1,315,000	1,761,000	1,518,950	1,615,062	1,583,300
Lard ..	799,730	689,805	693,758	702,437	792,230	681,875
Tallow ..	290,965	284,452	321,629	315,284	362,011	332,032
	7,783,241	6,965,924	7,668,729	7,262,779	7,513,169	7,340,842
Whale Oil ..	310,312	466,755	615,700	149,458	425,067	413,058

*Not included in total as it is the product of other oils.

A word may be added as to the relative values of other varieties of cotton seed, especially Empire, compared with American. It is difficult to get comparable figures because no quotations are available in England of American cotton seed ; but against the recent price of about $40 per ton in America the following quotations of different varieties in this country may be noted : Egyptian (black) about £6 5*s*. per ton and " White sorts " about £4 to £4 5*s*. But the real difficulty is in comparing the prices actually received by the growers, for this involves not merely the prices of the different kinds of seed when they reach a world market, but the cost of getting the seed from the grower to that market, and of course, with a commodity like cotton seed, of which the bulk is very great in proportion to its value, this cost is extremely high. In Uganda, for example, cotton seed was almost unsaleable in 1933-34 because the cost of the long railway haul to the port and thence by sea to England was almost more than the very low price which such seed was fetching in England at that time. In 1934-35, however, owing to the scarcity above referred to and the better prices obtainable for all classes of seed, the growers were able to secure a price of about 25*s*. per ton. That, of course, compares very badly with the $40 paid to the grower in America, but the difference is largely due to the fact that in the American Cotton Belt the market for the seed is at the growers' very door, for seed-crushing plants are scattered all over the Belt. The difficulties of setting up similar plants in the comparatively small areas of the Empire cotton fields are almost insuperable.