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.

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 $\frac{\text{Plant Yield}}{\text{P. C. Yield}}$
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

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.

THE COMPOSITION OF EXPRESSED LUMBANG OIL*

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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

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of linolenic acid in the oil was estimated from the weight of the ether-insoluble hexabromide obtained. It is known now, however, that only about one-third of the linolenic acid can be separated as the ether-insoluble hexabromide. This accounts for the small percentages of this acid (5.2 to 7.7 per cent) reported by previous investigators. This low value in turn causes the reported percentages of linoleic and oleic acids to differ from their true value. The total quantity of linolenic acid can be more accurately estimated through the use of the thiocyanogen and iodine values.

The oil used in the present investigation was expressed in the laboratory from the kernels separated from about ninety-five pounds of lumbang nuts received from the Philippine Department of Agriculture in September, 1935. These nuts consisted of 33.23 per cent of kernels and 66.77 per cent of shells. The kernels contained 69.2 per cent of oil and 3.1 per cent of moisture. After cracking the nuts, the kernels, which adhere firmly to the shells, were cut piecemeal from them, ground, and pressed in a Carver hydraulic press. The oil, which was filtered immediately after expression, was pale yellow and had a very slight but pleasant odor. A film of the oil on glass in a room where the temperature ranged from 85° to 95° F., after twenty days became hard and non-tacky. The film was smooth and transparent. T. H. Barry (J. Soc. Chem. Ind., **48**, 239 T, 1929) found that lumbang oil required about twice as much time as linseed oil to yield a non-tacky film.

The chemical and physical characteristics of the oil are given in Table 1.

TABLE 1—Chemical and Physical Characteristics of Lumbang Oil

Specific gravity at 25/25° C.	0.9233
Refractive Index at 25° C.	1.4749
Iodine number (Hanus)	151.7
Thiocyanogen value	97.1
Saponification value	190.8
Acid value	1.15
Unsaponifiable matter, per cent.	0.30
Iodine No. (R. & K.) of unsaponifiable matter	91.0
Saturated acids (Bertram), per cent	8.39
Unsaturated acids, per cent.	86.61
Hexabromide value (Steele and Washburn)	19.3

Recently, the Bertram method was applied to a sample of lumbang oil expressed in this laboratory in 1921 from Philippine nuts, which showed that it contained 8.26 per cent of saturated acids. It will be observed that this result is in good agreement with that of the oil being studied.

With the lead-salt ether method, 6.66 per cent of saturated acids in the oil was obtained, after making the customary correction for the small quantity of unsaturated acids present. The unsaturated acid fraction was found to contain 1.82 per cent of saturated acids, using the Bertram procedure. On the basis of the original oil, the total percentage of saturated acids amounts to 8.27, which is in good agreement with that (8.39%) given in Table 1.

With highly unsaturated oils, there appears to be an unavoidable loss of saturated acid when using the lead-salt ether method, even when the washing of the saturated acid lead soaps with ether is reduced to a minimum. The presence of large quantities of highly unsaturated acid lead soaps apparently causes the increased solubility of the saturated acid lead salts. On the other hand, in the case of less unsaturated oils, the lead-salt ether and Bertram methods give closely agreeing results.

Unsaturated Acids

The percentages of oleic, linoleic and linolenic acids in the oil were calculated in the customary way, from the iodine and thiocyanogen values and the quantity of unsaturated acids present in the oil. No evidence was obtained of the presence of any elaeostearic acid, which is the principal constituent of the seed oils of the other members of the genus Aleurites. In this connection, mention may be made that the oil in contact with a ten per cent chloroform solution of antimony trichloride remains liquid, whereas the oils from other genera of Aleurites quickly solidify.

Irradiation of the oil even in the presence of a small quantity of dissolved sulphur failed to cause the separation of any beta-elaeostearic acid glyceride. Furthermore, the iodine number of the saturated acids separated by the lead-salt ether method gives no indication that they contain any of this acid, the lead-salt of which is difficult by soluble in ether.

TABLE 2—Unsaturated Acids

Acids	Per Cent	Per Cent in Oil
Oleic	30.29	26.23
Linoleic	45.74	39.62
Linolenic	23.97	20.76
	100.00	86.61

The calculated quantities of unsaturated acids are given in Table 2.

Through a personal communication from Professor J. B. Brown, Ohio State University, it was learned that he had found that the quantity of ether-insoluble hexabromide obtainable from an oil is equivalent to about one-third of the total linolenic acid present. Using this proportion, it was calculated from the hexabromide percentage (19.3) of the fatty acids that the oil contained 20.6 per cent of linolenic acid, which is in close agreement with the result given in Table 2.

Saturated Acids

The saturated acids separated from the saponified oil by the lead-salt ether method were esterified with anhydrous ethyl alcohol in the presence of dry hydrogen chloride gas (J. Amer. Chem. Soc., **42**, 1200, 1920). The esters, which amounted to 59.3 grams after being freed from solvent and moisture, were fractionally distilled under a pressure of 6 mm. from a Ladenburg fractionation flask. Four fractions were collected, and the composition of each one was determined by methods previously described (J. Amer. Chem. Soc., **46**, 775, 1924). The final results calculated from the analytical data, including the acids obtained from the undistilled residue, are given in Table 3.

TABLE 3—Saturated Acids

Acids	Per Cent	Per Cent in Oil
Palmitic	52.18	4.38
Stearic	46.84	3.93
Arachidic	.98	0.08
	100.00	8.39

The acids were recovered from the ester fractions and the small undistilled residue by saponifying them with alcoholic potash and decomposing the soaps with hydrochloric acid. The acids were collected and completely separated from potassium chloride and any free hydrochloric acid by remelting them with hot distilled water in the usual manner, and in each case were subjected to fractional crystallization from ethyl alcohol. Arachidic acid was found only in the undistilled residue, which also contained a small quantity of stearic acid. Neither the acids from the first ester fraction nor the unsaturated acids recovered from the ether-soluble lead salts contained any detectable quantity of myristic acid.

The acids from the four distilled ester fractions, which were isolated and identified in each case, confirmed the deductions previously made from the mean molecular weights of the saturated acid esters.

The composition of the oil in terms of glycerides is given in Table 4.

TABLE 4—Glycerides of—

	Per Cent
Oleic	27.41
Linoleic	41.20
Linolenic	21.54
Palmitic	4.59
Stearic	4.10
Arachidic	0.08

SUMMARY

Lumbang oil expressed from kernels of Philippine nuts in 1936 and 1921 was found to contain 8.4 and 8.3 per cent respectively of saturated acids, whereas only about one-fourth of this quantity has been reported by previous investigators.

No elaeostearic acid could be detected.

The characteristics of the oil have been determined, as well as the approximate percentages of the component fatty acids.

THE APPLICATION OF CHEMISTRY TO THE LAW OF COMMODITY CONTROL*

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TO those momentarily interested in litigation, law represents simply a means for settling squabbles among men. In its largest sense, however, it is more than a mere temporary expedient. It signifies all those rules of action evolved in the course of human progress which are designed to control man's conduct in a world of infinite enterprise. In the complicated industrial society of today, human activities are so affected by the technical sciences that the specialist in any field of endeavor finds that he must narrow his sphere of action more and more as the years roll on and yet widen his background to include a greater infusion of those sciences that are closely related. This is especially true of the attorney, who finds most of his practice whittled down to a mere shadow of former years and any future business dependent on a combination of law with some other line. Hence the modern curriculum includes of necessity such separately treated departments of positive or man-made law as medical jurisprudence, aeronautical law and the law of business accounting. And in time we shall see a special branch under the designation of chemical jurisprudence, taught as a separate subject, dealing with the body of rules governing the merchandizing of commodities.

To most, this implies the administration of the pure food and drug laws of state and nation. The peculiar jurisprudence dealing with commodity control, however, is a broader conception, as it takes in the basic common law and the sales act as well. It also concerns the merchant in general, whether manufacturer, grower or dealer, buyer or seller, producer or consumer, and its subject matter is his wares; the quality and the nature of his products or article of trade.

Back of it all lies the science of chemistry. Analysis is required to determine the defects in food, drugs and the wares of commerce. A knowledge of the composition of matter, its properties and its reactions, becomes the useful handmaid in the interpertation of what law is applied here. The chemist becomes the indispensable referee, in the first instance, of quality and purity of merchandise, and the law must take cognizance of his science in deciding such issues as proper labeling, adulteration, wholesomeness and merchantability.

Under special circumstances, a knowledge of chemistry is of material help in the interpretation of what constitutes fungible goods, divisible contracts, as to when goods may be said to be put into deliverable state or appropriated to a contract, in differentiating between bailment and sale in those cases where raw materials have been delivered to another for manufacture into other forms, in drawing the distinction between sales and contracts for labor, service or material for goods not in existence, on the question of inspection and acceptance and on the question of measure of damages. Many cases can be dug out of the law books to illustrate the instances where the chemist played sometimes a minor and more often a major part in the arrival at a decision by the courts.

In the manufacture, sale and consumption of goods, some of the older remedies co-exist, on contract or in tort, along with those remedies later given the injured party by act of legislature. But the common law was never particularly interested in the ultimate consumer or the public; as a matter of fact, "caveat emptor" or "the buyer beware!" was the established principle of trade. Legislation substituted the more enlightened precept of "caveat venditor," and added considerably to the small burden of liabilities and duties imposed on the merchant by common law.

The personal property or sales act of a state define the implied warranties in any sale by description and by sample. Cases construing these sections are an excellent illustration of the injection of analytical chemistry into the subject matter of the litigation, quite often concluding the argument.

The classic example of Hawkins vs. Pemberton (51 N. Y. 198) turned upon the chemical analysis of what plaintiff had represented as "blue vitriol, sound and in good order," which the defendant found through his chemist to be mostly green vitriol, a product, stated to be "not only inferior but different." It was held that under the circumstances there had been a warranty at the auction that the article sold was blue vitriol, which had been

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*Taken from a thesis, submitted for the degree of J.S.D., 1935, Brooklyn Law School.