bership and to the oil and fat producing and consuming trades that might follow its adoption in spite of its limitations — is a question which obliges us to inquire into the *raison d'etre* of a Scientific Society's collection of official methods. Is such a collection maintained principally as a source of approved ones to be drawn upon by one or more trade associations to be used in trade settlement and referee testing? Or may we take a disinterested and unworldly scientific attitude and hold that we are not concerned with the uses to which our standard methods may be applied — that they simply represent our selection of the best available so far as our committees have been able to determine, and their use is advocated generally in the interest of uniformity. If we take the first or utilitarian stand, then it is doubtful if the proposed stability test is adequate for our needs, provided we are to confine our judgment solely to the Committees' reported results. If the detached scientific view is held to be more proper for us, there would seem to be no serious objection to including this test in our Methods as a convenience to the many chemists who have come to value our collection; for many laboratories have found the test when properly conducted, to be simple and accurate and of considerable value.

It is hoped that the membership will make some definite expressions so that our incoming President may decide whether to form a new Stability Committee to rewrite the Swift test as a method for tentative adoption, or to await the development of a new and better test — one more suited to the Society's official needs.

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Cottonseed and the Southern Regional Research Laboratory*

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Abstract

Since many cotton farmers have borrowed to the limit on the lint portion of their crop, the cash income from the cottonseed is frequently the only money handled. Of vital interest to the cotton farmer and oil miller are efforts to increase the oil content of cottonseed, improve methods of extracting the oil in order to increase yields, and other research designed to improve the products from and raise the value of cottonseed. The commodities selected for initial study in the Southern Regional Research Laboratory are cotton, peanuts and sweetpotatoes, and in addition to research on cottonseed, such as enumerated above, studies will be carried out on cotton cellulose, the whole cotton plant, peanut oil and protein, sweetpotato starch and other products and by-products of the assigned commodities.

IN 1938, Congress directed the Secretary of Agriculture to establish four regional research laboratories, one in each of the major agricultural producing areas of the United States. An annual appropriation not to exceed a million dollars was made for each of these laboratories. The laboratories are "to conduct researches into and to develop new scientific, chemical and technical uses and new and extended markets and outlets for farm commodities and products and by-products thereof. Such research and development shall be devoted primarily to those farm commodities of which there are regular or seasonal surpluses, and their products and by-products."

I am aware of the fact that the major interest of the group in attendance here is in oils and fats. Our interests coincide on cottonseed and peanut oils. Naturally, the other products of cottonseed and peanuts — meal, hulls, etc., although of lesser importance as producers of revenue, also command our mutual attention. Before entering upon a particular discussion of cottonseed and peanuts, I should like to outline briefly the new regional research program which the Department of Agriculture is now undertaking.

The searching for new and wider industrial outlets and markets for farm products through research is just one of the several lines of attack on our national farm problem. Other attacks on this problem are being applied. One important line of attack which until now has received only minor attention from a monetary standpoint, is by means of research; not simply research on specific problems as they arise, as a sort of glorified trouble-shooting program, but rather a comprehensive, concerted, closely-knit, program of research — chemical, physical, biological, technological, and economic — all carried on with the specific aim of finding new and extended uses for farm commodities. We believe that research of this nature will pay, not immediately of course—that would be too much to hope for — but more and more with the passing of each year. We believe, moreover, that such a program is long overdue.

As a preliminary step to the setting up of these four Regional Research Laboratories, Congress provided for a survey to find out what research is now being carried on, to obtain suggestions for needed research, and to obtain information which would be helpful in fixing the scope of the laboratories. The members of this special survey staff visited every State of the Union, interviewing representatives of private and public research laboratories, educational institutions, and agricultural organizations. There was thus obtained a knowledge of the extent and nature of present research activities in the United States, and also many hundreds of suggestions regarding needed research on various farm commodities. Such information will be an invaluable aid in avoiding wasteful duplication of effort and as a guide in the selection of specific research projects.

In its survey of research and formulation of the objectives of its program, the Department has had the assistance and cooperation of a large number of those engaged in like work in Federal and State

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Government organizations, in universities and colleges, and in the research staffs of industry.

This was particularly true in the Southern Producing Area. From the comparatively large amount of material submitted by these groups, the Department formulated a suggested research program for the Southern Regional Laboratory. This program was general in nature, being more in the form of major objectives than of research projects. It was presented to a meeting of representatives of the Southern Producing Area at Birmingham last September. At this meeting, the Department received promises of assistance in formulating the detailed research projects and I can *assure* you we intend to call on you gentlemen when we get to work on the individual projects.

The response of all groups to the requests for suggestions and assistance has been very gratifying. Almost without exception, our survey people met with cooperative spirit and general expressions of encouragement and approval. Experienced directors of research have repeatedly expressed their approval of this new enlarged plan for aggressive national attack on surplus problems by the Government through research. The only real criticism that the Survey investigators encountered was that this research should have been started 10 or 15 years ago.

In order not to scatter the research effort over so wide a field as to make early and useful results on any of the products highly improbable, the Department decided to take up initially in each of the four laboratories only a limited number of commodities.

In the Southern Laboratory, *cotton, peanuts,* and *sweetpotatoes* have been selected for initial study. The fact that certain other commodities were not chosen is no indication that the Department considers them unimportant, or that research on them would be unprofitable. Quite the contrary is true of many products, but those named were selected as being most urgently in need of attention because of the surpluses, or because of the large number of people affected. Cotton, of course, will receive by far the greatest amount of attention in the Southern Laboratory.

There is no need to point out to this audience the importance and urgency of a research program on cotton. Cotton is the greatest cash crop of the United States. It is our most important export crop. Its production provides a livelihood to more people than any other plant crop. During the last ten years, cash farm income from cotton and cottonseed, in the principal cotton growing States, has accounted for about one-half of the total cash income from all crops and livestock combined. And yet the cotton-growing industry of the United States today is facing, not an expanding, nor even a static market, but a declining market and one which shows definite tendencies toward a further decline.

To many farmers the income from the cottonseed is of relatively greater importance than the value of the lint cotton. This is true in spite of the fact that the farm value of the lint cotton is about four times the farm value of the products of the cottonseed. I think that the late B. F. Taylor of The Cottonseed Crushers Association of South Carolina summed up the situation of the Southeast very aptly at a meeting in Columbia last June. He said that "By cotton-picking-time the cotton planter has necessarily borrowed all the money he can get on his cotton. Even though he has raised the cotton he is really taking someone else's property to the gin. Therefore the cottonseed rather than the lint is truly *his cash crop.*" The changing custom of purchasing cottonseed on oil content rather than by gross weight logically enhances the value of any oil research to the cotton farmer. From the agronomist we hear that the oil content of cottonseed can be increased by as much as 4 percent without any indicated ill effect on the cotton lint. Such an increase in the oil content would mean about 20 percent more oil per ton of seed. Such an increase should prove very acceptable to the cottonseed crushers and *if* this cottonseed with the higher oil content were sold *by its oil content* that would enable industry to turn more dollars into the pockets of the farmers. Of course your analyses show us that generally the protein content drops with an increase in the oil content. However, I am sure your oil mills would be glad to exchange, at present prices, a few pounds of cottonseed protein for the same weight of oil. And what about the high-oil, high-protein cottonseed we get from the irrigated cotton acres of the Southwest?

As we see it one of our big objectives is to take cottonseed as separated from the lint at the gins and through our investigations *contribute* to the better utilization of this complex material by helping your industry to produce higher grade products from the cottonseed, recovering these products in larger yields and perhaps improving the processing.

The most valuable constituent of the cottonseed is the oil. More than fifty percent of the value of the products produced from the cottonseed is represented by the oil which constitutes less than 17% of the weight of the products. The per pound value of the oil averages about five times that of the cake and meal, about twice that of the linters, and about 19 times that of the hulls. Any increase, therefore, in the oil content of the seed, or in the yield of oil from the seed, cannot help but increase the value of the cottonseed as a whole.

The average oil content of cottonseed during the 1936-37 season was 18.08 percent varying from 11.6% up to 22.0%. The fact that many lots of seed are received with analyses showing over 20% of oil leads an interested person to hope that some basis might be discovered or developed that might raise the average oil content of the entire crop. From the 13,000 cotton gins, operating one to two months each year, each gin handling about 400 tons of seed, your industry receives its five million tons of raw material — cottonseed. Before your 500 crushing mills start cleaning and delinting these oil seeds isn't there a possibility of contributions through research by the Southern Regional Research Laboratory on the storing of this raw material so that it will not deteriorate in storage. So, better equipped mills can extend operations from the present 3 to 5 month crushing period to an operating period of substantially 12 months each year. The comparatively slight additional storage charges made necessary by the full year operation would be insignificant compared to the savings possible on your present overhead costs per ton of seed crushed. With a reported average net profit of all cottonseed mills over the last decade of about 17c per ton of seeds crushed, and with the average conversion of 10,000 tons of seeds per mill, even slight indicated improvements through research should be most acceptable to your industry.

The comparatively recent change in your delinting processing is a sample of technical improvement in point. The upholstery and inexpensive mattress trade on the one hand and the chemical cellulose users on the other complained of the mill-run linters for different reasons. The upholstery and mattress trade found that the shorter linters in their raw material imparted to their manufactured articles undesirable qualities, while the chemical cellulose industry found the shorter second-cut linters technically as desirable as the longer linters. The mixture of the long and shorter linters made chemical conversion more difficult to control and as usual with this industry any reduction in price of the raw material was most acceptable. With your change in procedure, offering first-cut and second-cut linters instead of mill-run linters the upholstery trade is finding that the first-cut linters are fulfilling their requirements and the chemical cellulose industry is increasing its demands for the second-cut linters. I don't think that this change in processing was responsible for any decrease in revenue.

A source of possible increased income from cottonseed that enthuses cellulose chemists is hull-fiber. This material is very good cellulose and users of chemical cellulose have shown interest in this material. Hull-fiber was produced in 1937-38 to the extent of 65,451 bales of 500 pounds each. Most of this was exported. Approximately 200 pounds of hull fiber are available per ton of hulls and using this figure, the potential production of hull fiber is roughly 10,000 tons, or 40,000 bales per million bales of cotton produced. From a 15 million bale crop there could be obtained approximately 150,000 tons, or 600,000 bales of hull fiber, or about 10 times the amount produced during 1937-38. At the present time the only hull fiber produced is made when there is an outlet for hull bran which is the residual by-product. Hull bran is used only in blending with high-protein content cottonseed meal, but present tendencies in the selling of cottonseed meal and cake point to a desire on the part of livestock feeders for higher protein percentages so that this outlet for hull bran faces curtailment. New uses for cottonseed hull bran must accordingly be found in order to encourage the production of hull fiber. In the process for the production of hull fiber small particles of the hull become mixed with the short fiber. These specks show up in subsequent acetylation and even the fine paper manufacturers complain that these specks make their product unacceptable. We feel that the complete removal of these hull particles is not insurmountable. The exported hull fiber is used in the production of rayon. Some of this material mixed with linters has been so utilized in this country. With present equipment a considerable amount of this very short fiber is lost if used without adding linters. Considerable increase in value of the total products from cottonseeds would be accomplished with additional utilization of hull fiber.

In the Southern Regional Research Laboratory we are planning to have a group of scientists investigate the agricultural by-products and wastes of the cotton crop. It is roughly estimated that the South produces as by-products of the cotton crop about 18 million tons of cotton stalks and over a million tons of cottonseed hulls including the 150,000 tons of hull fiber referred to above. The investigations on these materials will be coordinated with one of our most important projects, that on cellulose. As you know, cotton lint is almost pure cellulose but we need to know a great deal more about the chemical and physical properties of this substance before we can utilize it to the best advantage.

Most of our agricultural by-products and wastes are cellulosic in nature. One line of investigation of these ligno-celluloses which has attracted considerable attention recently is the lignin plastic work. The Forest Products Laboratory in Madison, Wisconsin, working with wood products and the Agricultural By-Products Laboratory at Ames, Iowa, working with agricultural wastes have recently made progress in the experimental production of cheap lignin plastics. You may have seen some of the reports from the Forest Products Laboratory, and a report of the work at Ames appears in the March issue of "Modern Plastics." The investigators see no reason why cottonseed hulls, bagasse and other wastes cannot be used as well as wood sawdust for the production of a cheap plastic. Outlets for *even some* of these wastes and by-products in the South would mean millions of dollars added to the income of southern farmers and incidentally bring added revenue to your industry.

There will be investigations among those now planned, which when under way, will be of more interest to this group than by-products and waste investigations. I refer to protein investigations which will concern the two large protein products of the South: — the peanut meal and cottonseed meal. Just now cellulose chemistry seems to be exerting the greatest impact on our present day civilization. If any branch of chemistry is to exert a greater influence on us in the future it is the chemistry of proteins. A tremendous amount of fundamental work must be done. The investigators in this field have just scraped the surface, but the vistas opening up are astounding. This work must necessarily be tied up with the oil mills since they supply us with high-protein, peanut and cottonseed meals. Once we know more about these proteins we may desire a process in which the oil is separated at low temperatures, since such a procedure would give us a protein unmodified by heat, thereby presenting greater research possibilities.

The investigations in the Southern Regional Research Laboratory which will be of greatest interest to this group, naturally, will be those on cottonseed oil itself. Many interesting problems are presented here. The general factory operations of oil extraction, refining, bleaching, deodorizing and hydrogenation, have been developed to their present stage through a great deal of experimentation and the improvements that have been made in the past 25 years are considerable, but I venture to say that there are very few at this meeting who are completely satisfied with the present methods of performing these different operations. Dr. C. B. Cluff in a paper presented before your Dallas meeting in 1937 pointed out some of the lines along which improvements might be expected. Among the many things suggested, improvements in separation of the oil from the seed and reduction of the refining losses are in themselves potential sources of increased yields of oil per ton of seed, and consequently increased profits for all. It is interesting to note that many of these improvements go hand in hand, for in-

stance, improved extraction processes may in themselves so improve the quality of the crude oil as to greatly lessen the extent and severity of the treatment during refining, bleaching, and deodorizing, and consequently decrease the possibilities for losses and some of the expense involved in these operations. In connection with refining losses, Mr. Guy S. Meloy's remarks in his paper presented at this meeting on his tentative theories concerning the production of free fatty acids in cottonseed oil during the development of the seed may bring about a general improvement in the quality of cottonseed oil. It is certainly uneconomic to market cottonseed with a high free fatty acid content.

It is obvious, of course, that much of the program that I have been discussing with reference to cottonseed oil applies also to peanut oil, and it is expected that the protein and oil problems of these two crops will be studied simultaneously. There will be other projects, which, naturally, will be of less interest to this group, as for example, those on carbohydrates for increasing the industrial utilization of sweetpotato starch.

I have mentioned previously the purpose of research in these Regional Laboratories and I should like to state it again. The ultimate objective of the work of the laboratories *must* be and *will* be the increased *industrial use of the products of agriculture*. Every effort will, therefore, be made to have the scientific and engineering projects at the Regional Laboratories so organized as to be promptly adaptable to industries' use. As soon as any project matures to the point that industrial development is justified, every facility of the laboratories will be afforded to those interested so that they may put into practice the experimental findings at the earliest practicable date. The fact that industrial research laboratories have been very generous in cooperation during the Survey indicates that continued cooperation can be expected.

The Southern Laboratory is off to a good start in that we are getting splendid cooperation from the agriculture colleges, experiment stations and private laboratories and industries in this Region. That's exactly what we want. We want all the educational institutions, agricultural organizations and interested industries in the States that comprise the Southern Region to realize that the amount of help rendered by this Laboratory will depend, to a very great extent, on the cooperation it can develop.

In conclusion I want to say that we expect to put our best efforts into the Southern Laboratory. We plan to work for something worthwhile instead of something spectacular. In short, we plan to do our best to help the farmers of the South find new and more profitable outlets for their crops.

Report of the Refining Committee 1938-9

Expeller and Hydraulic Soybean Oils

It will be recalled that the tentative refining methods for expeller and hydraulic soybean oils, adopted after the Committee activities of 1936-37, were changed slightly after last year's cooperative study and were continued as tentative. The cooperative examination of these methods has been carried on again this year. Four check samples were sent to the Committee and the detailed results on individual samples are given on the attached tabulations covering samples numbered 1, 2, 5, and 6. Another tabulation ("Percentage Accuracy") shows the percentage of results both as to losses and color readings falling within the several tolerance limits up to within 0.5% of the average and over 0.5%. For ready reference, the following condensed tabulation will give the degree of accuracy based on the percentage of refining results falling within 0.3% of the average, within 0.5% of the average, and over 0.5%:

Expeller Oil

		Maximum Lye	2/3 Maximum Lye
No. 1	Results within 0.3%	75.0%	33.3%
	Results within 0.5%	8.3%	16.7%
	Results over 0.5%	16.7%	50.0%
No. 2	Results within 0.3%	75.0%	81.2%
	Results within 0.5%	12.5%	
	Results over 0.5%	12.5%	18.8%
No. 5	Results within 0.3%	80.0%	73.3%
	Results within 0.5%	6.7%	13.3%
	Results over 0.5%	13.3%	13.4%
No. 6	Results within 0.3%	75.0%	53.3%
	Results within 0.5%	12.5%	33.3%
	Results over 0.5%	12.5%	13.4%
Grand Average:			
	Results within 0.3%	76.3%	60.3%
	Results within 0.5%	10.0%	15.8%
	Results over 0.5%	13.7%	23.9%

It will be noted that with maximum lye, 86.3% of the reported refining losses were within 0.5% of the average, and that 76.1% were within 0.5% of the average with the 2/3 maximum lye. The Chairman considers this an excellent showing, particularly in view of the lack of experience of a number of members of the Committee with this type of analytical method.

Extracted Oil

The Committee last year recommended the tentative adoption of a method for refining extracted soybean oil which appeared to give satisfactory results. The study of this method was continued this year through four cooperative samples numbered 3, 4, 7, and 8. The results reported on these samples are given on the attached tabulations. The percentage of results falling within the several tolerance limits are covered in the tabulation on "Percentage Accuracy." As in the case of the expeller and hydraulic oils, a condensed tabulation follows, giving the percentage of refining results falling within 0.3% of the average, within 0.5% of the average, and over 0.5%:

		⅞ Maximum Lye (14 Be')	2/3 Maximum Lye (14 Be')
No. 3	Results within 0.3%	35.7%	71.4%
	Results within 0.5%	35.7%	
	Results over 0.5%	28.6%	28.6%
No. 4	Results within 0.3%	73.3%	46.7%
	Results within 0.5%	20.0%	33.3%
	Results over 0.5%	6.7%	20.0%
No. 7	Results within 0.3%	18.8%	46.7%
	Results within 0.5%	12.5%	26.7%
	Results over 0.5%	68.7%	26.6%
No. 8	Results within 0.3%	38.5%	40.0%
	Results within 0.5%	7.7%	13.3%
	Results over 0.5%	53.9%	46.7%