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Cottonseed Products Industry

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The Cottonseed Products Industry

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The genesis of cotton has never been definitely determined, although the plant is believed to have originated in India and spread thence into other countries. Its presence in the western hemisphere antedates the discovery of America, since Columbus found it growing wild in the West Indies. The plant thrives only in warm climates, and approximately 90 per cent. of the world's cotton crop is produced in the southern part of the United States, India, Egypt and China.

Present interest in the cotton plant is confined to its function of bearing a valuable seed. Wherever the plant is cultivated seed is produced, and from the seed valuable commodities are now obtained, which may be classified under the general term of cottonseed products.

The histories of cotton and cottonseed products are entirely separate. The use of cotton fiber for cloth, etc., has been known for centuries, while the use of the seed and its products is of comparatively recent date. Fifty years ago, the seed was considered a nuisance and its disposal was a problem. It was either burned, dumped into rivers or piled up to rot. Laws were passed to prevent contamination of streams by it and to prevent its consumption by cattle, as it was considered injurious to them. All this has been changed and what was once thought to be an obnoxious waste product is now the raw material for a great industry. Through scientific investigation and improved machinery, a long list of byproducts is now obtained from the once despised cottonseed.

In 1799 the United States government issued a patent on a mechanical device, for extracting oil from cottonseed, to Charles Whiting of Massachusetts. The first cottonseed-oil mills in the United States were established about one hundred years ago. The commercial importance of the industry began about 1850, and in 1880 there were approximately forty-five mills in operation in the United States, as against 545 mills in 1929. That the industry has grown by leaps and bounds since that date may be seen by the following statistics:

Crop year	Cottonseed produced (M tons)	Cottonseed crushed (M tons)	Percentage of crush to production	Value of products obtained
1880	2,616	235	% 9	$ 5,640,000
1890	3,495	874	25	16,400,000
1900	4,668	2,479	53	42,410,000
1910	4,462	3,269	73	105,720,000
1920	5,074	4,013	79	352,138,000
1925	6,051	4,605	76	240,855,000
1929	6,435	5,061	79	265,247,000

It will be noted that while the cottonseed produced in 1929 was about 2½ times as much as in 1880, yet the amount crushed in 1929 was more than 20 times as much as in 1880. The percentage of the crop crushed, increased from 9 per cent. in 1880 to 79 per cent. in 1929.

Cottonseed-oil mills usually run the full twenty-four hours, and the capacity of a mill is stated at the number of tons of seed which can be manufactured in a day of twenty-four hours. In the United States there were 545 cottonseed-oil mills operated during the season of 1928–29, whose operations are classified, according to the quantity of seed crushed, in the following table:

Crushing less than 1,000 tons	18 mills
Crushing 1,000 but less than 2,000 tons	36 "
" 2,000 " " " 5,000 "	136 "
" 5,000 " " " 10,000 "	172 "
" 10,000 " " " 20,000 "	137 "
" 20,000 tons and over	46 "
Total	545

Recognizing the need of a united effort to promote the industry, oil-mill operators in the United States met in Nashville in July, 1897, and organized the Interstate Cottonseed Crushers Association. In July, 1929, the charter was amended and the name of the association was changed to National Cottonseed Products Association, Inc. The object, in general, of the association is to promote the industry by securing coöperation among the manufacturers, growers, producers and distributors of cottonseed and its products, by developing domestic and foreign trade, and by informing the public as to the economic value of the industry. The association now has about 700 members. It has adopted uniform trading rules, and cottonseed and its products are now

usually bought and sold on a basis of scientific standardized grades.

Volumes could be written regarding the different industries engaged in the further development of the various products obtained from cottonseed—the raw material. However, the comments here will be restricted to the products obtained through the operation of what are known as crude-oil mills. The various operations of refining and further manufacture of these products into the thousands of articles of merchandise will not be discussed.

The first step in obtaining the seed is its separation from the seed cotton. This was done by hand prior to the invention of the cotton gin by Eli Whitney in 1794. The seed cotton, as it is called before the separation of the lint from the seed, yields by weight about one third cotton and two thirds seed. After being ginned, the seed is placed in storage until ready for use by the oil mills. One of the most difficult problems in the cottonseed products industry is the proper storing and preservation of the seed. In wet seasons the damage is enormous, as the products from damaged seed are of inferior quality and their value decreases accordingly. Since the quality of the seed affects the quality and percentage yield of its products, it is essential that the seed be graded.

After several years of intensive research and study, the United States department of agriculture has recently developed a scientific system for sampling, analyzing and grading cottonseed with a certain standard of quality as "basis." Buyers now base their quotations for seed on "basis cottonseed," paying a premium for quality seed containing combined quantities of oil and protein (meal) above the basis standard, and discounting off-quality seed which is below the basis standard.

Quotations for cottonseed are made on basis cottonseed f.o.b. shipping point and purchases are settled on an index relation to such basis cottonseed. The index relation of basis cottonseed is determined in the following manner:

The seed is analyzed for its content of oil, ammonia, tare, and free fatty acids. To the pounds of oil, as indicated by such analysis, is added a figure found by dividing the indicated pounds of 8 per cent. ammonia (41.13% protein) cake by 5. The sum of these two is known as the reciprocal for basis cottonseed or index 100.

The index for seed, other than as in the basis analysis, is determined by dividing its reciprocal by 555, which is the reciprocal of basis cottonseed.

The standard analysis adopted as basis is as follows:

Oil	%19.00
Ammonia	% 3.50
Free fatty acids	% 1.80
Foreign matter	% 1.00

Based on the above standard a ton of seed will contain oil and ammonia as follows:

2,000 lbs. seed @ 19% = 380 lbs. oil
2,000 lbs. seed @ 3½% = 70 lbs. ammonia

An ammonia content of 70 pounds makes what is known as 8 per cent. cake containing 41.13 per cent. protein; therefore, if 8 per cent. cake requires 70 pounds, 100 per cent. cake would require 875 pounds. The ratio in value between cake and oil fluctuates, but a basic ratio of 5 has been agreed upon, i.e., 5 pounds of cake is the equal in value of 1 pound of oil. Therefore 875 pounds of cake would be the equal in value of 175 pounds of oil.

The reciprocal of basis cottonseed is 555 for seed containing 19 per cent. or more of oil content, and any lot of such seed whose reciprocal is 555 is basis cottonseed. This reciprocal, based on the above explanation is determined as follows:

Oil content	380
8% cake content	175
Total	555 = cake—oil reciprocal as par or index 100

As already stated the reciprocal of 555 is for seed containing 19 per cent. of oil. Whenever the seed contains less than 17 per cent. of oil a new basis reciprocal is used, which is determined on the following formula:

Subtract the percentage of oil from 19%. Multiply the result by 2.
From this result subtract 5 times the ammonia in excess of 3.75%.
The remainder represents the percentage by which the basis reciprocal of 555 is to be increased.
The result is the basis reciprocal for seed with less than 17% of oil.

The grade value per ton of any seed which has, upon analysis, a cake-oil reciprocal other than par of 555 is determined by multi-

plying the basis price by its price index. This index is computed by the following formula in which the several terms are indicated by letters:

a = reciprocal of the seed analyzed
b = reciprocal used as basis
c = quantitative index
d = qualitative index
e = free fatty acids of seed analyzed
f = free fatty acid tolerance
g = free fatty acid excess over tolerance
h = discount percentage
i = price index
j = basis price per ton
k = grade value per ton

Formula:

$\frac{a}{b} = c$ or quantitative index
$e - f = g$: $g \times 5 = h$: $100\% - h = d$ or qualitative index
$c \times d = i$ or price index
$j \times i = k$ or grade value

The following illustration shows the application of the formula to off-quality seed at $25.00 a ton basis price, which was found to have a grade value of $14.56 a ton or a discount $10.44 a ton:

Illustration of formula

Analysis:	
Total oil	16.70%
Total ammonia	3.89%
Free fatty acids	9.10%
Foreign matter	8.50%
Moisture	12.10%
(*a*) Reciprocal of above analysis:	
Total oil content	334.00
Total 8% cake content	194.50
Cake = oil reciprocal	528.50
(*b*) Reciprocal used as basis:	
Oil content as standard	19.00%
Oil content as above	16.70
Difference	2.30
Difference multiplied by 2	4.60
Deduct:	
5 times ammonia in excess of 3.75 (3.89—3.75×5)	.70
Percentage of increase	3.90%

555 + (555 × 3.9%) = 576.64 for basis reciprocal

(*c*) Quantitative index:		
528.50 ÷ 576.64 =		91.70%
(*d*) Qualitative index:		
(*e*) Free fatty acids	9.10%	
(*f*) Free acid tolerance	1.80%	
(*g*) Excess over tolerance	7.30%	
(*h*) Discount = 7.30% × 5	36.50%	
100% — 36.50% =		63.50%
(*i*) Price index:		
91.7% × 63.5% =		58.23%
(*j*) Basis price per ton		$25.00
(*k*) Grade value:		
$25.00 × 58.23% =		$14.56

When cottonseed is delivered on a basis contract, the excess of foreign matter over 1 per cent. is deducted to determine the weight of the clean seed. In the foregoing analysis, this excess is 7.5 per cent. The clean seed weight of a 40,000 pound delivery of such seed would be determined as follows:

	Pounds
Total weight of shipment delivered	40,000
Deduct:	
Excess foreign matter—40,000 @ 7.5%	3,000
Weight of clean seed	37,000

The buyer would settle for 37,000 pounds of seed at $14.56 a ton, less transportation charges on the 3,000 pounds of excess foreign matter.

While the application of the formula for grading cottonseed may seem rather intricate and cumbersome, its application has been simplified by the compilations of calculators. Published market quotations and reports of sales are now made on basis cottonseed. The analysis of samples, with their various indexes, classified by states, districts and counties are also published in market sections of newspapers.

The various steps in the manufacture of the raw material—cottonseed, into cottonseed products are as follows:

1—Cleaning and preparing the seed
2—Hulling or decortication
3—Separating the meats from the hulls
4—Crushing the meats
5—Cooking the meats
6—Extracting the oil

The seed is cleaned first by being run through a boll reel. The refuse from this cleaning is technically known as grabbots, flues (or cyclones) and motes (or tailings), which may be run through a grabbot gin to obtain the cotton on the immature bolls. Sand screens, blowers and magnetized steel plates remove all remaining foreign matter. The seed is covered with a fuzz or lint, which is the remnant of the fiber not completely removed by the gin. This lint is removed by means of saws and brushes in the linter machine through which the seed is run for further cleaning. The lint, when removed, is called "linters" and is a marketable product.

The next step is the separation of the hull from the kernel or meat of the seed. This is accomplished by running the cleaned seed through a huller which cracks the hulls between revolving knives and bars. Seed that is mature and dry is easily hulled, but when the seed is immature, damp or soft, the hull mashes, making it difficult to separate the hull from the meat. The mass discharged from the huller is a mixture of the meats and hulls separated and meats with the hull adhering, together with the thin membrane between the meat and the hull.

The meats are separated from the hulls by running the mass of chopped seed, meats and hulls through a separator, which contains a cylindrical screen through which the meats fall, as it revolves. The hulls are conveyed to the hull house and the meats to an oscillating screen for further separation.

The by-product obtained from this step in the manufacture of cottonseed products is the hulls, which are used chiefly for cattle feed and fertilizer.

The meats are composed of tiny cells filled with oil, which must be crushed or ruptured in order to obtain the oil. This is accomplished by running the meats through a crusher consisting of several pairs of heavy rollers. The meats are fed into the crusher and pass between pairs of rolls, emerging in thin flakes with every oil cell crushed. Crushing is one of the important steps leading up to the extraction of the oil. When the meats are uniformly well crushed and soft, the cooking is more thorough, and the oil is separated easier and in larger quantities. Improper crushing means a reduced yield and an inferior quality of oil.

The most modern machinery and methods used in crushing do not enable the mills to make a 100 per cent. extraction of the oil content of the seed, as indicated by the chemist's analysis. A

certain percentage of the oil always remains in the meal and some oil and meal remain in the hulls. Therefore, in crushing a ton of basis cottonseed the mill actually recovers less than the standard of 380 pounds of oil and 875 pounds of 8 per cent. meal.

In order that the maximum yield of oil be obtained it is necessary to cook the meats. The heat expands the oil, makes it more fluid, expels excessive moisture and coagulates the albumen. This is done in steam-jacketed heaters with two or more in a series. The meats are cooked from 15 to 45 minutes, depending upon their condition, at a temperature of about 230 degrees. This is another very important operation, for if cooked too rapidly the oil is dark and if cooked too much the cake is brittle. The right temperature and speed must be maintained for the proper length of time to produce the best results. The meats are formed by the machinery into cakes of uniform size and density, each wrapped with press cloth, ready for extracting the oil.

There are three methods of extracting the oil from the cooked meats: by solvents, by hydraulic pressure and by compression.

Solvent extraction is accomplished by dissolving the oil which is carried away by the solvent. It is the most efficient method for extracting all the oil, but not desirable, as the flavor of the oil is effected by the solvent and the cake does not contain sufficient oil to make good feed.

Hydraulic pressure extraction is most commonly used and is accomplished by means of powerful hydraulic presses. The pressure is applied gradually, until a maximum of about 4,500 pounds per square inch is exerted. The capacity of a press is governed by the number of fills per hour—usually three or four. After being allowed to drain a few minutes, the dry meats, known as cottonseed cake, are removed.

Compression extraction is accomplished by the same method as hydraulic extraction, except that the meats, instead of being separated in cakes, are pressed in one mass and afterward ground up into cottonseed meal. Both the cake and the meal are used for cattle feed and for fertilizer.

The press cloth used for enclosing the cooked meats is made of coarse hair. This has been found to be the most desirable material, as it allows free passage of the oil, with little sediment. The life of press cloth is determined by the quality of the seed, the efficiency of the cooking and the care used in applying the pressure, which if applied too quickly will burst the cloth.

The crude oil, as it flows from the press, is a thick fluid of varying color, ranging from reddish-brown to black and contains more or less moisture, meal, lint and other impurities. It should be filtered or refined to prevent its spoiling and to improve the quality. The oil, as recovered, is piped into storage tanks where it is ready for the market under the name of crude cottonseed oil.

Cottonseed oil mills engaged solely in the manufacture of crude oil obtain from the raw material, (cottonseed), the following cottonseed products and by-products, stated in the order of their value and the approximate yield per ton of seed crushed:

	Pounds
Crude oil	311
Cake and meal	901
Linters	110
Hulls	565
Grabbots, flues, motes, dirt and crushing loss	113
Total	2,000

This yield is the average in the United States for the years 1927, 1928 and 1929 as compiled by the United States department of commerce. Yields vary according to localities, climatic conditions, the quality of the seed, efficiency of the mills, etc. In addition to the range in quantities, there is also quite a range in the qualities of the various products. These ranges are designated by the grades under which they are marketed.

The crude oil, as it flows from the press, is dark in color and contaminated with moisture, albuminous matter and meal, in solution and in suspension. The removal of this matter constitutes the work of refining. The percentage of free fatty acids is an index to the approximate refining loss, but is not an index to the quality. The value is determined by the proportion of refined oil which is produced.

Crude oil is divided into three general grades, viz., prime, choice and off, described briefly as follows:

Prime—must be sweet in flavor and odor, free from water and settlings and must produce a prime summer yellow grade of refined oil with a refining loss of not more than 9% in weight.

Choice—must be sweet in flavor and odor, free from water and settlings and test not over 1% free fatty acids, must refine choice summer yellow with a refining loss of not over 7%.

Off—all oil neither prime nor choice.

The crude oil is sold to refiners who convert it into refined oil. For contract purposes it may be sold in tank cars or in barrels. A barrel of oil weighs 400 pounds net and a gallon weighs 7½ pounds.

Crude oil is refined by removing all impurities, free fatty acids, moisture, etc., and is accomplished by heat, caustic soda and other solvents. The refined oils are divided into three general classes, viz., prime, choice and off. These are further divided into summer and winter oils and also into yellow and white. The three general classes may be described briefly as follows:

Choice—must be clear, of sweet odor and flavor, free from water and settlings, brilliant in appearance and contain not more than ⅛ of 1% free fatty acids.

Prime—must be clear, of sweet odor and flavor, free from water and settlings and must be the required color, and contain not more than ¼ of 1% free fatty acids.

Off—must be off in odor, flavor and color, and free from moisture and settlings.

The different grades of summer oils produce corresponding grades of winter oils. The chief difference is that winter oils must be limpid at a temperature of 32 degrees Fahrenheit, and that the solids are separated at reduced temperatures.

The white oils are produced from the yellow oils by bleaching and are used chiefly in the manufacture of lard compound. The refined oils are used in the manufacture of salad and cooking oils, glycerine, vegetable lard, for preserving olives, sardines, fruits, vegetables, etc., while the fats and solids obtained by refining are used principally in the manufacture of soap, soap powder, etc.

Cottonseed cake is the residue of ground meats left in the presses after the oil has been extracted. It is removed from the press in cake form, each cake weighing about 15 pounds and measuring approximately 32 inches long, 13 inches wide and 2 inches thick. The press cloth, with which it was wrapped while in the press, is removed by machinery and stored for future use. The ends of the cake are soft and contain a large percentage of oil. This is recovered by passing the cakes through a trimmer and the portion so removed is worked over again. The cake is graded and classed as choice, prime or off according to color, odor, taste, texture and freedom from hulls and lint. It is used principally for cattle feed, as it may be fed with less trouble and expense than the meal.

Cottonseed meal is produced by grinding the cakes in a cake-mill, to any degree of fineness desired. A domestic ton is 2,000 pounds, an export ton is 2,240 pounds and a sack is 100 pounds, net weight.

Cottonseed meal is a very rich concentrated stock food, as it contains more protein, per pound, than any other food. It is also rich in ammonia, phosphoric acid and potash and, for that reason is much used as fertilizer. It is classed and graded as choice, prime and off. Market quotations are also for 41 per cent. and 43 per cent. meal, according to the protein content.

The short fiber or lint, cut from the seed by the linter machine, as described in a previous paragraph, is called linters. The amount of linters recovered depends somewhat upon their market value as it sometimes costs more to recover them than they are worth. However, a certain amount must be removed from the seed, to prevent the oil from being absorbed by the lint, during its extraction.

The usual grades are the private type names used by the various linter dealers. Market quotations usually specify three grades, valued in their order, as first cut, mill run and second cut, representative of their order of passing through the linter machine.

When the seed is passed through the machine once, the linters obtained are called mill run and contain a combination of both long and short fiber. When they are run through the machine twice, the first run produces first cut linters of long fiber and the second run produces second cut linters of short fiber. A bale of linters weighs 600 pounds.

While government grades of American cotton linters have been established by the United States board of cotton linters examiners, they are seldom used, principally because of the wide range of the grades. There are 169 different established grades, which only an expert grader could classify correctly. Government standardized grades are based on two factors of value, viz., fiber and character. The variations of fiber, from the highest first cut, to the lowest second cut, have been graduated and divided into standard groups, called grades, of which there are seven, designated as grade 1, grade 2, etc. Each of these grades is further subdivided by three character grades, standardized as southeastern, valley and western, to designate the characteristics peculiar to the section where grown. Four further subdivisions are used to denote the range of variation, viz., high, low, short

and broad, while two more are used to denote the limit of variation, viz., plus and minus. An additional grade, designated as "mixed packed" is used to show a variation of fiber greater than the range of any two adjacent grades. The basic color of linters is indicated by the terms, olive and buff, and the depth of color, by the same terms used to describe the grade.

Linters are no doubt used in more manufactured articles than any other cottonseed product and new uses are being discovered constantly. Among others in the list are artificial fabric, bakelite, batting, cellophane, celluloid, felt, films, lacquers, paper, rayon, yarns and the very important one, explosives. The heavy demand for linters in the manufacture of explosives during the world war resulted in better methods in their production and the consequent increase in the tonnage produced, which ranged from 602,324 bales in 1913 to 1,300,163 bales in 1917. Five years later (1922) the production was only 382,375 bales while in 1929 it was 1,085,766 bales or nearly equal to war time demand.

The hulls are composed of crude fiber (about 45%), nitrogen free extract (about 35%), water, protein, fat and ash. Two products are manufactured from the hulls, viz., hull bran and hull fiber. The fiber is removed after decortication and the hulls are ground into bran, used principally to dilute cottonseed meal and reduce its protein content. Hull fiber is really low grade linters, the fiber of which is below the lowest standard grade of linters and is used in cellulose processes and for paper and roofing stock.

When hulls are not manufactured into hull fiber and hull bran they may be sold loose in bulk, or in bags of 100 pounds, net weight. For contract purposes, there are two grades, viz., prime and off, with specifications as follows:

Prime must be sound, good color, not musty, reasonably clean, with no lint removed except by the linter machines.
Off, all hulls not prime.

The by-products, grabbots, flues, motes, etc., which are the first to be obtained, are the least valuable of all and for that reason only the larger mills make any effort to save or re-work them.

Grabbots are the flakes of cotton attached to faulty seeds, which the gin did not separate from the seed. They must be run through a grabbot gin for further separation. The fiber is usually long staple of good quality and is used in spinning, candle wicks, yarns, etc.

Flues are small twists of cotton, usually attached to faulty seed, the fiber of which is shorter than that of grabbots, but longer than that of motes. Flues are used in the manufacture of mattresses, commercial felting, etc.

Motes are very small tufts of cotton which fall in the mote board under the linter gin and must be run through a beater for cleaning, as they contain quite a quantity of trash, small pieces of broken hulls, etc. The fiber is very short and except for the dirt and trash, motes are very similar to low grade linters and are used for the same purposes.

All of these by-products are shipped in bales of about 500 pounds each. Unlike other by-products, they have no government or established grades.

At present, the domestic demand for cottonseed products exceeds the foreign demand. Exports of oil show a marked decrease beginning with 1922 when high tariffs were placed on oil, while cake and meal were free of duty. Statistics issued by the United States department of commerce, for the exports of oil, cake and meal, by years, show the trend in foreign demand since 1900.

Year ended June 30	Cottonseed oil (pounds)	Cake and meal (tons)
1900	351,767,925	571,852
1905	386,516,850	625,954
1910	223,955,003	320,044
1915	318,366,525	739,533
1921	283,268,025	227,350
1922	91,614,638	266,360
1925	53,260,613	442,687
1929	29,531,258	286,334

Financial Accounting

The financial accounting for cotton-oil mills is, in general, similar to that of any other manufacturing industry. It is simpler than some others, since there are fewer commodities manufactured. In general, the accounts may be divided into three classes, viz., balance-sheet, profit-and-loss accounts and production records.

A condensed balance-sheet would comprise the following items:

Assets:
  Current assets:
    Cash in banks and on hand
    Notes and accounts receivable—less reserve

Inventories:
Raw material—seed, bagging, etc.
Finished products—oil, meal, etc.
Prepaid expenses—insurance, licences, etc.
Investments, memberships, etc.
Fixed assets—less reserve for depreciation
Deferred charges—bond discount, etc.

Liabilities:
Current liabilities:
Notes payable
Accounts payable
Accrued expenses—payrolls, interest, commissions, federal and local taxes, etc.
Bonded indebtedness
Capital stock
Surplus

The notes and accounts receivable should be comparatively few, as the sales are usually conducted on a cash basis. It will be noted that the inventories do not contain work in process. In case the mill is closed down for any reason, it is necessary to run the machinery long enough to clear it of any work in process, especially the cookers and presses; otherwise the products therein would deteriorate. For that reason, there is no work in process of any consequence.

For balance-sheet purposes the inventories of seed, bagging, etc., should be valued at cost or market, whichever is the lower at the date of the balance-sheet. The finished products should be valued at the selling market prices, less the selling, packing and shipping expenses applicable.

The largest single asset, ordinarily, is the property, plant and equipment, sometimes called the fixed assets. Additions to this account should comprise only additional property, improvements or expansions. New machinery should be charged to the asset account. Replaced machinery may be charged as an asset, provided the old machinery which it replaces, together with the accumulated depreciation thereon, is transferred to a separate account, if not sold at the time, and its net book value written down to its salvage value until disposition of it.

The reserve for depreciation should be adequate. Cottonseed-oil mills run the full 24 hours a day for approximately six months of the year. Depreciation is therefore heavy, as in six months they run a greater number of hours than most other mills do in a year.

Machinery in continuous operation for six months of the year and idle the rest of the year sustains heavier depreciation than machinery run normally 8 or 10 hours a day, as continuous operation gives no opportunity for effective repairs and increases the possibilities of sudden breakdowns. If ordinary repairs, made during the busy season, are charged as expense, and a sufficient reserve for depreciation is provided during the season, to take care of the general overhauling of the plant at the end of the season, the burden of repairs and the restoration of the plant is distributed to the period in which the property actually sustained the wear and tear. The adoption of this plan is the only method by which each season's operations can be burdened with its proportionate share of the cost of restoring the property to the efficiency obtaining at the beginning of the season.

The other items on the balance-sheet call for no special comment, as they are not unlike those of most other manufacturing concerns. Should occasion arise for any reserves for unsettled claims or contingencies, they should, of course, be provided.

Profit-and-Loss Account

The income and expense accounts may be condensed or expanded into many classifications, but an adequate number should be provided to disclose any needed data on any particular class of income or expense. A pro-forma profit-and-loss account is presented on a subsequent paper, as exhibit "A". It includes the most necessary classifications, some of which could be further reclassified and expanded if desired. This exhibit has been prepared to record the operations of a large company owning and operating several oil mills. It may be condensed or expanded as desired.

Sales. Separate accounts should be provided in which to record the sales of each different product manufactured and of raw materials. These accounts should contain, not only the money values, but also the quantities, so that the operating ledger will serve as a control for the production records. It is desirable, although not necessary, that separate sales accounts be maintained for the various grades of the same product, such as hulls—sacked, hulls—loose, meal—43%, meal—41%, etc. They may, however, be so classified in a subsidiary sales record.

All returns and allowances should be entered as debits to the appropriate sales account, with care to record the quantities of

all returns and, vice versa, to omit the quantities of all allowances or price adjustments. Cash discounts, both on sales and purchases, should be kept in a separate account, as a matter of record for ready reference.

Cost of products sold comprises the following classifications:

Raw materials or cost of seed crushed,
Manufacturing expenses or cost of crushing,
Inventory variations of finished products,
Packing and shipping expenses,
Mill office expenses.

The difference between the products sold and cost of the products sold represents the gross operating profit of that particular mill. The cost of the seed crushed (or the raw material) should include all costs of every kind applicable to the seed, from the time it is purchased until it is stored in the seed house. The seed-purchase accounts should reflect both values and quantities as a control for the production records. If any seed is sold, its cost should be credited against the purchases and charged to seed sales, in order that the records may correctly reflect the cost of the seed manufactured. In order to ascertain the cost of the seed manufactured for any given period, the variations in the inventories of seed at the beginning and the end of the period must be taken into consideration. The seed inventories should be valued at cost or market, whichever is the lower at the date of the inventory.

The cost of crushing includes the various items classified in exhibit "A" as manufacturing expenses. All expenses necessary to convert the seed into its various finished products of crude oil, cake, linters, hulls, etc., should be included and should comprise, not only the direct expenses of labor power, press cloth, repairs, etc., but also such indirect charges as depreciation, taxes and insurance, since they are equally applicable with the labor and other direct charges to crushing cost.

The necessity for charging adequate depreciation has already been stressed. While this is an invisible and an indirect expense, yet it exists. The machinery and equipment are gradually worn out by use, and the importance of depreciation as an item of manufacturing expense must not be overlooked.

The inventories of the finished products, at both the beginning and the end of the period, must be taken into consideration in computing the cost of the products sold. The basis of their valua-

tion has already been described in the section dealing with the balance-sheet items.

The packing and shipping expenses and the mill-office expenses complete the charges that enter into the cost of the products sold. All expenses for bags, twine and other shipping supplies should comprise only those consumed, viz., the purchases, increased or decreased by the variations in the inventories of them, and less any bags or supplies sold.

The classifications of the selling and administrative expenses are similar to those of most other manufacturing concerns. The administrative expenses should comprise only those which represent general supervision of the business as a whole and can not be allocated to any particular mill.

The miscellaneous income and charges should reflect such non-operating items as dividends on outside investments, profit or loss on the sale of fixed assets, interest, amortization of deferred charges, etc.

The net earnings should be reduced by the amount of the federal income taxes, in order to determine the net income available for transfer to surplus account.

Production Records

Subsidiary records should be kept in which all quantities purchased, manufactured, or sold should be recorded, not only by commodities, but by different grades of commodities. These records are controlled by the operating accounts (sales and purchases), as already described. If all weights are properly recorded, the total crush, crushing loss, yields, etc., may be ascertained by using the following formulas:

$$a+c-e=X$$
$$d+f-b=y$$
$$X-y\ \ =Z$$

a = opening inventory of seed
b = opening inventory of products
c = seeds purchased (net)
d = products sold (net)
e = closing inventory of seed
f = closing inventory of products
X = crush
y = yield
Z = crushing loss

It is important that the production records be accurately kept in order to ascertain shrinkages and losses which might be above

normal. There should be no difficulty in keeping accurate records of the raw material, because seed is the only raw material used. The combined weight of the manufactured products should be about equal to the weight of the seed purchases, less the weight of any seed sold and the loss by weight in cleaning. The latter is difficult to determine unless the seed is weighed after it is cleaned. Usually the seed is run direct from the cleaners to the linters and the loss through cleaning is combined with the loss in manufacturing, under the general term "crushing loss."

Unless a cut-off is made and an inventory taken at stated intervals, it is impossible to obtain data on production and crushing loss until the end of the season.

The Future of the Industry

Great changes have taken place in the industry in the last few years. Ownership and control has become more centralized with the organization of larger companies operating a series of mills.

Through the efforts of the national association, with a membership of nearly 700, a code of trade practices has been adopted with the approval of the federal trade commission. The adoption of this code is an intelligent effort on the part of the members to eliminate many bad practices previously in vogue. General trading rules have been adopted, which include definitions of grades and quality, shipping and general terms, weights and measures, etc. These rules also prescribe remedies for breach of contract and provide for settlement of controversies through arbitration and appeals committees.

Another important step in the development of the industry is the recent adoption of standard methods of determining grade and value of cottonseed. These were evolved by the United States department of agriculture.

The demand for cottonseed oil has been firmly established in the markets of the world and its prices are quoted in the financial papers. Cottonseed meal stands at the head of stock foods in the percentage of fat and protein content. The uses of linters have multiplied and demand for them has increased in proportion. Beginning with the extraction of oil as its prime object, the industry has developed to such an extent that the dirt in the seed is practically the only matter not utilized in the manufacture of cottonseed products.

Exhibit "A"

PROFIT-AND-LOSS ACCOUNT

(Operating accounts arranged as to sales, cost of sales, etc.)

Sales—net (less returns, allowances and discounts):	
Crude oil—various grades	$
Meal—43% and 41%	
Cake—various grades and sizes	
Hulls—loose and sacked	
Linters—1st and 2nd cuts and mill run	
Grabbots, motes, flues, etc.	
Total sales—net	
Cost of products sold:	
Raw material—seed:	
Cottonseed (less sales, allowances, discounts, etc.)	
Freight (or hauling) on seed	
Seed buying expense—commissions, salaries, etc.	
Sundry expenses—such as depreciation, taxes, insurance, repairs, etc., on seed house and equipment	
Inventory variations of raw material	
Total cost of seed	
Manufacturing expenses:	
Wages—superintendents, engineers, etc.	
Labor—productive	
Light, heat, power and water	
Press cloth, yarn, etc., consumed	
Lubricating oil and waste	
Laboratory expense	
Mill supplies, brooms, small tools, etc.	
Repairs and maintenance	
Taxes and licences (except federal income)	
Insurance—fire, tornado, liability, etc.	
Depreciation on mill and equipment	
Total manufacturing expenses	
Inventory variations of finished products	
Packing and shipping expenses:	
Labor—packers, loaders, truckers, etc.	
Bags, twine, tags, bagging, tax stamps, etc., consumed	
Total packing and shipping expenses	
Mill office expenses:	
Salaries—clerical, night watchman, etc.	

Telephone and telegraph	$
Postage, stationery and office supplies	
Depreciation, insurance, taxes, repairs, etc., on office	
Other mill office expenses (detailed)	
Total mill office expenses	
Total cost of products sold	
Selling expenses:	
Salesmens' salaries and expenses	
Advertising	
Brokerage	
Telephone and telegraph	
Other selling expenses	
Total selling expenses	
Administrative expenses:	
Officers salaries	
Clerical salaries	
Telephone and telegraph	
Postage	
Stationery and printing	
General traveling expenses	
Office rent	
Heat, water, light, ice, etc.	
Insurance—fire, etc.	
Insurance—officers' life	
Taxes and licences—general	
Exchange and collections	
Repairs to office and equipment	
Legal and auditing services	
Membership dues and subscriptions	
Donations to charity	
Depreciation on office and equipment	
Other general expenses	
Total administrative expenses	
Net operating profit	
Miscellaneous income:	
Interest on notes and accounts receivable	
Dividends on investments	
Profit on sale of assets	
Other miscellaneous income	
Total miscellaneous income	

Miscellaneous charges:
- Interest on indebtedness
- Amortization of deferred charges
- Loss on sale of assets
- Bad debts—less recoveries

Total miscellaneous charges

Net earnings

Provision for federal income taxes

Net income

Exhibit "B"

COTTONSEED PRODUCTS AND THEIR USES

(*Food and feed products shown in italic type.*)

Cottonseed
- *a—Crude oil*
- *b—Cake and meal*
- c—Linters
- *d—Hulls*
- e—Grabbots, flues and motes

a—Crude oil:
- *Refined oil:*
  - *Prime summer yellow oil:*
    - *Bleached, for cooking or salad oils*
    - *Hydrogenate, for lard substitutes*
    - *Cold pressed, for packing oils and margarin*
    - *Emulsion for medical purposes*
    - *Substitute for sweet oil*
    - *Deodorized oil*
    - Cosmetics
  - Off-grade summer yellow oil:
    - Synthetic stearin
    - Miners' oil
    - Soap
- Foots:
  - Washing powder, soap
  - Acidulated foots or black grease:
    - Glycerin, nitroglycerin
    - Fat acids:
      - Candle pitch
      - Distilled fat acids:
        - Washing powder, soap
        - Stearic acid, candles
        - Oleic acid
        - Stearin pitch:
          - Composition roofing

Insulating materials
Cheap paint base
Oil cloth, linoleums
Artificial leather
Cotton rubber
Waterproofing

Putty

b—Cake and meal:

Fertilizers
Dyestuffs
Flour:
Bread, cake, cracker
Feed for:
Cattle, horses, mules, swine, sheep, poultry

c—Linters:

Felts, batting, wadding, absorbent cotton
Wool adulterants
Stuffing material for:
Pads, cushions, mattresses, upholstery, comforts
Low grade yarns:
Twine, rope, candle wicks, carpets
Cellulose:
Paper
Guncotton, nitrocellulose or pyrocellulose:
Smokeless powder
Pyroxylin:
Varnishes
Plastics:
Celluloid, collodion
Photographic films
Varnishes
Artificial silk

d—Hulls:

Bran and cattle feed
Fertilizer, fuel, packing materials
Fiber:
Cellulose (same as under linters)
Paper stock

e—Grabbots, flues, motes:

Grabbots:
Candle wicks, yarn, twine, rope, carpets
Flues:
Mattresses, felt, padding, cushions, comforts
Motes:
Low grade yarn, mattresses, pads, cushions