Skelly Oil Company, 121 West Wacker Drive, Chicago.

Bowling Tourney

A. E. King is arranging for a bowling tournament along the lines of those conducted in previous years. The Amaizo Cup will again be the coveted prize. This cup is now in the hands of the bowlers from the American Maize Products Company who took the tournament last year. The cup has been won successively by teams from Lever Bros., The American Maize Company, and a group of exhibitors, prior to being lodged in the hands of its present holders. Send in your entries early, addressed to A. E. King, Swift & Company, Soap Department, Chicago.

Golf—

No definite plans for golf have been made although arrangements will be made for those desiring to play. Further plans in this regard will depend upon the interest shown at the convention.

Annual Dinner—

The dinner this year will not be held in the convention hotel. By way of innovation, the affair will be held at Old Heidelberg Inn. This German-American restaurant originated in the Chicago Century of Progress Exposition where it enjoyed a large measure of success. It has continued as one of Chicago's best downtown dining places. Its entertainment is famous—the "Old Heidelberg Octette" being known throughout the country. Some of our members may wish to visit the "Rathskeller" in the basement of "Old Heidelberg Inn." Here Herr Louie and his "hungry five" conduct a very informal and enjoyable entertainment program.

● MUSEUM OF SCIENCE AND INDUSTRY . . . Housed in the Fine Arts building of the Columbian Exposition, here are graphically presented many of the important discoveries of science and their application to modern industry, including an operating replica of a coal mine and many of the science exhibits of A Century of Progress.

* * *

● ORIENTAL INSTITUTE AT THE UNIVERSITY OF CHICAGO . . . Ancient civilizations brought to the 20th Century . . . Babylon . . . Thebes . . . The Gateways of Nebuchadnezzar . . . Relics from the Stables of Solomon . . . A model of the Tower of Babel. Among unusual American Museums, the most unusual.

* * *

● FIELD MUSEUM OF NATURAL HISTORY . . . The universe from creation to today. Exhibits in anthropology, botany, geology and zoology. Collections from all times and all parts of the world. Fossils, minerals, the world's largest collection of meteorites, plant life and mankind from the prehistoric to the various peoples of the present.

* * *

● ADLER PLANETARIUM . . . Only institution of its kind in America where daily the planets, the stars, the moon, the entire celestial orbit reproduce under a dome over your head all of the mysterious workings of the universe. Hundreds of thousands, here for the first time, have learned in layman's language the real meaning and importance of astronomy.

THE DETERMINATION OF CELLULOSE VALUE OF LINT FOR CHEMICAL INDUSTRY*

By L. N. ROGERS

PULP DEPARTMENT, BUCKEYE COTTON OIL COMPANY, MEMPHIS, TENN.

THE value of lint for chemical industry can be divided into two classifications of equal importance. (1) The money, or dollars and cents value as reflected in the amount or yield of purified cellulose obtainable from the lint in question. (2) The quality of purified cellulose.

The lint may have a good yield but may be trashy, off color, full of cinders, high iron, or have any number of other bad qualities, any one of which would render it either unusable or suitable only for a low grade of purified cellulose. The quality angle of the value of lint will not be discussed in this paper.

There are a number of ways to estimate the yield value of lint. The most accurate way to tell what yield will be obtained from a given lint is to subject it to some conditions that bear a direct relationship to the plant yields. This we will try to do throughout this paper. The cellulose manufacturer is told the quality of cellulose he is to furnish by his customers and he makes the greatest yield possible from the lint, at the same time fulfilling the customer's quality requirements.

There is no direct relationship between the staple of the lint and the yield. The following typical table gives data we collected over a period of one year.

TABLE 1

Yield Range	Cars	Season 1934-35 Yield	Average Staple*
68	17	68.9	5 L
69	37	69.0	6 H
70	28	70.5	5 L
71	9	71.2	5 L
72	152	72.2	5 L
73	154	73.6	5 L
74	47	74.7	6 H
75	276	75.6	5 L
76	147	76.5	6 H
77	217	77.3	5 M
78	64	78.0	5 L
79	4	79.2	5 M
81	7	81.1	5 H
82	3	82.0	4 L

*Graded as to length of fiber according to Standard U. S. Government Grade.

Naturally, if the lint is to be used chemically, it should be tested chemically. While mechanical methods may be all right on some types of lint, there are certain conditions under which they do not show the true yield.

It is with these thoughts in mind, backed up by about 15 years' experience that we present the pot cook yield method for yield determinations.

Lint and Hull Fibre Sampling of Cars

Due to the wide variation of lint found in some cars the sampling of the car is a very important part of this method. It is essential that the sample obtained from the car truly represents the type of lint or hull fibre, as the case may be. Lint should be unloaded under shelter if it should happen to be raining, as the chemical and money values of lint are lowered after being wet.

Wet and rusting ties contaminate the lint with iron and a damp outer surface makes accurate sampling for yield more difficult.

*A Paper Presented at Twenty-Eighth Annual Convention A. O. C. S., Dallas, Tex., May 13-14, 1937.

Car Sampling

Several handfuls of lint are taken from each bale as it is unloaded. These should be taken at different parts of the bale to insure a representative sample. The number of handfuls to pull may vary from one to about four, depending on the uniformity of the lint.

One can tell after experience in sampling a number of cars whether the lint in any given car is uniform or not and be governed accordingly. The lint pulled is put in a can, or bucket, with a close fitting air-tight lid. The lid is replaced after each handful is put in the can, keeping the lint pressed down in the can to prevent the moisture of the sample from changing. Some of these precautions probably are not necessary, as the part of the sample already taken is subjected to the same weather conditions as the other bales to be sampled, however, it safeguards contaminating the sample with foreign matter when the lid is off. The lid should be placed on tight when the sample is sent to the laboratory for analysis.

Laboratory Division of Sample

When the sample is received at the laboratory it is spread out on a smooth top table without mixing, and two samples are picked out, one for moisture and one for yield. Small bits of each handful of lint pulled from the bales are taken and put to one side or in another container. After approximately equal parts of each handful have been separated, it is given a gentle mix or stirring to insure a representative sample of the car. Care must be used here to avoid loss of hull pepper. Part of the sample is taken for a moisture test and part for a yield test. If the conditions in the laboratory are such that the sample will dry out during above division, a moisture test should be taken as soon as emptied, by taking small parts throughout the sample. This condition can best be established by checking moistures before and after mixing to determine correct procedure for each laboratory.

Moisture Determination

About 25 grams of the lint sample are put in a tared aluminum or tinned iron weighing can. These small cans must have airtight tops, with a capacity of about 30 cubic inches. The sample is weighed on a balance that weighs to the third decimal place and the weight recorded. It is dried bone dry in a mechanical or gravity convection oven at 105 to 110 degrees Centigrade for 4 hours. If a mechanical convection oven is used, only a very slow current of air should be used. After drying, the sample should be cooled in a desiccator. After cooling, weigh and calculate the loss in weight as percent moisture. Moistures should be run in duplicate unless the analyst is able to get identical checks on the composite sample.

Moistures were determined on lint conditioned to insure uniform moistures, and the average deviations of the moisture determinations were calculated. The results are given in the table below. The moisture determinations were computed from the mean moisture and the average deviations obtained and calculated to per cent.

TABLE 2

No. Moisture Tests	Average Moisture	% Dev. ±
10	7.3	2.7
5	10.4	1.92

From the above results one would expect the average per cent deviation in moisture determinations to be 2½% or less on 8% moisture lint. On this basis 8% moisture lint may be expected to test between 7.8% and 8.2%.

Cooking or Digesting Sample

Apparatus and Chemicals—

(1) Galvanized iron (glue) pots with a capacity of 1000 cc. are used for digesting samples. Lids are made for the pots with one-eighth inch iron or nickel plate, with a three-quarter inch hole to one side of center. This hole is covered on the bottom with 60 mesh copper or nickel wire. An asbestos sheet one-sixteenth inch thick covers the entire bottom of the iron or nickel plate with the exception of the hole. Another plate (with hole matching the first) one-sixteenth thickness, is cut of a smaller diameter to fit inside the pot and holds the asbestos and screen wire in place by being bolted through the asbestos to the upper plate. The asbestos acts as a gasket around the edges of the pot. An asbestos flap cover is made for the top of the hole that closes when steaming the digester and opens when the pressure is released. The top is fastened on the pot with a screw clamp.

(2) A Digester, or autoclave, with a working pressure of 105 pounds per square inch (341 degrees Fahrenheit) of steam.

(3) A sodium hydroxide solution of exactly 1.0 per cent concentration using C.P. or U.S.P. caustic.

Photographs show two small digesters with capacity of 25 pots each.

Figure No. 1 with Trees out of Digester.

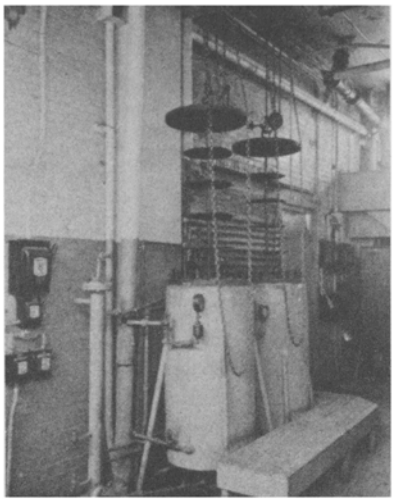

FIGURE 1.

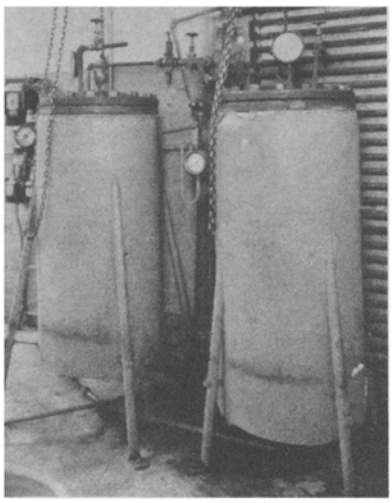

FIGURE 2.

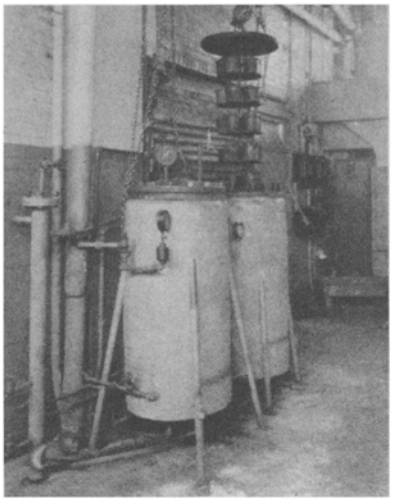

FIGURE 3.

Figure No. 2 with Trees in Digester and Top Fastened.

Figure No. 3 with Trees, one Tree in and one full of pots.

Mixing Lint and Caustic Solution

Exactly thirty-five grams of the final sample are weighed on a balance that is accurate to the second decimal. It is transferred to the pot and 525 cc. of the one per cent caustic solution is added, pressing the lint down as the addition of caustic is made, with a strong glass flask or bottle, to insure a good wetting-out. The mixture is then stirred with a glass rod to complete the mix, as a good mix is essential to this test. The lids are fastened on and the pots are put in the digester.

Digesting

Fasten the lid securely on the digester and bring the steam pressure up to 105 pounds pressure (341° F.). The temperature should be watched closely. It is held at this temperature for three hours after the pressure is up and then the steam is blown off.

Washing

Both the method previously used and the one being used at present are described.

Description of Hand Washer Previously Used

The washing screen or pan is made as follows: The diameter of the pan is 9 inches and the height is 3.5 inches. The sides are straight and are made of copper. The bottom of the pan consists of a U. S. Standard 45 mesh copper wire soldered to the sides.

Hand Washing Procedure Previously Used

The pulp is emptied on the washing screen and the pot rinsed to insure complete removal of the sample. The screen with material to be washed is placed under a running faucet. The water pressure should be about 50 pounds per square inch. A one-half inch valve should be given a half turn or opened enough to run about four gallons per minute at the above pressure. The material should be held under the stream of water by raising it off the bottom of the pan with the fingers about a dozen times during the one minute wash time. Only about one-half of the stock can be raised at one time, which means that part of the material will be raised about 24 times. This is necessary to free the fibres of the hulls cooked apart but not dissolved.

It has been found that if all conditions are held constant one trained operator can check himself within close limits. This washing method has not proven entirely satisfactory due to the human element encountered, particularly when this test is made by several laboratories. For this reason, a mechanical washer has been designed and built to eliminate the human element from the test as far as possible.

Description of Mechanical Washer

The principle of the washer is to suspend the cooked sample of lint or fibre in water, subject it to the beating action of tiny jets of water to separate the hulls from the fibres and finally to drain off these fine partly cooked hulls with the cooking solution. This is accomplished by a slow end over end rotation of a washing cylinder, 8½ inches long, 6½ inches in diameter, one end of which has a standard 60 mesh nickel screen, the other being closed except for a small one-half inch, 60 mesh, screen-covered opening which permits air to enter during draining. The cylinder turns on an axis through which a one-quarter inch brass water line enters. This brass line has 44 1/64-inch openings, spaced regularly along the entire length. Water enters at a constant pressure of 22 pounds per square inch. During one complete rotation the cylinder becomes about one-half to three-quarters full of water, which drains out each time the screened end is turned downward. A deflector plate ¾ inch above the 60 mesh screen prevents water from spraying over the operator.

The cylinder during operation rotates at 4 r.p.m., being driven by an electric motor and reducing gear. A clutch arrangement permits disengagement of the cylinder and driving mechanism at any desired point.

Figure No. 4 shows Washer with screen end downward.

Figure No. 5 shows Washer with screen end off.

Figure No. 6 shows Washer in horizontal position, with one screened end off.

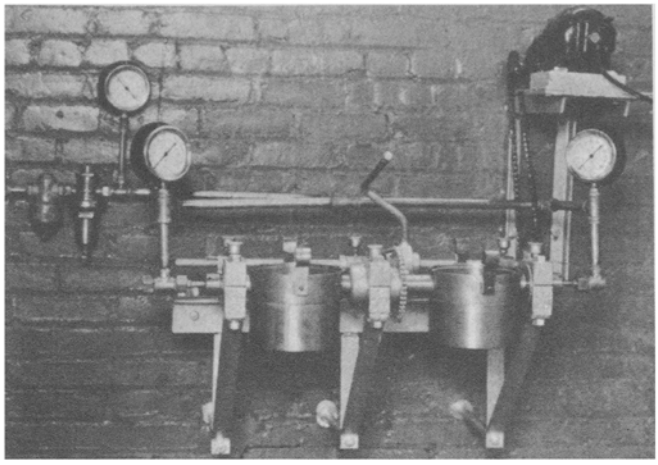

FIG. 4.

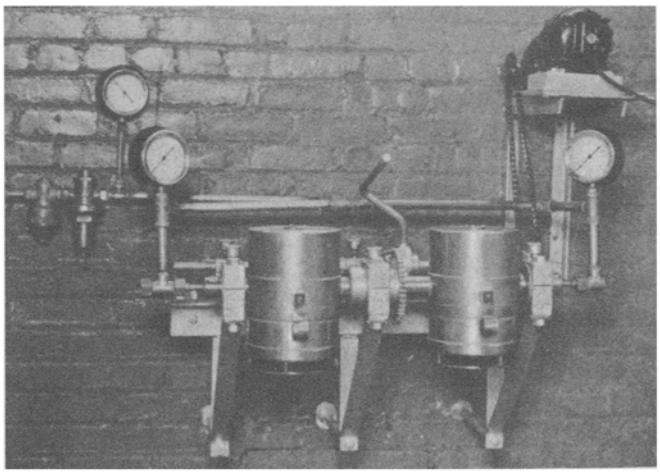

FIG. 5.

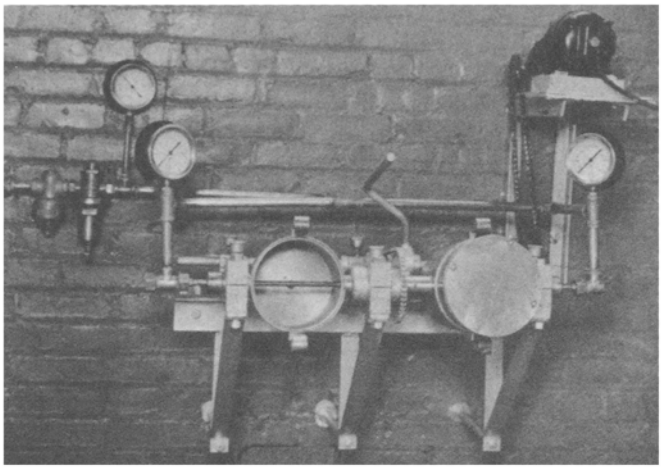

FIG. 6.

The Washing Procedure

A small amount of water is added to the cooked lint or fibre after it is removed from the autoclave in order to facilitate removal from the cooking pot. This mix is poured directly into the lower half of the washing cylinder. The cooking pot is given one rinse in order to assure complete transference of all fibres to the washer. The upper half of the washing cylinder is clamped on and the washer is started. The water is turned on when the screened end reaches the bottom of its rotation. This eliminates plugging of the screen. The washing time begins when the water is turned on. The water is held constant at 22 pounds per square inch with a reducing valve.

At the end of five minutes the water is cut off, and the revolving motion stopped when the washing screen is near the bottom of its rotation. The cylinder should be slightly off vertical to assure rapid drainage. After the flow of drainage water has almost stopped, the water valve is again turned on for an instant to wash any adhering fibres from the walls of the cylinder. The lower half of the washer with its accompanying lint or fibre is taken off and the stock on the screen carefully removed and squeezed hard by hand.

Drying

The wet sample is dried in the ovens mentioned above at 105 to 110 degrees Centigrade over night (14 hours). The weighing cans used in lint moisture determination may be used, but good results are obtained by putting the squeezed samples alone in the oven in a screened partitioned tray and weighing these samples hot immediately on taking out. The same balance as used for lint moisture is used. From dry weight the lint yield is calculated, as bone dry yield from the lint or fibre as received.

The following table compares the results of mechanical washes with hand washes on different types of lint and hull fibre. Time of washing for mechanical washer—5 minutes. Pressure of water—22 lbs. per square inch. Per cent yield on lint and hull fibre was calculated to an 8% moisture basis of the raw materials used.

The lint tests as tabulated in Table No. 3 are on lints whose percentage yield range from 69 to 76 per cent. In 100 tests on the mechanical washer the average deviation was 0.6 per cent as compared to 0.8 per cent for hand washing. The maximum deviation for both types of washes was a little above 1 per cent, which is an allowable error.

Determinations on five different hull fibres whose per cent yield ranged from 53 to 73 per cent showed the two washes to be about the same. The average deviation on 40 hand washed samples was 0.4 per cent and the maximum deviation 0.5 per cent as compared to 0.6 per cent and 0.7 per cent, respectively, for 74 tests on the mechanical washes. It is to be noted that the results of the mechanical washer are compared to hand washes of our best and most experienced operator, who during the last six years has washed in round numbers about 50,000 samples.

Hull fibre containing hulls that are too large to be disintegrated during the cook will give results that are too high because the uncooked portion of the hulls will not pass through the screen. Determinations on fibre of that type cannot be made. Tests on such fibre, however, have little commercial value, as fibre containing large hulls is usually of very little value to a bleachery and can easily be avoided by visual inspection of the raw fibre.

Yield Variation of Different Parts of Bales

Duplicate samples were taken on 75 cars of lint, one from the end of the bale, and one from the side center of the bale. This test run was made over a period of about two months.

Hand washing procedure was used.

TABLE 3
LINT

Type	Hand Wash Pct. Yield	Mech. Wash Pct. Yield	No. Samples Hand Wash	Avg. Dev. Per cent	Max. Dev. Per cent	No. Samples Mech. Wash	Avg. Dev. Per cent	Max. Dev. Per cent
L 1	69.5	69.5	4	0.6	0.6	8	0.6	1.0
L 2	71.4	71.2	8	1.0	1.1	16	0.6	1.0
L 3	73.6	73.5	8	0.6	1.4	14	0.6	1.1
L 4	74.0	74.1	8	1.0	1.1	14	0.6	1.0
L 5	74.1	74.3	8	1.0	1.1	16	1.0	1.1
L 6	75.4	74.2	8	1.0	1.0	16	0.6	1.0
L 7	76.0	76.0	8	0.6	1.0	16	0.3	1.0
Avg	73.4	73.3	62	0.8	1.04	100	0.6	1.03
FIBRE (With hulls that are disintegrated during cooking)								
F 1	53.4	53.4	8	0.3	0.3	12	0.3	0.6
F 2	61.9	61.9	8	0.6	1.4	14	1.0	1.0
F 3	68.2	68.6	8	0.3	0.6	16	0.6	1.0
F 4	70.8	71.1	8	0.6	0.6	16	0.6	1.1
F 5	73.3	73.2	8	0.3	0.6	16	0.6	1.0
Avg	65.5	65.6	40	0.4	0.5	74	0.6	0.7
FIBRE (With large hulls too large to disintegrate during cooking)								
F 6	54.6	56.9	4	0.6	0.6	4	0.3	0.3
F 7	65.4	67.3	8	0.2	1.0	13	0.2	0.6
F 8	46.3	48.3	4	0.2	0.6	8	0.2	0.6

The table below gives the yield results obtained.

TABLE 4

	Yield
Ratio $\frac{\text{Yield end Sample}}{\text{Yield Center Sample}}$	1.01
Avg. per cent Spread ±	2.3
Max. per cent	5.0

Pot Cook Yield and Plant Yield Relationship

During the period of eight years from the season of 1928-29 to 1935-36 the following pot cook yields have been obtained on second cut lint. Year runs from July 1st to July 1st. Some 7,000 cars of lint and fibre received at the plant were sampled and analyzed during this period.

Moisture

The lint moisture obtained on 1,744 cars since January, 1936, have averaged 8.1 per cent. During same period 372 cars of hull fibre tested 7.7 per cent moisture. This will probably vary 1.5 per cent plus or minus, depending on weather conditions at time of ginning, storage, or sampling. There is no method to determine the moisture throughout the bale without removing the bands. So far no constant relationship between the relative humidity and the moisture of the lint or fibre has been found. This statement is based on experiments on this subject carried on for two months with bales of lint exposed to outside conditions, ranging from 40 to 90 per cent relative humidity, with the bales well protected from precipitation.

It is suggested that an average moisture of 8.0 per cent be assumed for the time being for all lint and fibre and that samples taken be adjusted in yield to that basis.

It is not the purpose of this paper to try to prove that the pot cook plant yield ratios given herein hold for every bleachery and every type of purified cellulose. In our case, the plant yield results are given on averaged types for chemical uses. We do believe, however, that there will be a definite relationship between yields obtained by this method and those obtained by any carefully controlled plant procedure for producing any type of purified cellulose. It is of no great concern whether this method gives the exact plant yields for every set of conditions as long as there is a direct relationship.

Since 1931 the second cut lint yields have dropped 4 to 5 points and the price has increased from about one cent to nearly four cents per pound, showing that there is no relationship between the market price of lint and the yields from year to year.

The price of the lint is governed by the supply and demand. Furthermore, the differentials that a bleachery may pay for lints of varying yields will change with the base value of average lints.

TABLE 5

Year	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
Pot Cook Yields	75.8	77.7	80.2	79.0	78.0	78.2	74.9	75.3

The average actual plant yield during this eight-year period varied from the predicted yield based on pot cooks by only .1 per cent, though a plant variation of ± 1.0 per cent from theory from any particular year would be considered normal.

The following lint yield was used and plant yield obtained on bulk stock during the typical calendar year of 1934, showing drop in plant yields with pot cook yields:

TABLE 6

	Pot Cook Yield	Plant Yield	Ratio Plant Yield / P. C. Yield
1st Quarter	78.85	78.72	0.998
2nd Quarter	78.69	79.77	1.013
3rd Quarter	77.93	77.87	1.000
4th Quarter	76.25	76.70	1.005
Avg.			1.004

THE COMPOSITION OF EXPRESSED LUMBANG OIL*

By G. S. JAMISON and R. S. McKINNEY

OIL, FAT AND WAX SECTION, CARBOHYDRATE RESEARCH DIVISION, BUREAU OF CHEMISTRY AND SOILS, U. S. DEPARTMENT OF AGRICULTURE

LUMBANG OIL is obtained from the kernels in the nuts of the lumbang tree, Aleurites moluccana, family Euphorbiaceae, which is widely distributed in the tropics. The tree is known by many local names, such as the candlenut, iquape, kekuna, kekulin, kukui, kermiri, keras, and Indian or country walnut tree. In Madagascar the oil is called bakoty.

Production of the oil now appears to be confined to the Philippines. Many years ago, it was produced on a small commercial scale in Hawaii (T. C. Zshokka, Oil Miller and Cotton Ginner, **41**, No. 5, pp. 5-6, 1933), where there are still thousands of the trees. The expansion of the lumbang oil industry has been retarded largely on account of the difficulty of separating the kernels from the shells, which constitute about sixty-eight per cent of the nuts.

At various times, different investigators have made some study of this oil. The proportions of the saturated and the individual unsaturated fatty acids were first investigated by A. P. West and Z. Montes (Philippine J. Sci., **18**, 619-33, 1921), and again later by A. O. Cruz and A. P. West (ibid., **42**, 251-7, 1930). The most recent investigation was made by J. L. Riebsomer and N. Foote (Proc. Indiana Acad. Sci., **45**, 116-9, 1935). In these investigations, the quantity

*A paper Presented at Twenty-Eighth Annual Convention, A. O. C. S., Dallas, Tex., May 13-14, 1937.