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To the Graduate Council:

I am submitting herewith a thesis written by Carol Sterling Murphey entitled "Cotton Fiber Testing by Mills in Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

DE A. Martin  
Major Professor

We have read this thesis  
and recommend its acceptance:

Laurence V Skold  
B. D. Raspopf  
O. Glen Hall  
J. J. Whitley

Accepted for the Council:

Dale Thantling  
Dean of the Graduate School

COTTON FIBER TESTING BY MILLS IN TENNESSEE

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A Thesis

Presented to  
the Graduate Council of  
University of Tennessee

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science

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by

Carol Sterling Murphey

March 1960

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## CHAPTER I

### INTRODUCTION

The official measures of raw cotton quality are grade and staple; however, cotton classers have attempted to estimate other characteristics of cotton. Mills have long recognized that grade and staple alone do not determine the spinning quality of cotton. In order to improve their buying practices, some mill buyers have purchased only from certain areas or specified varieties.

In recent years instruments have been developed to measure certain fiber properties. Fineness, strength, length, elongation, maturity, color, and nonlint content are among the properties that can be measured with the use of instruments. As mills use more accurate measures to determine spinning quality their demands are reflected in all channels of the cotton trade. In the 1956-57 season 82 percent of the domestic shipments and 72 percent of the foreign shipments by Memphis shippers were tested for one or more fiber properties.<sup>1</sup>

#### A. NEED FOR THE STUDY

Many instruments have been developed for measuring certain properties of cotton. However, no economic evaluation of the use of these measures by spinners has been made. Neither has an attempt been made to determine whether these tests are economically worthwhile, under what conditions they can be profitably utilized, and the nature and extent of

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<sup>1</sup>Jack Fontana, "Cotton Fiber Testing by Shippers in Tennessee" (unpublished Master's thesis, University of Tennessee, 1959).

the benefits of their use in buying, selling, and spinning cotton.

The shippers assemble cotton for the mills; consequently, it is desirable that they know the qualities of cotton that mills demand. The producer of cotton needs to evaluate its quality in the light of mill requirements.

Mills set up their fiber testing laboratories and began using test data more-or-less on a trail and error basis. Their need for a study to determine the feasibility of expanding the use of fiber testing is probably the most important one this study will fulfill.

#### B. OBJECTIVES OF THE STUDY

The overall objective of this study is to present information pertaining to fiber testing by cotton spinners in Tennessee.

The specific objectives are to determine the:

1. Nature and use of fiber test data by spinners in Tennessee.
2. Practices used in fiber testing.
3. Cost of fiber testing.
4. Fiber test results of specified properties.

#### C. REVIEW OF RELATED LITERATURE

In 1937 a study of cotton mills was made by the Tennessee Agricultural Experiment Station.<sup>2</sup> Included in this study were the purchasing practices of cotton mills and the quality of cotton they consumed. Fiber testing instruments and laboratory techniques as we know them today had

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<sup>2</sup>B. D. Raskopf, Relationship of Cotton Production to Consumption, Monograph 58, Tennessee Agricultural Experiment Station, 1937.

not been developed at this time, but it was evident that the mill operators were endeavoring to obtain a better evaluation of cotton quality characteristics.

A later study<sup>3</sup> by the Tennessee Agricultural Experiment Station, completed in 1950, revealed that as early as 1945 some cotton mills were using fiber testing instruments. This study indicated that laboratory tests of cotton fiber were becoming more important. Included in this report were the improvements needed to meet mill demand.

A bulletin by the Tennessee Agricultural Experiment Station in 1957 covered the status of fiber testing in foreign countries.<sup>4</sup> This study dealt with the magnitude, procedure, cost, and use of cotton fiber testing.

A regional study<sup>5</sup> has been made which deals with the use of fiber testing in the marketing of cotton by shippers in the United States. Several agricultural experiment stations have also published a portion of the data collected. These latter publications deal in particular with the status of fiber testing by shippers in their respective states.

The United States Department of Agriculture has published many reports dealing with fiber testing. Among the most useful to the spinner

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<sup>3</sup>B. D. Raskopf, Improvements Needed in Tennessee Cotton Quality and Marketing Practices to Meet Mill Requirements, Monograph 259, Tennessee Agricultural Experiment Station, 1950.

<sup>4</sup>B. D. Raskopf and Jack Fontana, Cotton Fiber Testing in Foreign Countries, Tennessee Agricultural Experiment Station, Bulletin 271, September, 1957.

<sup>5</sup>The Use Made of Fiber Testing by United States Cotton Shippers, Southern Cooperative Series Bulletin 62, June, 1959.

is the yearly summary of spinning results<sup>6</sup> and one dealing with the correlation of fiber properties to yarn strength.<sup>7</sup>

#### D. METHOD OF ANALYSIS

In order to show more clearly certain relationships, the eighteen cotton mills studied in Tennessee were classified according to the texture of yarn which they produced. Four classes were set up. They were as follows:

- Class I - Fine to very fine yarns for use in products meeting rigid strength and appearance requirements such as very fine yarn, combed broadcloth, lawns, dress materials and other fine fabrics.
- Class II - Medium to fine yarns for use in such products as print cloth, good quality sheeting and shirting, drills, poplins, chambray, sateens, knit heavy underwear, and hosiery yarns.
- Class III - Coarse to medium yarns for use in such products as twine, tire cord and fabrics, medium quality sheeting, ticking, duck, denim, twills, calicos, and bags.
- Class IV - Very coarse yarns for use in such products as low quality twine, mops, and batting.

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<sup>6</sup>Summary of Fiber and Processing Test Results on Some Varieties of Cotton Grown by Selected Cotton Improvement Groups for Crops of 1947 and Subsequent Years, Agricultural Marketing Service, United States Department of Agriculture.

<sup>7</sup>Robert W. Webb, Influence of Yarn Size on the Relative Contribution of Six Cotton Fiber Properties to Strength of Corded Yarn, United States Department of Agriculture Marketing Research, Report 109, December, 1955.

Even though some mills produced more than one class of yarn, the predominating quality of yarn produced determined the class into which the mill was placed.

#### E. MAJOR FIBER TESTS AND INSTRUMENTS

Fineness. Fineness is one of the most common fiber properties tested in the cotton trade. The degree of fineness of lint influences carding speed, nepiness, bleaching and dyeing, yarn appearance, and general processing performance.

The Micronaire is the most widely used instrument used to measure the fineness of lint. Studies have indicated that the Micronaire is the most common testing instrument used in the cotton trade. In 1956, the Port-ar, also an instrument for measuring fineness, was introduced. This instrument is gaining in popularity. Both the Micronaire and the Port-ar use air flow to measure the fineness of cotton fiber. Other instruments used to measure fiber fineness are the Arealometer, Speedar, and Fibronaire.

For comparative purposes, the United States Department of Agriculture has established descriptive designations for various ranges of fineness of cotton. These are as follows:

#### Fiber Fineness

(Micronaire readings or Micrograms-per-inch)

| <u>Range</u>            | <u>Descriptive designations</u> |
|-------------------------|---------------------------------|
| Below 3.0 . . . . .     | Very fine                       |
| 3.0 to 3.9 . . . . .    | Fine                            |
| 4.0 to 4.9 . . . . .    | Average                         |
| 5.0 to 5.9 . . . . .    | Coarse                          |
| 6.0 and above . . . . . | Very coarse                     |

Strength. Strength is probably the second most common property test of cotton fibers used by the cotton trade. The strength of cotton fiber affects yarn strength and spinning quality. Two methods are used to test cotton fibers for strength. One method, which is gaining in popularity, is measuring the breaking strength of an one-eighth inch array of fibers. Instruments used to measure fiber strength include the Pressley, Stelometer, and Clemson Flat Bundle Tester.

The United States Department of Agriculture uses the following descriptive designations for cotton fiber strength:

#### Fiber Strength

(Zero gauge)

| <u>Thousand of pounds<br/>per square inch</u> | <u>Descriptive<br/>designation</u> |
|-----------------------------------------------|------------------------------------|
| Above 95 . . . . .                            | Very strong                        |
| 86 to 95 . . . . .                            | Strong                             |
| 76 to 85 . . . . .                            | Average                            |
| 66 to 75 . . . . .                            | Fair                               |
| Below 66 . . . . .                            | Weak                               |

Staple length and length uniformity. Even though staple length and length uniformity are somewhat different properties they are usually associated together. These properties influence carding and drafting setting, yarn strength, mill waste, and general processing performance.

While the official length of cotton fiber is a subjective measure as determined by hand cotton classing, the Fibrograph and Suter Webb Sorter are instruments used to measure the length of cotton fiber.

The United States Department of Agriculture uses the following descriptive designations for uniformity of length of cotton:

#### Uniformity Ratio for Fiber Length

| <u>Ratio</u>           | <u>Rating</u>             |
|------------------------|---------------------------|
| Above 80 . . . . .     | Uniform in fiber length   |
| 75 to 80 . . . . .     | Average uniformity        |
| 74 and below . . . . . | Irregular in fiber length |

The uniformity ratio expresses the ratio between the mean length and upper half mean. In computing the mean length, fibers less than one-fourth inch are disregarded. The upper half mean, commonly referred to as the length as determined by the fibrograph, is the average length of the fibers longer than the mean. This is usually expressed to the nearest one-hundredth of an inch, or converted to thirty-seconds of an inch.

#### F. SELECTED SPECIALIZED TEST

In addition to the tests listed above, other tests have been developed. In general these tests have not been used as frequently as have tests for fineness, strength, or length.

Maturity. Nepiness, dyeing quality, yarn appearance, and picker and card waste are influenced by maturity. Instruments and techniques used to measure maturity are Causticaire, microscope, differential dye technique, and AreaLometer.

The United States Department of Agriculture uses the following

descriptive designations for maturity.

| Fiber Maturity<br>(Index) |                                    |
|---------------------------|------------------------------------|
| <u>Range</u>              | <u>Descriptive<br/>designation</u> |
| Above 81 . . . . .        | Mature                             |
| 76 to 81 . . . . .        | Average                            |
| 70 to 75 . . . . .        | Immature                           |
| Below 70 . . . . .        | Very immature                      |

Nonlint content. Foreign matter in lint affects grade, waste, spinning quality, and yarn appearance. The Shirley Analyzer is used to measure nonlint content. No standard descriptive designation has been established for nonlint content. However, the average nonlint content for the White grades are as follows:

| Percent Nonlint Content        |                            |
|--------------------------------|----------------------------|
| <u>Grades</u>                  | <u>Percent<br/>nonlint</u> |
| Strict Middling . . . . .      | 2.9                        |
| Middling . . . . .             | 3.7                        |
| Strict Low Middling . . . . .  | 5.1                        |
| Low Middling . . . . .         | 7.6                        |
| Strict Good Ordinary . . . . . | 11.0                       |
| Good Ordinary . . . . .        | 17.0                       |

Nep count. Neps in cotton influence grade, "ends down" in spinning, yarn appearance, and dyeing quality. Nep count is measured in neps per

area of card web or neps per grain of cotton. Nep count is determined with either the Nepmeter or Nepometer. The following descriptive designations are used by the United States Department of Agriculture.

Number of Neps per One Hundred Square Inches of Card Web

(Based on card production rate of 9 1/2 pounds per hour)

| <u>Number<br/>of neps</u> | <u>Descriptive<br/>designation</u> |
|---------------------------|------------------------------------|
| Below 16 . . . . .        | Low                                |
| 16 to 30 . . . . .        | Average                            |
| 31 to 45 . . . . .        | High                               |
| Above 45 . . . . .        | Very high                          |

Sugar content. High sugar content of cotton fibers makes bleaching and dyeing as well as carding and spinning more difficult. High sugar content may be associated with immaturity. The percent sugar is determined by chemical analysis. The level that sugar content may reach before adversely affecting spinning seems to be about 0.3 percent reducing sugar.

Acid-alkaline values. Acid-alkaline values are measured in pH. A pH above 7.0 indicates alkalinity and a pH below 7.0 indicates acidity. The pH of the water extract is measured with either a chemical-colorimeter test or with an electronic meter.

Color. Color influences grade, yarn appearance, bleaching and dyeing. The Colorimeter is used to measure this property. The color values may be used for comparison with the color of cotton in official standards.

Other tests. In addition to those described, tests have been developed to measure elongation, oxidation, wax content, moisture content, and moisture regain, as well as other tests for processed or partially processed cotton.

#### G. COLLECTION OF DATA

All of the eighteen cotton mills in Tennessee were included in this study. The locations of the mills are shown in Figure 1. The schedules were taken during July and September of 1958.

The information recorded on the schedules was obtained by personal interview. At each mill the enumerator requested an interview with the cotton buyer for that mill. Unless the cotton buyer was out of town he acted as respondent. The buyer frequently called upon other personnel in order to furnish more accurate data. If the cotton buyer were not available, someone else, usually the laboratory technician or mill superintendent, was interviewed. No difficulty was experienced in securing data from the cotton mills. See Appendix B for a copy of the mill schedule used in the survey.



## CHAPTER II

### EXTENT AND USE OF COTTON FIBER TEST DATA

#### A. PURCHASES BASED ON FIBER TEST DATA

The two mills producing fine to very fine yarn (Class I) purchased 8,000 bales of cotton direct from producers and ginners on which test data for fineness were available prior to purchase (Table I). Fineness was specified on the remainder of their purchases which was from shippers. Strength data were available prior to purchase on cotton bought direct, but no cotton was purchased from shippers on strength specifications by Class I mills.

The seven mills producing medium to fine yarn or Class II mill purchased 45,320 bales direct on which fineness test data were available prior to purchase. These mills purchased a total of 114,688 bales of cotton with known or specified fineness, and 85,620 bales of cotton with known strength properties. The four mills in Class III, producers of coarse to medium yarn, purchased 24,150 bales on which test data were available or specified for fineness.

Purchases based on fiber test by origin are shown in Appendix A, Table XV.

#### B. REASONS FOR USING FIBER TEST DATA

The official measures of raw cotton quality are grade and staple which are subjective measures determined by a cotton classer. Laboratory measures are available which will aid or supplement the classer in

TABLE I

COTTON PURCHASES BASED ON FIBER TEST BY END PRODUCT CLASSES,  
EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| End<br>product<br>classes | Direct purchases on which<br>test data were available<br>prior to purchase for: |          | Purchases from shippers<br>made on fiber test<br>specifications for: |          | Total cotton purchased<br>with specified or known<br>characters for: |          | Total<br>all<br>cotton |
|---------------------------|---------------------------------------------------------------------------------|----------|----------------------------------------------------------------------|----------|----------------------------------------------------------------------|----------|------------------------|
|                           | Fineness                                                                        | Strength | Fineness                                                             | Strength | Fineness                                                             | Strength |                        |
| Class I                   | 8,000                                                                           | 8,000    | In running bales                                                     |          | 23,400                                                               | 8,000    | 23,400                 |
| Class II                  | 45,320                                                                          | 42,420   | 15,400                                                               | --       | 114,688                                                              | 85,620   | 127,168                |
| Class III                 | 14,400                                                                          | 14,400   | 69,368                                                               | 43,200   | 24,150                                                               | 15,600   | 27,931                 |
| Class IV                  | --                                                                              | --       | 9,750                                                                | 1,200    | 1,000                                                                | --       | 35,072                 |
| Total                     | 67,720                                                                          | 64,820   | 1,000                                                                | --       | 163,238                                                              | 109,220  | 213,571                |

determining the grade and staple as well as measuring properties which the classer is unable to determine or only approximate. Ten of the mills in Tennessee were using fiber test data in order to better measure the qualities of raw cotton (Table II).

Mixing is the process whereby a spinner takes cotton of different grades or staple lengths from several bales and mixes them together. By the process of mixing the spinner is able to develop more uniform mixes throughout the year. In the last several years spinners have begun to use laboratory tests in order to obtain more uniform mixes and to obtain mixes of desired qualities. Ten of the eighteen mills in Tennessee used fiber test data in their mixing and blending operations. This gave the spinner more control over the finished product since by knowing the properties of cotton going into the mix the miller is able to adjust the mill machinery to make different products.

The spinner can exercise control over the quality of end products when the different qualities of cotton are known. This is possible since certain cotton properties are closely related and partial substitutes for each other. The adjusted beta values of specified properties to yarn strength have been measured for three crop years on 842 lots of cotton and 3,267 observations. The average contributions of these properties to yarn strength are as follows:<sup>1</sup>

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<sup>1</sup>Robert W. Webb, Influence of Yarn Size on the Relative Contribution of Six Cotton Fibers Properties to Strength of Corded Yarn, United States Department of Agriculture Marketing Research, Report 109, December, 1955.

TABLE II

REASONS GIVEN FOR USING FIBER TEST DATA, EIGHTEEN COTTON MILL  
OPERATORS, TENNESSEE, 1957-58

| Reasons for using cotton fiber tests                                            | Number<br>of mills |
|---------------------------------------------------------------------------------|--------------------|
| To obtain better measures of raw cotton quality . . . . .                       | 10                 |
| For mixing and blending . . . . .                                               | 10                 |
| To develop data for use in controlling<br>processing operations in the area of: |                    |
| Carding rate . . . . .                                                          | 10                 |
| Nep count . . . . .                                                             | 7                  |
| Ends down in spinning . . . . .                                                 | 10                 |
| Yarn strength . . . . .                                                         | 10                 |
| Yarn appearance . . . . .                                                       | 9                  |
| Bleaching and dyeing . . . . .                                                  | 9                  |
| Quality control . . . . .                                                       | 9                  |
| To avoid getting culls . . . . .                                                | 9                  |
| Total using fiber test data . . . . .                                           | 11                 |
| Total all mills . . . . .                                                       | 18                 |

| <u>Factor</u>                         | <u>Percent</u> |
|---------------------------------------|----------------|
| Yarn size . . . . .                   | 49.72          |
| Upper half mean . . . . .             | 16.60          |
| Fiber strength . . . . .              | 10.34          |
| Fiber fineness . . . . .              | 6.11           |
| Length uniformity ratio . . . . .     | 1.71           |
| Percentage of mature fibers . . . . . | 1.12           |
| Grade index . . . . .                 | 1.00           |

To reduce labor cost many mills are using larger bobbins, even though these larger bobbins increase "ends down,"<sup>2</sup> or the breakage of the yarn at the spinning frame. By varying the speed of the frames, some of these "ends down" can be eliminated. Not only is the spinner plagued by "ends down," but the weaver is also. Ten of the mills in Tennessee were developing data which will help them control the number of "ends down" (Table II).

Only seven of the mills used fiber tests to develop data in controlling nep count, while eleven mills used fiber test data. Nine of the mills used fiber testing to aid in their bleaching and dyeing operations.

#### C. NUMBER AND TYPE OF INSTRUMENTS AND LENGTH OF OWNERSHIP

More Micronaires, instruments for measuring the fineness of cotton, were owned than any other type of instrument. Five of the mills had

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<sup>2</sup>"Ends down" refers to the breakage of yarn in either spinning or weaving.

owned a Micronaire for over eight years (Table III). Ten Micronaires were owned by nine mills. One mill which did not own a Micronaire owned a Port-ar for measuring fineness.

The Port-ar is a relatively new instrument for measuring fineness and only two mills owned them. This instrument is portable and easy to operate. Several cotton buyers expressed the opinion that the Port-ar would be a very useful instrument to use at the cotton gin or other places where the Micronaire is not commonly found.

Six mills owned nine Pressleys, instruments used for measuring the strength of cotton. Three of these mills had owned a Pressley for over eight years. Only one mill which had not previously owned a Pressley had purchased one during the last four years. One of the chain mills had tests for strength made at its central laboratory, and another mill had tests for strength made at a commercial laboratory.

Seven Fibrographs for measuring staple length and length uniformity were owned by six cotton mills. All of the mills which operated a Fibrograph had owned them five or more years. These machines were not used as intensively as were the Micronaires or Pressleys as there is a very high correlation between the upper half mean as measured by the Fibrograph and staple length as determined by a cotton classer.

Two mills owned a Colorimeter which is an instrument used to measure color by reflectance and degree of yellowness of lint. The Suter Webb Sorter which is an instrument used for measuring length, and the Shirley Analyzer which is an instrument used for measuring the non-lint content in cotton were both owned by one mill. Two other mills owned either the Suter Webb Sorter or the Shirley Analyzer. Ultra

TABLE III

NUMBER AND TYPES OF COTTON FIBER TESTING INSTRUMENTS OWNED AND LENGTH OF OWNERSHIP, EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58<sup>a</sup>

| Instruments               | Number of instruments | Length of ownership |           |              | All mills |
|---------------------------|-----------------------|---------------------|-----------|--------------|-----------|
|                           |                       | 1-4 years           | 5-8 years | Over 8 years |           |
| Number of mills reporting |                       |                     |           |              |           |
| Micronaire                | 10                    | 1                   | 3         | 5            | 9         |
| Port-ar                   | 2                     | 2                   | -         | -            | 2         |
| Pressley                  | 9                     | 1                   | 2         | 3            | 6         |
| Fibrograph                | 7                     | -                   | 3         | 3            | 6         |
| Colorimeter               | 2                     | -                   | 1         | 1            | 2         |
| Suter Webb Sorter         | 2                     | -                   | 1         | 1            | 2         |
| Shirley Analyzer          | 2                     | -                   | 1         | 1            | 2         |

<sup>a</sup>Other instruments or devices owned by mills:

Ultra violet light, 3 mills

Differential dye, 1 mill

Microscope, 1 mill

violet light was used by three mills as an aid in determining the color and degree of disintegration of lint. The differential dye technique was used by one mill to determine maturity while another used a microscope for the same purpose.

#### D. TIME OF USING FIBER TEST DATA

Nine of the eleven mills which used fiber test data possessed knowledge of the cotton quality based on fiber test before purchasing cotton (Table IV). Some of these data were supplied by the seller. On other occasions the mill buyer made these tests.

Eight mills used test data at the time of purchase. Some shippers would test individual samples on the table for the mill buyer. At other times the buyer would test the samples. This was a common method when cotton was purchased from a ginner or small shipper.

Ten mills owned instruments and all of the cotton mill operators tested cotton after it had been purchased. The one mill which used fiber test data, but did not test cotton after purchase, was supplied fiber test information by the shipper.

#### E. POSSIBLE RESULTS IF FIBER TEST WERE DISCONTINUED

Tests for fineness and strength were the two most commonly used by millers. Three spinners stated that without fiber tests for fineness they would have less knowledge on which to base their decisions in cotton processing (Table V). It was impossible for them to say exactly what would have been the results if fiber testing were discontinued. Four were of the opinion that they would have poorer operations if fiber tests

TABLE IV

TIME OF USING FIBER TEST DATA BY VOLUME OF COTTON CONSUMED,  
EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| Bales of<br>cotton<br>consumed | Time of using fiber test data |                           |                                               | All mills                   |                                 |
|--------------------------------|-------------------------------|---------------------------|-----------------------------------------------|-----------------------------|---------------------------------|
|                                | Before<br>purchase            | At time<br>of<br>purchase | After purchase<br>and/or during<br>processing | Using<br>fiber test<br>data | Not using<br>fiber test<br>data |
| Number of mills reporting      |                               |                           |                                               |                             |                                 |
| Less than 10,000               | 1                             | 1                         | 2                                             | 2                           | 6                               |
| 10,000-20,000                  | 4                             | 3                         | 3                                             | 4                           | 1                               |
| Over 20,000                    | 4                             | 4                         | 5                                             | 5                           | -                               |
| All mills                      | 9                             | 8                         | 10                                            | 11                          | 7                               |

TABLE V

POSSIBLE RESULTS IF FIBER TEST WERE DISCONTINUED FOR SPECIFIED  
PROPERTIES, EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| Test<br>used              | Less<br>knowledge | Poorer<br>operation | Poorer<br>quality<br>product | Higher<br>cost | Very<br>little<br>or no<br>effect | All mills       |                        |
|---------------------------|-------------------|---------------------|------------------------------|----------------|-----------------------------------|-----------------|------------------------|
|                           |                   |                     |                              |                |                                   | Making<br>tests | Not<br>making<br>tests |
| Number of mills reporting |                   |                     |                              |                |                                   |                 |                        |
| Fineness                  | 3                 | 4                   | 2                            | 1              | 1                                 | 11              | 7                      |
| Strength                  | 3                 | -                   | 1                            | -              | 4                                 | 8               | 10                     |

for fineness were not used. This was probably most noticeable in the control of "ends down" in spinning. Two stated that they would turn out a poorer quality product if it were not for fiber test. One mill operator had become rather proficient in mixing cotton fibers that were to be spun and dyed. In fact, this spinner had not had a claim due to inferior dyeability since he had started testing for fineness.

Four millers, that had strength test data, felt that without this information their milling operations would be affected very little or none at all. Only one felt this way about fineness testing.

## CHAPTER III

### PROCEDURE USED IN FIBER TESTING

#### A. TESTING COTTON FOR FINENESS

No standard procedure in determining the number and kind of sample has been developed in testing for fineness. The procedures used by the spinners in Tennessee are shown in Table VI.

Nine of the ten mills testing for fineness used only one test per sample. Five mills, or half of those testing for fineness, tested only one side of the bale. Two of the mills blended two sides in preparing their test sample. One mill secured its test sample by removing small quantities of cotton throughout the bale and blending these for testing.

Two mills blended lots of cotton for testing. These lots ranged in size from 50 to 100 bales. In lot testing, samples were secured from each bale, and these samples were then blended. One mill ran one test per sample, and the other ran four tests per sample.

#### B. TESTING COTTON FOR STRENGTH

Six mills tested cotton for strength in their laboratories. All of these used zero gauge setting but the number of breaks used per sample varied from 1 to 6 (Table VII). The zero gauge was in use before the one-eighth inch came into existence. There is a higher correlation between yarn strength as measured with one-eighth inch gauge setting

TABLE VI  
FINENESS: TESTS PER SAMPLE AND PROCEDURE  
EIGHTEEN COTTON MILLS, TENNESSEE  
1957-58

| Tests per<br>sample | Procedure used<br>in testing | Number of<br>mills testing |
|---------------------|------------------------------|----------------------------|
| 1                   | One side of bale             | 5                          |
| 1                   | Blend two sides              | 2                          |
| 1                   | Blend throughout the bale    | 1                          |
| 1                   | Blend lots                   | 1                          |
| 4                   | Blend lots                   | 1                          |

TABLE VII

BREAKS PER SAMPLE AND GAUGE SETTING USED IN TESTING FOR STRENGTH,  
EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| Number<br>of mills | Breaks made<br>per sample | Gauge setting |
|--------------------|---------------------------|---------------|
| 1                  | 1                         | Zero          |
| 2                  | 2                         | Zero          |
| 2                  | 3                         | Zero          |
| 1                  | 6                         | Zero          |

than there is as measured with the zero gauge setting.<sup>1</sup> There is no standard conversion factor for converting one-eighth gauge to zero gauge or vice versa since the two measure somewhat different properties. The conversion table below was calculated by the writer and is based on data collected by the United States Department of Agriculture.<sup>2</sup>

| Zero gauge<br>(In 1,000 pounds) | One-eighth inch gauge<br>(Fiber strength index) |
|---------------------------------|-------------------------------------------------|
| over 95                         | over 113                                        |
| 86 - 95                         | 102 - 113                                       |
| 76 - 85                         | 90 - 101                                        |
| 66 - 75                         | 78 - 89                                         |
| 65 and below                    | 77 and below                                    |

#### C. TESTING COTTON FOR OTHER FIBER PROPERTIES

Six mills owned Fibrographs. In using this instrument a specimen from the sample was combed. The combed fibers were placed in the machine which plotted a curve of the length of fibers. The operator then read the mean length and upper half mean length. From these two readings the uniformity ratio was calculated.

Two mills used the Colorimeter. This instrument measures two properties: percent of reflectance (degree of lightness) and degree of yellowness. The operator placed a sample of cotton over an opening and

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<sup>1</sup>Cotton Testing Service, United States Department of Agriculture, Cotton Division, AMS No. 16, February, 1955.

<sup>2</sup>Ibid.

pressed a button and both property readings were automatically indicated on two different scales. One mill used a microscope to examine cotton fibers for maturity and another mill used the differential dye technique to determine fiber maturity.

The Shirley Analyzer was used by two mills. The technician placed a known amount of cotton by weight in the machine. By mechanical means the trash was separated from the lint. The trash was collected and weighed and then the percentage of trash in the sample was calculated.

The Suter Webb Sorter gave the most complete information on fiber length of any instrument used. The standard procedure for mill utilization was to calculate by weight the upper quartile length and mean length of the cotton. The standard deviation of the weight-length frequencies was calculated and expressed as a percentage of the mean length which was known as the coefficient of length variation.

#### D. CHECKING FIBER TESTING INSTRUMENTS

All ten mills which owned instruments reported the use of calibrated cottons in checking their instruments. Most of the mills used these samples daily, but one mill used its samples only when the mill's instrument did not agree with the contract specifications.

The mills had several sources of calibrated cottons. Among these were the United States Department of Agriculture and the ASTM Standards on Textile Materials. In addition, other private firms and state agencies sold blended samples. Test cottons for fineness are prepared by the United States Department of Agriculture.

When checking with a control or standard sample, the Micronaire may be considered synchronized if the reading deviates 0.1 or less Micronaire reading. If the readings are consistently either above or below standard, the instrument should be checked. In check testing for strength, no standard tolerance has been established due to the many factors that may influence the reading.

## CHAPTER IV

### COST OF FIBER TESTING

#### A. COST OF INSTRUMENTS

The Micronaire was owned by more mills than any other instrument even though other machines for measuring fineness compared favorably in price (Table VIII). All instruments for measuring fineness do not express fineness in a common unit. However, the Port-ar has a scale for Micronaire readings. This is the most common unit of measurement for fineness in the spinner's market in Tennessee. The Port-ar is relatively new and has the advantage of ease of portability. However, the Arealometer can also be used to determine the maturity of lint as well as fineness.

The Pressley and Stelometer measure the strength of cotton fibers. Readings of both machines are expressed in a common unit. The Pressley is priced below the Stelometer; however, the Stelometer can be used to determine elongation. The Fibrograph and Suter Webb Sorter both measure the length of cotton fibers. Each instrument measures the fibers differently and thus expresses fiber length and fiber length relationships in non-interchangeable units.

The Shirley Analyzer is rather expensive when compared with instruments for measuring other properties. The United States Department of Agriculture has determined the average amount of trash in the different grades of cotton.<sup>1</sup> However, grades of cotton do not accurately reflect

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<sup>1</sup>Summary of Fiber and Processing Test Results on Some Varieties of Cotton Grown by Selected Cotton Improvement Groups, Crop of 1956, United States Department of Agriculture, Agricultural Information, Bulletin No. 70, March, 1957.

TABLE VIII  
RETAIL PRICES OF SPECIFIED FIBER TESTING INSTRUMENTS,  
F.O.B. SUPPLIER, 1959<sup>a</sup>

| Instrument                     | Test                          | Price   |
|--------------------------------|-------------------------------|---------|
| <sup>b</sup> Micronaire        |                               |         |
| Automatic                      | Fineness                      | \$1,500 |
| Non-automatic                  | Fineness                      | 800     |
| <sup>b</sup> Port-ar           | Fineness                      | 685     |
| Speedar                        | Fineness                      | 1,237   |
| Arealometer                    | Fineness and maturity         | 858     |
| <sup>b</sup> Pressley          | Strength                      | 465     |
| Stelometer                     | Strength                      | 675     |
| <sup>b</sup> Fibrograph        | Length and length uniformity  | 2,380   |
| <sup>b</sup> Suter Webb Sorter | Length and length variability | no data |
| <sup>b</sup> Colorimeter       | Yellowness and reflectance    | 2,900   |
| <sup>b</sup> Shirley Analyzer  | Nonlint content               | 3,500   |

<sup>a</sup>Source: Various price lists for 1959

<sup>b</sup>Instruments owned by mills in Tennessee

the amount of foreign matter in cotton, especially when minute leaf particles are present. Actual data for the cost of owning and operating a fiber testing instrument are not available. However, some estimated costs are available.<sup>2</sup>

#### B. TESTING COST PER SAMPLE

The mills had no way of accurately determining how much it cost to test a sample for different fiber properties. Nevertheless, some were able to give rough estimates. Wide variations occurred in the estimates, partially due to variations in length of time it took laboratory technicians to perform a test, the number of tests performed per mill, the basis of testing, and the method of securing samples.

Ten mills estimated the cost of testing for fineness. Nine of these mills were using the Micronaire, one the Port-ar, and the other was using both instruments. The median of the estimates was \$0.03 per test (Table IX). Six mills estimated the cost of testing for strength. The median of the estimated cost in testing for strength was \$0.09. Only four mills estimated the cost of testing for length uniformity, and the median of these estimates was \$0.30 per test.

#### C. FEE LABORATORY COST OF COTTON FIBER TESTING

Commercial laboratories will generally grant special discounts for annual contracts or volume commitments. Many commercial laboratories use a sliding price schedule whereby, as the number of tests performed

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<sup>2</sup>Jack Fontana, "Cotton Fiber Testing by Shippers in Tennessee," (unpublished Master's thesis, University of Tennessee, 1959).

TABLE IX

FIBER TESTING COST PER SAMPLE OF COTTON, EIGHTEEN COTTON MILLS,  
TENNESSEE, 1957-58

| Test              | Number of<br>mills<br>reporting | Median cost<br>per test | Range<br>in<br>cost |
|-------------------|---------------------------------|-------------------------|---------------------|
| Fineness          | 10                              | \$0.03                  | \$0.01-0.75         |
| Strength          | 6                               | 0.09                    | 0.04-0.80           |
| Length uniformity | 4                               | 0.30                    | 0.15-1.00           |

increase, the price per test decreases. Also, combination tests are sometimes performed at a discount. The common basis of reporting fiber tests vary among fee laboratories. Minimum charges are usually stipulated by all commercial laboratories. Price quotations of three laboratories are shown in Table X.

In general, the number of determinations or basis of reporting of a sample is a factor in the variations of charges. For example, the United States Department of Agriculture charges \$0.75 for the average Micronaire reading based on two specimens from a blended sample. On the other hand, they charge \$0.25 per Micronaire reading on each unblended sub-sample. In addition, at no extra charge, they give the average Micronaire reading of the sub-samples as based on one specimen from the sub-samples.

TABLE X

RANGE IN PRICES OF SPECIFIED FIBER TESTS PER SAMPLE AS BASED  
ON VOLUME DISCOUNT BY FEE LABORATORIES,  
MEMPHIS, TENNESSEE, 1958<sup>a</sup>

|                               | Fineness   | Strength    | Length<br>uniformity | Combination<br>of all three |
|-------------------------------|------------|-------------|----------------------|-----------------------------|
| Com. Lab. I                   | \$0.08-.20 | \$0.75-0.85 | \$0.60-0.70          | <sup>b</sup>                |
| Com. Lab. II                  | 0.08-.20   | 0.60-0.85   | 0.50-0.75            | 1.20-1.70                   |
| U.S. Dept. Agri. <sup>c</sup> | -.75       | 1.50        | 1.50                 | 3.00                        |

<sup>a</sup>Source: Regulations of the Department of Agriculture for Cotton Fiber and Processing Tests, Agricultural Marketing Service, United States Department of Agriculture, 1958, and price list of two commercial testing laboratories.

<sup>b</sup>Not available.

<sup>c</sup>Price per single sample. Fineness based on two determinations  
Strength and length uniformity based on four determinations.

## CHAPTER V

### FIBER TEST RESULTS FOR SPECIFIED PROPERTIES

#### A. RANGE IN QUALITY OF COTTON CONSUMED

The eighteen mills in Tennessee consumed a total of 213,571 bales of cotton (including 25,153 bales of waste). Of the cotton consumed, 7.4 percent or 15,795 bales were Strict Middling. Middling cotton accounted for 58.3 percent or 124,548 bales. Strict Low Middling or lower totaled 48,075 bales or 22.5 percent. The balance of consumption was waste which amounted to 11.8 percent or 25,153 bales.

With the exception of waste, only one mill used cotton with a staple length of less than one inch (Figure 2). The quality of cotton consumed by this mill covered a wide range. Excluding waste, approximately 79 percent of the cotton consumed by the mills had a staple length longer than an inch.

Only two mills consumed cotton with a Micronaire reading below 3.0. One of these mills consumed cotton with a Micronaire reading of 6.0 or above. This was the only mill which had test data available that used such coarse cotton.

Eight mills used fiber test data for strength. Only two of these used cotton that tested 95,000 pounds per square inch or over at zero gauge setting. On the other hand, only two mills used cotton that tested below 76,000 pounds per square inch at zero gauge setting.

#### B. RELATIONSHIP OF FIBER PROPERTIES TO END PRODUCT CLASSES

Fineness. Fineness information was available on 184,718 bales or

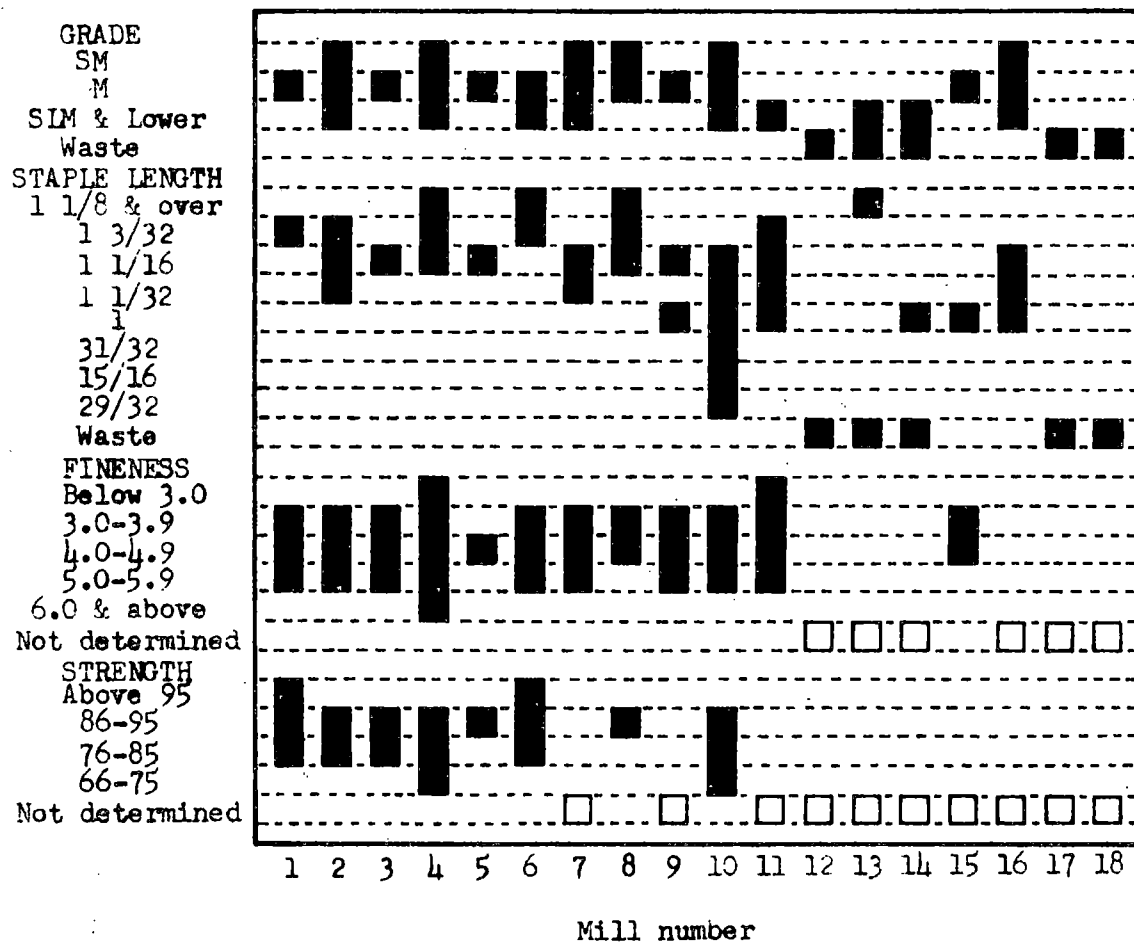


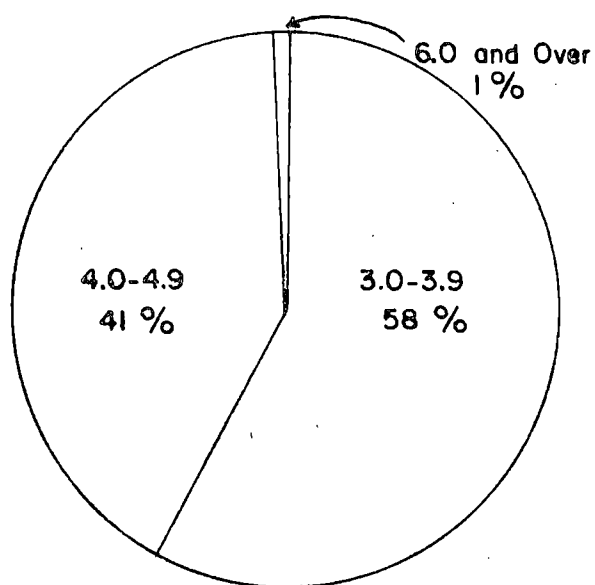
Figure 2. Ranges in specified properties of cotton consumed, eighteen cotton mills, Tennessee, 1957-58.

approximately 86 percent of the 213,571 bales consumed by the eighteen cotton mills. The mills that were in Class I, producers of fine to very fine yarn, consumed no cotton with a Micronaire reading below 3.0 nor any coarser than 5.9 (Figure 3 and Appendix A, Table XVI). Approximately 58 percent of their 23,400 bale consumption or 13,632 bales had a Micronaire reading of 3.0 to 3.9. Most of the rest of the cotton consumed, 9,448 bales or about 41 percent of their consumption, had a Micronaire reading of 4.0 to 4.9. Only 320 bales or approximately 1 percent had a Micronaire reading of 5.0 or above. As a group these mills consumed cotton with a finer lint than did mills in any other group.

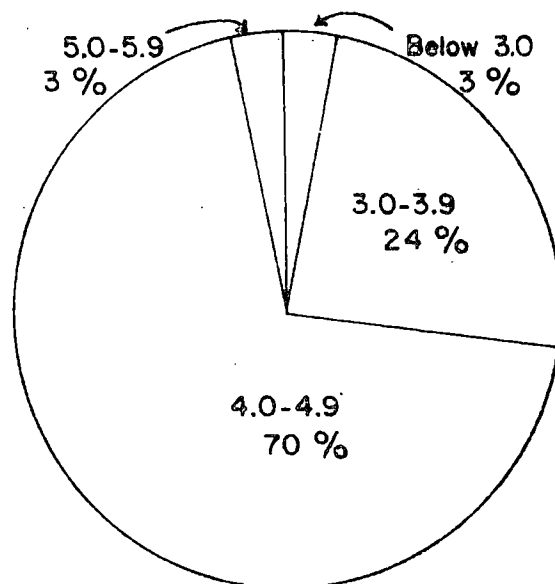
Mills in Class II, manufacturing medium to fine yarn, were the largest class from both the standpoint of number of mills and amount of cotton consumed. These mills consumed 127,168 bales of cotton. Approximately 3 percent or 3,437 bales of cotton consumed by Class II mills had a Micronaire reading of 3.0 or above. About 70 percent of the cotton which these mills consumed had a Micronaire reading of 4.0 to 4.9. Only 0.3 percent of the cotton consumed by these mills had a Micronaire reading of 6.0 or above. No other class of mills which had fiber test data on fineness consumed cotton which was this coarse.

The mills in Class III, producing coarse to medium yarn, consumed a total of 27,931 bales of cotton. The fineness of lint was not known on 3,781 bales or about 14 percent. Most of their consumption, or approximately 59 percent, had a Micronaire reading of 4.0 to 4.9.

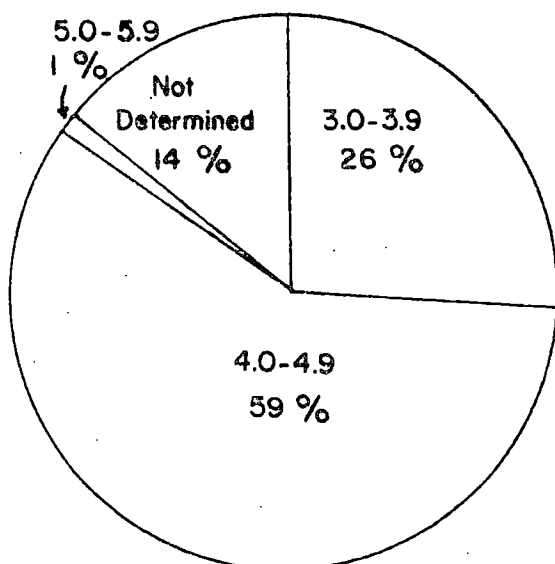
Of the cotton consumed by mills producing very coarse yarn, or Class IV mills, 71 percent had not been tested for fineness. Most of the cotton consumed by these mills was low grade or waste.



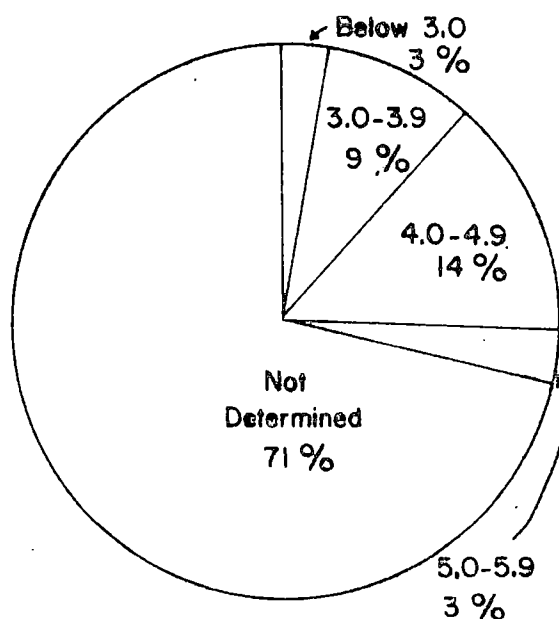
Class I  
(23,400 bales)



Class II  
(127,168 bales)



Class III  
(27,931 bales)



Class IV  
(35,072 bales)

Fineness in Micronaire readings indicated in ranges

Figure 3. Percentage distribution of fineness of cotton consumed by end product classes, eighteen cotton mills, Tennessee, 1957-58.

Strength. Fiber strength data were available on 142,200 bales or approximately 67 percent of the 213,571 bales consumed by the 18 cotton mills. The cotton consumed by Class I mills was stronger than the cotton used by the other classes of mills. Nine percent of the cotton consumed by Class I mills had a reading of 95<sup>1</sup> or above (Figure 4 and Appendix A, Table XVII). Of the 23,400 bales consumed by these mills, 19,000 bales or 81 percent of the cotton tested in the strength range of 86 to 95. No cotton consumed by Class I mills tested below 76.

Class II mills used weaker cotton than did Class I mills. Of the 127,168 bales of cotton consumed by Class II mills, 34 percent tested in the 86 to 95 range, and 38 percent tested in the 76 to 86 range. No strength data were available on 26 percent of the cotton consumed by Class II mills.

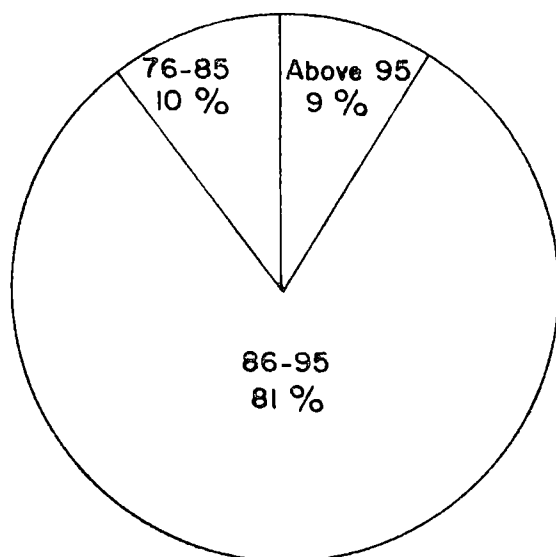
Class III mills used weaker cotton than did either Class I or Class II mills. The mills in Class III used cotton that was predominantly in the 76 to 85 range.

Of the mills that had test data on strength, none of the cotton tested below 66. No mill in Class IV had strength data on cotton even though break tests were used on yarn.

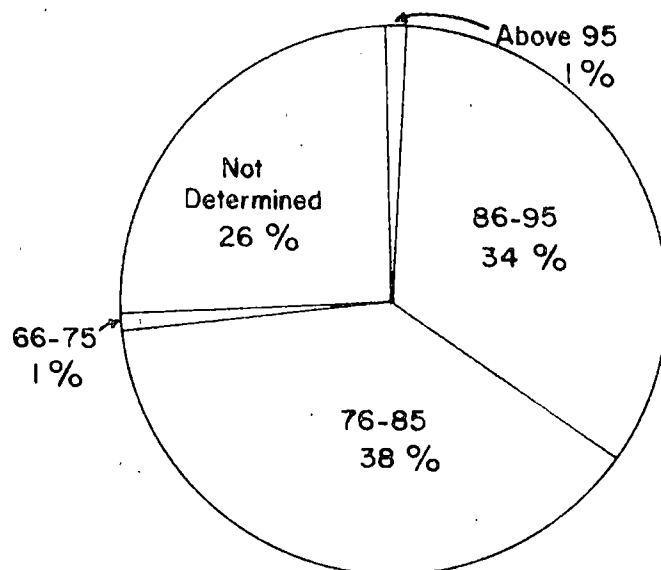
Length uniformity. Length uniformity or the ratio of mean to upper half mean length of fibers was the third most frequent fiber property tested. Length uniformity data were available on approximately 31 percent of total mill consumption.

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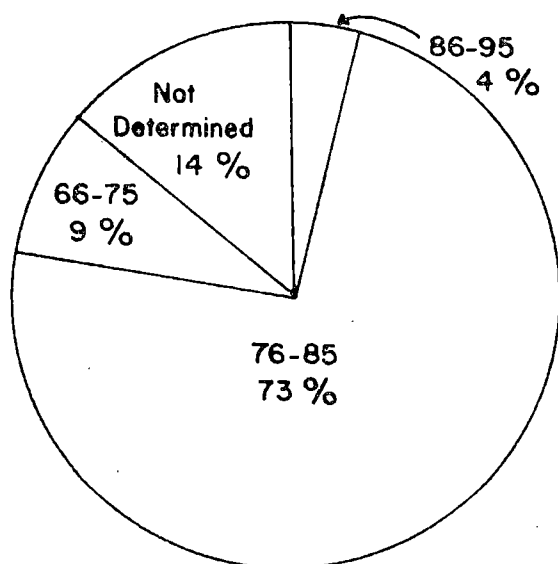
<sup>1</sup>Abbreviation for 95,000 pounds per square inch at zero gauge setting.



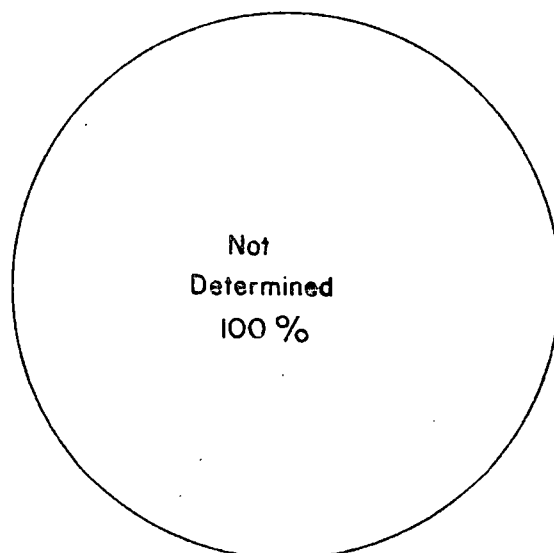
Class I  
(23,400 bales)



Class II  
(127,168 bales)



Class III  
(27,931 bales)



Class IV  
(35,072 bales)

Strength in thousand pounds per square inch indicated in ranges

Figure 4. Percentage distribution of strength of cotton consumed by end product classes, eighteen cotton mills, Tennessee, 1957-58.

The mills in Class I, producers of fine to very fine yarn, consumed 23,400 bales of cotton. On 8,000 bales, test data were available for length uniformity. This was approximately 34 percent of their consumption. All of this cotton tested above 80 (Figure 5 and Appendix A, Table XVIII).

The mills in Class II, manufacturing medium to fine yarn, had fiber test data for length uniformity on approximately 28 percent of their consumption. Of their total consumption about 3 percent tested 80 and above, and approximately 25 percent tested 75 to 80.

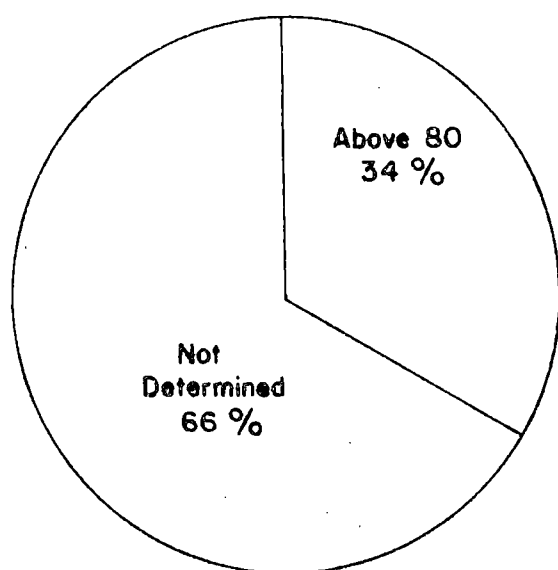
Class III mills producing coarse to medium yarn consumed 27,931 bales of cotton. Length uniformity data were available on 25,000 bales or approximately 86 percent of their consumption. About 77 percent of the cotton consumed by Class III mills tested in the 75 to 80 range, and 9 percent tested 74 and below.

No mill in Class IV had test data for length uniformity.

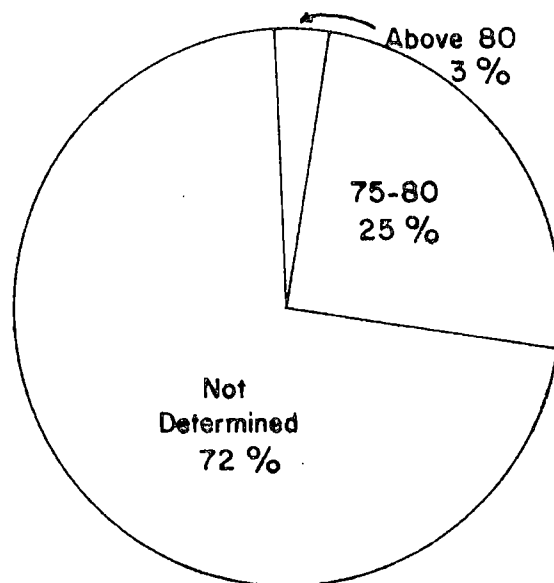
#### C. QUALITY CONSUMPTION IN RELATION TO PRODUCTION

Fineness. Fineness data were not available on the entire Tennessee crop of 1957. However, the Mid-South Cotton Growers Association received 6,000 bales or 1.5 percent of the Tennessee crop. Each of these bales was tested for fineness. This was probably the most representative sample of which each bale was tested for fineness.

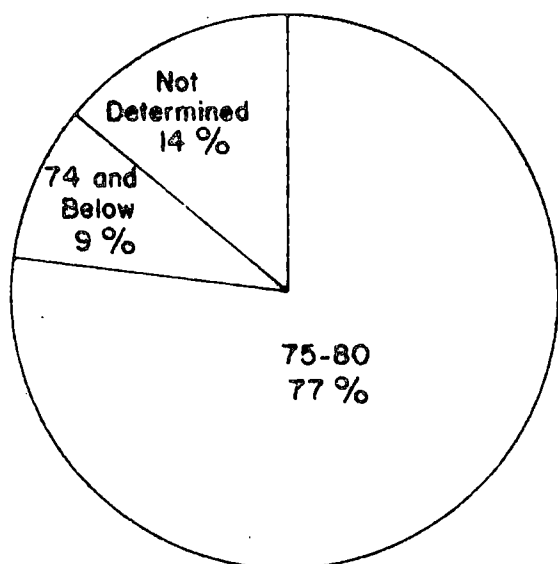
When the cotton received by the Mid-South Cotton Growers Association of the 1957 crop was projected on a state basis, it showed 81.0 percent or 328,725 bales of the 405,833 bale crop being in the 4.0-4.9 range (Figure 6). The Tennessee mills consumed cotton predominantly in



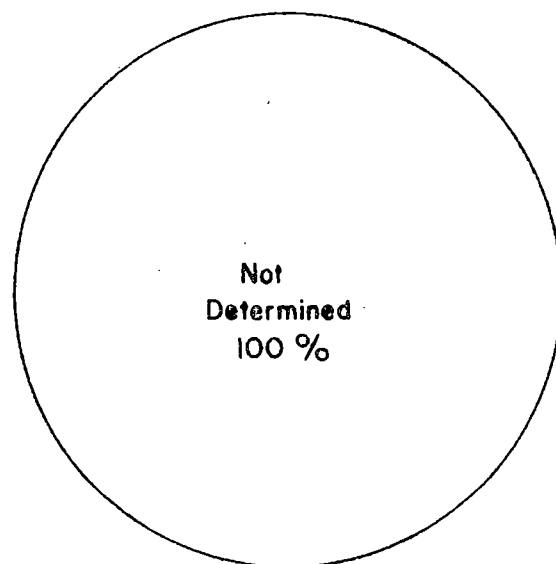
Class I  
(23,400 bales)



Class II  
(127,168 bales)



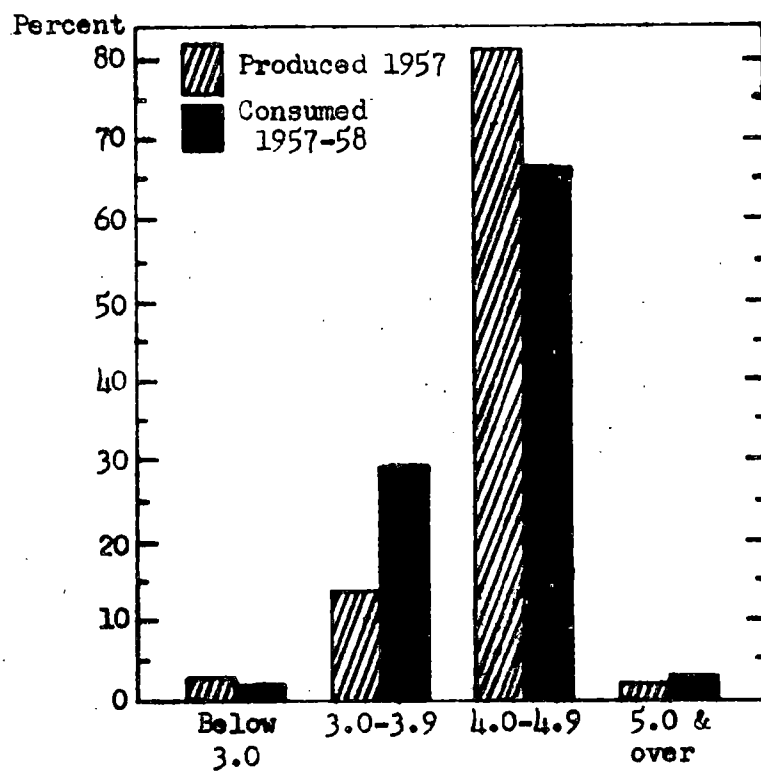
Class III  
(27,931 bales)



Class IV  
(35,072 bales)

Uniformity index indicated in ranges

Figure 5. Percentage distribution of length uniformity of cotton consumed by end product classes, eighteen cotton mills, Tennessee, 1957-58.



Micronaire readings indicated in ranges

Figure 6. Percent distribution of fineness of cotton produced and consumed in Tennessee, 1957 crop.

this range. Many mills try to maintain a mix of 4.2 which was the average fineness of the Tennessee cotton for the twelve year period of 1947-58.<sup>2</sup> Tennessee produced approximately 11,000 bales of cotton which fell below 3.0 in test of fineness in 1957. This cotton is considered of low quality by most of the cotton trade. In fact, cotton below 3.5 in fineness can not be used to cover delivery on the New York Cotton Exchange.

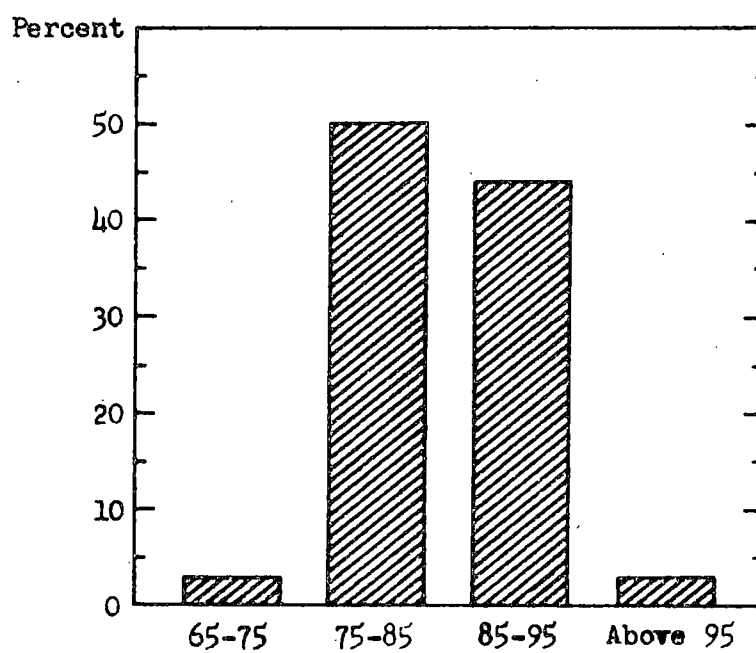
Strength. There were little data available to give a reliable estimate as to the variations in strength of Tennessee cotton. The average of test results for the crop year of 1957 was 79,000 pounds per square inch at zero gauge setting. When the summaries<sup>3</sup> of the annual test results of Tennessee cotton were analyzed for the crop years 1956 and 1957, a mean strength, in thousand pounds per square inch of 79.7 and a standard deviation of 4.2<sup>4</sup> was found to exist. The strength of Tennessee cotton has averaged about 80,000 pounds. On 142,200 bales of cotton consumed by Tennessee mills in 1957 for which strength data were available, the mean strength was 84,700 pounds per square inch and considered to be about average. Fifty percent of the cotton consumed fell in the 75-85,000 range (Figure 7).

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<sup>2</sup>B. D. Raskopf, Cotton Yields and Quality in Tennessee, Agricultural Experiment Station, Bulletin 298, April, 1959.

<sup>3</sup>Summary of Fiber and Processing Test Results on Some Varieties of Cotton Grown by Selected Cotton Improvement Groups for Crops of 1947 and Subsequent Years, Agricultural Marketing Service, United States Department of Agriculture.

<sup>4</sup>The standard deviation would have probably been larger had actual results for each bale been used instead of averages at various times in selected locations.



Strength in thousand pounds per square inch  
indicated in ranges

Figure 7. Percent distribution of known strength of cotton consumed, eighteen cotton mills, Tennessee, 1957-58.

Length uniformity. Data on length uniformity were available on 67,000 bales. The mean uniformity ratio was 78.1 with 79 percent of the cotton falling in the 75-80 range or average uniformity. The cotton produced in the state in 1958 had a mean uniformity ratio of 79 which was about equaled the average of 80 for the 1947-58 period.<sup>5</sup>

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<sup>5</sup>B. D. Raskopf, Cotton Yields and Quality in Tennessee, Agricultural Experiment Station, Bulletin 298, April, 1959.

## CHAPTER VI

### COMPARISON OF THE USE OF FIBER TEST BY MILLS IN THE UNITED STATES AND TENNESSEE

A study of the use of fiber test by cotton mills in the United States was conducted by thirteen southern states in 1958.<sup>1</sup> In drawing the sample of the 187 mill firms,<sup>2</sup> all mills with less than 5,000 spindles were omitted. This study represented approximately 497 plants<sup>3</sup> or 82 percent of the cotton mills in operation in the United States (Table XI). A few comparisons will be made between all mills in Tennessee and these 497 mills which also included the Tennessee mills.

#### A. OWNERSHIP OF FIBER TESTING INSTRUMENTS

Percent of firms owning specified instruments. More mills owned Micronaires than any other instrument. In Tennessee 55 percent of the mills owned this instrument, compared with 65 percent in the United States (Table XII). The Port-ar, also an instrument for measuring fineness, but a later introduction than the Micronaire, was owned by 11 percent of the mills in Tennessee. Only 2 percent of the mill firms in the United States owned this machine.

The most universal instrument used by mills to measure strength

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<sup>1</sup>Use of Fiber Testing by United States Cotton Mills, Southern Cooperative Series Bulletin 70, December, 1959.

<sup>2</sup>Mill firm as used here refers to one mill or a group of mills under one management.

<sup>3</sup>Plant as used here refers to an individual mill.

TABLE XI

COTTON SPINNING PLANTS IN OPERATION, FIRMS CONTACTED, AND PLANTS REPRESENTED, BY THIRTEEN STATE SURVEY OF FOUR HUNDRED NINETY-SEVEN COTTON SPINNING PLANTS, UNITED STATES, AUGUST, 1958<sup>a</sup>

| Location                  | Plants in operation <sup>b</sup><br>(number) | Firms contacted <sup>c</sup><br>(number) | Plants represented <sup>d</sup> |                                                      |
|---------------------------|----------------------------------------------|------------------------------------------|---------------------------------|------------------------------------------------------|
|                           |                                              |                                          | Plants<br>(number)              | Proportion<br>of plants<br>in operation<br>(percent) |
| Alabama                   | 53                                           | 12                                       | 53                              | 100.0                                                |
| Georgia                   | 101                                          | 32                                       | 69                              | 68.3                                                 |
| North Carolina            | 240                                          | 71                                       | 189                             | 78.8                                                 |
| South Carolina            | 134                                          | 34                                       | 129                             | 96.3                                                 |
| New England States        | 36                                           | 13                                       | 27                              | 75.0                                                 |
| Other states <sup>e</sup> | 44                                           | 25                                       | 30                              | 68.2                                                 |
| Total                     | 608                                          | 187                                      | 497                             | 81.7                                                 |

<sup>a</sup>Source: Use of Fiber Testing by United States Cotton Mills, Southern Cooperative Series Bulletin 70, December, 1959.

<sup>b</sup>Plants with 5,000 or more spindles.

<sup>c</sup>Firms contacted is number of firms having cotton buying offices located within the state.

<sup>d</sup>Plants represented is the number of plants which were represented in contacts to the buying office.

<sup>e</sup>Other states include Arkansas, Tennessee, Texas, and Virginia.

TABLE XII

PERCENT OF UNITED STATES COTTON MILL FIRMS AND  
TENNESSEE MILLS OWNING SPECIFIED  
INSTRUMENTS, 1957-58

|                                     | Micronaire | Port-ar | Pressley | Fibrograph | Colorimeter | Suter Webb<br>Sorter | Shirley<br>Analyzer |
|-------------------------------------|------------|---------|----------|------------|-------------|----------------------|---------------------|
| Percent of mills owning instruments |            |         |          |            |             |                      |                     |
| United States                       | 65         | 2       | 41       | 25         | 4           | 9                    | 14                  |
| Tennessee                           | 50         | 11      | 33       | 33         | 11          | 11                   | 11                  |

was the Pressley. Approximately 41 percent of the mill firms in the United States owned this instrument. Thirty-three percent of the mills in Tennessee possessed this machine. Of the instruments used to measure length, the Fibrograph was the most commonly found in cotton mills.

In the United States there was a relationship between the size of firm and ownership of instruments for testing fiber properties.<sup>4</sup> However, there was little relationship between end products produced and ownership of instruments. In Tennessee there was also a relationship between the size of mills and ownership of instruments. No instruments were owned by mills in Tennessee with less than 10,000 spindles. Each of the mills with 10,000 or more spindles owned one or more instruments. In Tennessee, there was also a relationship between the "texture of yarn going into end products" and ownership of instruments. However, the smaller mills were the ones which produced the coarser texture of yarn. Much of the consumption of the smaller mills in Tennessee were cotton samples<sup>5</sup> or other types of waste. It would be difficult to draw a representative sample for testing purposes from this kind of cotton.

Percent of firms owning instruments capable of performing specified test. Approximately 65 percent of the cotton mills in the United States have instruments for measuring fineness (Table XIII). In Tennessee only 55.5 percent of the mills are so equipped. However, five of the mills

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<sup>4</sup>Use of Fiber Testing by United States Cotton Mills, Southern Cooperative Series Bulletin 70, December, 1959.

<sup>5</sup>After cotton has been ginned, about two pounds is removed from the bale to determine the quality of the bales. These samples are not returned to the producer and are sold to mills by cotton merchants.

TABLE XIII

PERCENT OF ONE HUNDRED EIGHTY-SEVEN UNITED STATES MILL FIRMS AND  
EIGHTEEN TENNESSEE MILLS OWNING INSTRUMENTS FOR MEASURING  
SPECIFIED FIBER PROPERTIES, 1957-58

| Cotton fiber test | Proportion of mills testing cotton |                            |
|-------------------|------------------------------------|----------------------------|
|                   | Tennessee<br>(percent)             | United States<br>(percent) |
| Fineness          | 55.5                               | 65.3                       |
| Strength          | 33.3                               | 42.2                       |
| Length Uniformity | 33.3                               | 28.3                       |

in Tennessee consumed primarily waste cotton. Fiber test data on this type of material is not as important nor reliable as it is for raw cotton.

Approximately 42 percent of the mills in the United States performed tests for strength. On the other hand, only one-third of the mills in Tennessee made this test.

#### B. REASONS FOR USING FIBER TEST DATA

About three-fifths of the cotton spinning firms in the United States and slightly less than three-fifths of the mills in Tennessee used fiber test data to obtain a better measure of raw cotton quality and to assist in the mixing and blending operations. In the spinning industry "ends down" presents a serious problem.<sup>6</sup> In the United States 31.5 percent of the firms were using fiber test to develop data for use in controlling this problem. In Tennessee 55.5 percent of the mills were following this procedure.

#### C. ORIGIN OF COTTON

During the 1957-58 season there was little difference in the origin of cotton purchased by the mills in Tennessee and the 187 mill firms; Tennessee consumed a slightly higher percentage from the Southcentral and West and a lower percentage from the Southeast and High Plains Area than did the 187 mill firms. Tennessee mills purchased 36.2 percent of their cotton direct and 63.8 percent from shippers, while the 187 mill firms purchased 36.8 percent direct and 62.3 percent from shippers.

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<sup>6</sup>"Ends down" refers to the breakage of yarn during spinning or weaving.

#### D. USE OF FIBER TEST DATA IN PURCHASING COTTON

Fiber fineness data were utilized more than any other type of test data by the mills. For this reason, this section will be limited primarily to a discussion of the use of fineness data in purchasing cotton.

Only 29 of the 187 mill firms did not use test data in purchasing cotton. However, several of the firms stated that they owned no fiber testing instruments, and their use of test data was a fineness specification in the shipper's contract. Only one mill in Tennessee relied upon this method.

Fiber fineness data were available prior to purchase on about 75 percent of the direct purchases by the 187 mill firms (Table XIV). The 187 mill firms had fineness data available on 63 percent of their purchases in the Southeast and 89 percent in the West. The Tennessee mills did not purchase any cotton direct from the Southeast. However, fineness data were available on some purchases from all areas.

The 187 mill firms specified fineness readings on 86 percent of their shipper contracts. The Tennessee mills specified the degree of fineness on 70 percent of their shipper contracts. Fewer fineness specifications on the shipper purchases by the Tennessee mills may be explained in part by the purchases of waste cotton from shippers. The 187 mill firms had test data available or specified on 82 percent of their total purchases. Tennessee mills had this information available on 76 percent of their purchases.

Mills were relying upon fiber test data in their purchases to

TABLE XIV

USE OF FINENESS TEST DATA IN PURCHASING COTTON, ONE HUNDRED EIGHTY-SEVEN UNITED STATES  
MILL FIRMS AND EIGHTEEN TENNESSEE COTTON MILLS, 1957-58a

| Type of purchase                                | Southeast                       |                                                       | Southcentral                    |                                                       | High Plains                     |                                                       | West                            |                                                       | Total                           |                                                       |
|-------------------------------------------------|---------------------------------|-------------------------------------------------------|---------------------------------|-------------------------------------------------------|---------------------------------|-------------------------------------------------------|---------------------------------|-------------------------------------------------------|---------------------------------|-------------------------------------------------------|
|                                                 | Total pur-chases<br>(000 bales) | Proportion with known or specified fineness (percent) | Total pur-chases<br>(000 bales) | Proportion with known or specified fineness (percent) | Total pur-chases<br>(000 bales) | Proportion with known or specified fineness (percent) | Total pur-chases<br>(000 bales) | Proportion with known or specified fineness (percent) | Total pur-chases<br>(000 bales) | Proportion with known or specified fineness (percent) |
| Direct Purchases<br>United States<br>Tennessee  | 553<br>-                        | 63.1<br>-                                             | 1,429<br>49                     | 74.2<br>82.4                                          | 142<br>7                        | 76.0<br>100.0                                         | 565<br>21                       | 89.0<br>100.0                                         | 2,689<br>77                     | 75.1<br>87.7                                          |
| Shipper Purchases<br>United States<br>Tennessee | 905<br>11                       | 86.1<br>29.5                                          | 1,808<br>64                     | 86.3<br>73.7                                          | 889<br>14                       | 90.8<br>12.8                                          | 1,021<br>47                     | 81.5<br>91.9                                          | 4,623<br>136                    | 86.1<br>70.0                                          |
| All Purchases<br>United States<br>Tennessee     | 1,458<br>11                     | 77.4<br>29.5                                          | 3,237<br>113                    | 81.0<br>76.8                                          | 1,031<br>21                     | 88.8<br>41.9                                          | 1,586<br>68                     | 84.2<br>94.4                                          | 7,312<br>213                    | 82.1<br>76.4                                          |

aSource: Use of Cotton Fiber Tests by United States Cotton Mills, Southern Cooperative Series Bulletin 70, December, 1959, and University of Tennessee Survey Data.

avoid buying culls. However, shippers must dispose of such cotton of inferior quality, which may explain in part, some of the "Micronaire Clauses" in contracts. Mill buyers were avoiding buying in areas where fiber characters were of inferior or undesirable quality. Areas of inferior quality could easily be determined by spot checking during the ginning season.

#### E. TIME OF TESTING FIBER PROPERTIES

About 75 percent of the mills in the United States tested cotton after it was purchased. In Tennessee, all of the mills that owned instruments (56 percent) tested cotton after it was purchased. In Tennessee, 50 percent of the mills tested cotton before purchase while in the United States less than 30 percent performed this operation. In Tennessee, as well as the United States, less than half of the firms tested cotton at the time of purchase.

## CHAPTER VII

### SUMMARY AND CONCLUSIONS

The official measures of cotton quality are grade and staple as determined by the cotton classer. In recent years instruments have been developed to more accurately measure these and other cotton qualities. The introduction of these instruments has brought about changes in the marketing of cotton.

This study involved the use of fiber testing by the 18 mills in Tennessee. From earlier studies it was shown that mill buyers relied mainly upon variety and area of growth in order to get better quality cotton. By 1945 some mills owned fiber testing instruments or were making use of fiber test facilities and services offered by commercial laboratories.

For analytical purposes the mills were divided into four classes. They were as follows:

Class I - Producers of fine to very fine yarn

Class II - Producers of medium to fine yarn

Class III - Producers of coarse to medium yarn

Class IV - Producers of very coarse yarn

The major fiber test used by mills were fineness, strength, staple length and length uniformity in order of their importance by volume tested.

The mills producing the higher quality of yarn used fiber test data

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<sup>1</sup>B. D. Raskopf, Improvements Needed in Tennessee Cotton Quality and Marketing Practices to Meet Mill Requirements, Monograph 259, Tennessee Experiment Station, 1950.

more in purchasing cotton than did mills producing lower quality yarn. Also, there was a relationship between size of operation and extent of use of fiber test data.

The mills used fiber test data in their purchasing as well as their processing operations. As data on processing operations are collected and analyzed, better quality control measures can be put in effect.

The Micronaire, an instrument for testing fineness, was the most commonly found or used instrument in mills. However, the Port-ar will probably gain in popularity very fast since it has the advantage of portability and low initial cost.

The Pressley was the principal instrument used by mills for testing fiber strength. The primary instrument used for testing length and length uniformity was the Fibrograph. The Fibrograph was more costly to operate than was either of the other three instruments listed above.

Fiber tests were helping the mills avoid buying cull cotton. The better knowledge gained by testing was producing smoother mill operations. One spinner reported he has not had a claim due to inferior dyeability since he started testing for fineness.

No standard procedure in determining the number and kind of sample for fiber testing has been developed. Nine of the ten mills testing for fineness used only one test per sample. Two of the mills blended lots of cotton for testing.

The mills testing for strength used from one to six breaks per sample. All of the mills were using zero gauge setting. If the spinners were to use one-eighth inch setting they would get a much better measurement of the factors they were trying to measure. However, this would

necessitate a change in the cotton trade since zero gauge setting is the most common used and recognized.

All of the mills owning cotton fiber testing instruments were using calibrated cotton to check their machines. For fineness a tolerance of 0.1 Micronaire reading is considered synchronized. No standard tolerance has been established for strength tests.

The cost of fiber testing instruments commonly used by mills vary from less than \$500 to \$3,500 depending on the kind of instrument and test. The mills in Tennessee had a median cost of \$0.03 per sample for fineness tests and \$0.09 per sample for strength tests. This is considerably less than the fee laboratory charge. Fineness seems to be the most important fiber property tested and most of the larger mills find it advisable to own a machine capable of performing the fineness test. Where small mills have experienced no difficulty with strength of cotton, occasional tests by commercial laboratories would probably be the most economical. As spinners become better able to utilize strength data, the small mills might find that the ownership of a machine to test strength would be advisable. However, all mills may in the near future find that strength data will have to be used more in the purchasing of cotton to prevent them from receiving weak cotton that other mill buyers have refused to purchase.

There was little relationship between quantity of yarn produced and the fineness of fibers consumed. However, mills in Class I, producers of fine to very fine yarn, used slightly finer lint. There was a relationship between the strength of cotton and the class of yarn produced.

Mills in Class I used predominantly strong cotton fibers.<sup>2</sup> Mills in Class II, producers of medium to fine yarn, used about an equal amount of strong and average fiber strengths.<sup>3</sup> Class III mills, producers of coarse to medium yarn, consumed mostly cotton of average strength.

The fineness of Tennessee lint seems to be in a very desirable position and is meeting mill requirements. The strength of the Tennessee cotton averages about 80,000 pounds per square inch which is classified as average strength. Tennessee mills consume cotton predominantly in the 75 to 85 pound range. However, no lint is too strong and some mills were specifying cotton of a stronger character.

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<sup>2</sup>Strong - 86,000 to 95,000 pounds per square inch.

<sup>3</sup>Average - 76,000 to 85,000 pounds per square inch.

## BIBLIOGRAPHY

## BIBLIOGRAPHY

Cotton Testing Service. United States Department of Agriculture, Cotton Division, Agricultural Marketing Service No. 16, February, 1955.

Fontana, Jack. "Cotton Fiber Testing by Shippers in Tennessee." Unpublished Master's thesis, University of Tennessee, 1959.

Raskopf, B. D., and Jack Fontana. Cotton Fiber Testing in Foreign Countries. Tennessee Agricultural Experiment Station, Bulletin 271, September, 1957.

Raskopf, B. D. Cotton Yields and Quality in Tennessee. Tennessee Agricultural Experiment Station, Bulletin 298, April, 1959.

Raskopf, B. D. Improvements Needed in Tennessee Cotton Quality and Marketing Practices to Meet Mill Requirements. Tennessee Agricultural Experiment Station, Monograph 259, 1950.

Raskopf, B. D. Relationship of Cotton Production to Consumption. Tennessee Agricultural Experiment Station, Monograph 58, 1937.

Regulations of the Department of Agriculture for Cotton Fiber and Processing Tests, Agricultural Marketing Service, United States Department of Agriculture, 1958.

Summary of Fiber and Processing Test Results on Some Varieties of Cotton Grown by Selected Cotton Improvement Groups for Crop of 1947 and Subsequent Years. Agricultural Marketing Service, United States Department of Agriculture.

The Use Made of Fiber Testing by United States Cotton Shippers. Southern Cooperative Series Bulletin 62, June, 1959.

Use of Fiber Testing by United States Cotton Mills. Southern Cooperative Series Bulletin 70, December, 1959.

Webb, Robert W. Influence of Yarn Size on the Relative Contribution of Six Cotton Fiber Properties to Strength of Corded Yarn. United States Department of Agriculture Marketing Research, Report 109, December, 1955.

## APPENDIX A

TABLE XV

COTTON PURCHASES BASED ON FIBER TEST, BY ORIGIN,  
EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| Origin<br>of<br>cotton | Direct purchases on which<br>test data were available<br>prior to purchase for: |          | Purchases from shippers<br>made on fiber test<br>specifications for: |          | Total cotton purchased<br>with specified or<br>known properties for: |          | Total<br>all<br>cotton |
|------------------------|---------------------------------------------------------------------------------|----------|----------------------------------------------------------------------|----------|----------------------------------------------------------------------|----------|------------------------|
|                        | Fineness                                                                        | Strength | Fineness                                                             | Strength | Fineness                                                             | Strength |                        |
|                        | In running bales                                                                |          |                                                                      |          |                                                                      |          |                        |
| Southeast              | --                                                                              | --       | 3,318                                                                | --       | 3,318                                                                | --       | 11,262                 |
| Southcentral           | 39,800                                                                          | 36,900   | 47,300                                                               | 16,800   | 87,100                                                               | 53,700   | 113,476                |
| High Plains            | 7,020                                                                           | 7,020    | 1,800                                                                | 600      | 8,820                                                                | 7,620    | 21,035                 |
| West                   | 20,900                                                                          | 20,900   | 43,100                                                               | 27,000   | 64,000                                                               | 47,900   | 67,798                 |
| Total                  | 67,720                                                                          | 64,820   | 95,518                                                               | 44,400   | 163,238                                                              | 109,220  | 213,571                |

TABLE XVI

DISTRIBUTION OF FINENESS OF COTTON CONSUMED BY END PRODUCT CLASSES,  
EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| End<br>product<br>classes | Fineness of cotton in Micronaire Units |             |             |             |               |                   | Total   |
|---------------------------|----------------------------------------|-------------|-------------|-------------|---------------|-------------------|---------|
|                           | Below<br>3.0                           | 3.0-<br>3.9 | 4.0-<br>4.9 | 5.0-<br>5.9 | 6.0 &<br>over | Not<br>determined |         |
| Running bales             |                                        |             |             |             |               |                   |         |
| Class I                   | -                                      | 13,632      | 9,448       | 320         | -             | -                 | 23,400  |
| Class II                  | 3,437                                  | 30,082      | 89,831      | 3,458       | 360           | -                 | 127,168 |
| Class III                 | -                                      | 7,342       | 16,568      | 240         | -             | 3,781             | 27,931  |
| Class IV                  | 1,000                                  | 3,000       | 5,000       | 1,000       | -             | 25,072            | 35,072  |
| Total                     | 4,437                                  | 54,056      | 120,847     | 5,018       |               | 28,853            | 213,571 |

TABLE XVII

DISTRIBUTION OF STRENGTH OF COTTON CONSUMED BY END PRODUCT CLASSES,  
EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| End<br>product<br>classes | Strength <sup>a</sup> |        |        |       |               |                   | Total   |
|---------------------------|-----------------------|--------|--------|-------|---------------|-------------------|---------|
|                           | Above<br>95           | 86-95  | 76-85  | 66-75 | 65 &<br>below | Not<br>determined |         |
| Running bales             |                       |        |        |       |               |                   |         |
| Class I                   | 2,000                 | 19,000 | 2,400  | -     | -             | -                 | 23,400  |
| Class II                  | 1,750                 | 42,650 | 48,600 | 1,800 | -             | 32,368            | 127,168 |
| Class III                 | -                     | 1,200  | 20,400 | 2,400 | -             | 3,931             | 27,931  |
| Class IV                  | -                     | -      | -      | -     | -             | 35,072            | 35,072  |
| Total                     | 3,750                 | 62,850 | 71,400 | 4,200 |               | 71,371            | 213,571 |

<sup>a</sup>In thousands of pounds per square inch at zero gauge setting on the Pressley.

TABLE XVIII

DISTRIBUTION OF LENGTH UNIFORMITY OF COTTON CONSUMED BY END PRODUCT  
CLASSES, EIGHTEEN COTTON MILLS, TENNESSEE, 1957-58

| End<br>product<br>classes | Uniformity ratio |          |             |                   | Total   |
|---------------------------|------------------|----------|-------------|-------------------|---------|
|                           | Above<br>80      | 75 to 80 | Below<br>75 | Not<br>determined |         |
| Running bales             |                  |          |             |                   |         |
| Class I                   | 8,000            | -        | -           | 15,400            | 23,400  |
| Class II                  | 3,500            | 31,500   | -           | 92,168            | 127,168 |
| Class III                 | -                | 2,400    | 21,600      | 3,931             | 27,931  |
| Class IV                  | -                | -        | -           | 35,072            | 35,072  |
| Total                     | 11,500           | 33,900   | 21,600      | 146,571           | 213,571 |

## APPENDIX B

**COTTON MILL FIBER TESTING SCHEDULE**  
1958-59 Season

No. \_\_\_\_\_

Date \_\_\_\_\_

Name of firm \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_

**1. Extent of operations**

- a. Number of cotton spindles in place at end of 1957-58 season \_\_\_\_\_  
b. Number of bales of cotton consumed, 1957-58: Upland \_\_\_\_\_ Other \_\_\_\_\_  
c. Number of plants using cotton \_\_\_\_\_. If more than one, complete the following:

| <u>Location</u> | <u>No. of plants</u> | <u>No. of spindles</u> | <u>Total bales cotton consumed</u> |
|-----------------|----------------------|------------------------|------------------------------------|
| Ala.            | _____                | _____                  | _____                              |
| Ga.             | _____                | _____                  | _____                              |
| N. C.           | _____                | _____                  | _____                              |
| S. C.           | _____                | _____                  | _____                              |
| _____           | _____                | _____                  | _____                              |
| _____           | _____                | _____                  | _____                              |

2. Did you use any fiber test data: (a) Before purchase of cotton? Yes ☐ No ☐  
(b) At time of purchase? Yes ☐ No ☐, (c) After purchase and/or during processing? Yes ☐ No ☐

**3. Reasons for use of fiber test data:**

- a. To obtain better measure of raw cotton quality----- ☐  
b. For mixing and blending----- ☐  
c. To develop data for use in controlling processing operations----- ☐  
If yes, indicate area of control--carding rate ☐ nep count ☐  
ends down ☐ yarn strength ☐ yarn appearance ☐  
bleaching and dyeing ☐ quality control ☐  
d. Avoid getting culls----- ☐

**4. Number and type of instruments owned by firm:**  
(Indicate year of purchase of each instrument.)

|                   |                      |                        |
|-------------------|----------------------|------------------------|
| Micronaire _____  | Stelometer _____     | Colorimeter _____      |
| Speedar _____     | Clemson Tester _____ | Shirley Analyzer _____ |
| Portar _____      | Fibrograph _____     | Ultra violet _____     |
| Arealometer _____ | Nepotometer _____    | _____                  |
| Pressley _____    | Fiber blender _____  | _____                  |

5. a. In testing cotton for strength, what gauge setting was used? \_\_\_\_\_  
(space between clamps)  
b. How many breaks made per test sample? \_\_\_\_\_

## 6. Origin of upland cotton and method of purchase:

| Origin                               | % of total purchases | Method of purchase by region |               |         |
|--------------------------------------|----------------------|------------------------------|---------------|---------|
|                                      |                      | Direct                       | From shippers | Percent |
| Southeast-Ala.-Ga.-N.C.-S.C.         |                      |                              |               | 100     |
| So. Central-Ark.-La.-Miss.-Tenn.-Mo. |                      |                              |               | 100     |
| S.W.-Texas                           |                      |                              |               | 100     |
| -Oklahoma                            |                      |                              |               | 100     |
| West-Cal.-Ariz.-N.M.-Dist. 6 Texas   |                      |                              |               | 100     |
| Total                                | 100                  | xx                           | xx            |         |

## 7. Relation of use of fiber tests to origin and method of purchase

| Origin        | Percent of direct purchases on which test data were available prior to purchase for: |          |  |  |  | Percent of purchases from shippers made on fiber test specifications for: |          |  |  |  |
|---------------|--------------------------------------------------------------------------------------|----------|--|--|--|---------------------------------------------------------------------------|----------|--|--|--|
|               | Fine-ness                                                                            | Strength |  |  |  | Fine-ness                                                                 | Strength |  |  |  |
| Southeast     |                                                                                      |          |  |  |  |                                                                           |          |  |  |  |
| South Central |                                                                                      |          |  |  |  |                                                                           |          |  |  |  |
| S.W.-Texas    |                                                                                      |          |  |  |  |                                                                           |          |  |  |  |
| -Okla.        |                                                                                      |          |  |  |  |                                                                           |          |  |  |  |
| West          |                                                                                      |          |  |  |  |                                                                           |          |  |  |  |

8. Cotton purchases made on: Actual samples \_\_\_\_\_% Private types \_\_\_\_\_%  
Description \_\_\_\_\_%

## 9. Purchases on description bought on fiber test specifications:

| Specification | Fineness | Strength |                        |  |  |  |  |
|---------------|----------|----------|------------------------|--|--|--|--|
|               |          |          | (Percent of purchases) |  |  |  |  |
| None          |          |          |                        |  |  |  |  |
| Minimum       |          |          |                        |  |  |  |  |
| Range         |          |          |                        |  |  |  |  |
| Total         |          |          |                        |  |  |  |  |

10. Do fiber test specifications in purchase contracts result in a higher price per pound? Yes ☐ No ☐ If yes, how much for: Fineness? \_\_\_\_\_  
Strength? \_\_\_\_\_ Other (specify) \_\_\_\_\_

11. What percent of direct purchases, if any, required discounting for being:  
too fine \_\_\_\_\_%, too coarse \_\_\_\_\_%, too weak \_\_\_\_\_%, too immature \_\_\_\_\_%.  
If yes, what were the discounts? \_\_\_\_\_



Supplementary Schedule

1. What fiber tests does your mill use on raw cotton, how long have these tests been used, and who does the testing?

| Test for physical<br>or chemical<br>properties | Instrument<br>or<br>method | Year<br>first<br>used | Source of test data (check) |         |          |             |
|------------------------------------------------|----------------------------|-----------------------|-----------------------------|---------|----------|-------------|
|                                                |                            |                       | Own<br>mill                 | Brokers | Shippers | Com.<br>lab |
| Fineness                                       | Micronaire                 |                       |                             |         |          |             |
|                                                | Speedar                    |                       |                             |         |          |             |
|                                                | Portar                     |                       |                             |         |          |             |
|                                                | Arealometer                |                       |                             |         |          |             |
| Strength                                       | Pressley                   |                       |                             |         |          |             |
|                                                | Stelometer                 |                       |                             |         |          |             |
|                                                | Clemson tester             |                       |                             |         |          |             |
| Fiber length & uniformity                      | Fibrograph                 |                       |                             |         |          |             |
|                                                | Suter Webb Sorter          |                       |                             |         |          |             |
| Elongation                                     | Stelometer                 |                       |                             |         |          |             |
| Maturity                                       | Arealometer                |                       |                             |         |          |             |
|                                                | Microscope                 |                       |                             |         |          |             |
|                                                | Differential Dye           |                       |                             |         |          |             |
|                                                | Causticaire                |                       |                             |         |          |             |
|                                                | Micronaire                 |                       |                             |         |          |             |
|                                                | Speedar                    |                       |                             |         |          |             |
| Perimeter & wall thickness                     | Arealometer                |                       |                             |         |          |             |
| Nonlint content                                | Shirley analyzer           |                       |                             |         |          |             |
| Color                                          | Nickerson-Hunter           |                       |                             |         |          |             |
|                                                | Gardner                    |                       |                             |         |          |             |
|                                                | Ultra Violet Ray           |                       |                             |         |          |             |
| Sugar content                                  | Extraction                 |                       |                             |         |          |             |
| Acid-alkaline (pH)                             | Extraction                 |                       |                             |         |          |             |
| Cavitoma (pH)                                  | Extraction                 |                       |                             |         |          |             |
| Wax content                                    | Soxhlet extraction         |                       |                             |         |          |             |
| Moisture                                       | Oven                       |                       |                             |         |          |             |
| Oxidation                                      |                            |                       |                             |         |          |             |
|                                                |                            |                       |                             |         |          |             |
|                                                |                            |                       |                             |         |          |             |
|                                                |                            |                       |                             |         |          |             |
|                                                |                            |                       |                             |         |          |             |

2. What fiber tests does your mill use on finished goods, how long have these tests been used, and who does the testing?

| Test for physical<br>or chemical<br>properties | Instrument<br>or<br>method | Year<br>first<br>used | Source of test data |             |  |
|------------------------------------------------|----------------------------|-----------------------|---------------------|-------------|--|
|                                                |                            |                       | Own<br>mill         | Com.<br>lab |  |
| Waste                                          | Opener                     |                       |                     |             |  |
|                                                | Picker and card            |                       |                     |             |  |
|                                                | Comber                     |                       |                     |             |  |
| Nep count                                      |                            |                       |                     |             |  |
| Raw stock                                      | Nep test machine           |                       |                     |             |  |
| Spin test                                      | Card web evaluation        |                       |                     |             |  |
| Yarn appearance                                | ASTM standards             |                       |                     |             |  |
| Spinning twist                                 | Spin twist tester          |                       |                     |             |  |
| Strength                                       |                            |                       |                     |             |  |
| Yarn skein                                     | Yarn strength tester       |                       |                     |             |  |
| Single strand                                  | Uster                      |                       |                     |             |  |
|                                                | Scott                      |                       |                     |             |  |
|                                                | I. P. tester               |                       |                     |             |  |
|                                                | Scott grab tester          |                       |                     |             |  |
| Strength of fabric                             | Raveled strip              |                       |                     |             |  |
|                                                | Tear strength              |                       |                     |             |  |
|                                                | Mullen tester              |                       |                     |             |  |
| Bursting strength                              | Scott tester               |                       |                     |             |  |
| Elongation                                     | Stall                      |                       |                     |             |  |
| Abrasion                                       | Taber                      |                       |                     |             |  |
|                                                |                            |                       |                     |             |  |
| Dimensional change                             | Washing machine            |                       |                     |             |  |
|                                                | Launderometer              |                       |                     |             |  |
| Crease resistance or<br>wrinkle recovery       | Monsanto                   |                       |                     |             |  |
|                                                | Celanese                   |                       |                     |             |  |
| Color                                          |                            |                       |                     |             |  |
| Cracking                                       | Crackmeter                 |                       |                     |             |  |
| Fastness-light<br>washing                      | Fadeometer                 |                       |                     |             |  |
|                                                | Launderometer              |                       |                     |             |  |
| Flammability                                   | AATCC Flam. tester         |                       |                     |             |  |
| Snag resistance                                | Snag tester                |                       |                     |             |  |
| Drape                                          | Drape tester               |                       |                     |             |  |
|                                                |                            |                       |                     |             |  |
|                                                |                            |                       |                     |             |  |
|                                                |                            |                       |                     |             |  |
|                                                |                            |                       |                     |             |  |

3. Of the cotton used by your mill during the past season, what were the estimated percentages in the following test categories?

| Fineness (a)   |     | Strength (b) |     |                  |     | Length uniformity(c) |     |
|----------------|-----|--------------|-----|------------------|-----|----------------------|-----|
| (Micronaire)   |     | (Pressley)   |     | (Stelometer)     |     | (Fibrograph)         |     |
| Range          | %   | Range        | %   | Range            | %   | Range                | %   |
| Below 3.0-VF   |     | Above 95-VS  |     | Above 1.99-VS    |     | Above 80-U           |     |
| 3.0 to 3.9-F   |     | 86 to 95-S   |     | 1.75 to 1.99-S   |     | 75 to 80-Av.         |     |
| 4.0 to 4.9 Av. |     | 76 to 85-Av. |     | 1.50 to 1.74-Av. |     | 74 & below-I         |     |
| 5.0 to 5.9-C   |     | 66 to 75-F   |     | 1.25 to 1.49-F   |     |                      |     |
| 6.0 & above-VC |     | 65 & below-W |     | 1.48 & below-W   |     |                      |     |
| Total %        | 100 | Total %      | 100 | Total %          | 100 | Total %              | 100 |
| Bales-         |     | Bales-       |     | Bales-           |     | Bales-               |     |

- (a) Fineness measured in micrograms per inch of fiber. VF = very fine, F = fine, Av. = average, C = coarse, VC = very coarse.  
 (b) Pressley strength measured in 1,000 lbs. per sq. in. Stelometer strength measured in Grams per Grex 1/8" gauge. VS = very strong, S = strong, Av. = average, F = fair, W = weak.  
 (c) The uniformity ratio expresses the relation between the mean length of the fibers and the upper half mean length. U = uniform in fiber length, Av. = average uniformity, I = irregular.

| Maturity (a)  |     | Nep content (b) |     |               |     | Other (specify) |     |
|---------------|-----|-----------------|-----|---------------|-----|-----------------|-----|
|               |     | Raw stock       |     | Card web      |     |                 |     |
| Range         | %   | Range           | %   | Range         | %   | Range           | %   |
| 82 & above-M  |     | 10 & below-L    |     | 15 & below-L  |     |                 |     |
| 76 to 81-Av.  |     | 11 to 20-Av.    |     | 16 to 30-Av.  |     |                 |     |
| 70 to 75-I    |     | 21 to 30-H      |     | 31 to 45-H    |     |                 |     |
| 74 & below-VI |     | 31 & above-VH   |     | 46 & above-VH |     |                 |     |
| Total %       | 100 | Total %         | 100 | Total %       | 100 | Total %         | 100 |
| Bales-        |     | Bales-          |     | Bales-        |     | Bales-          |     |

- (a) Fiber maturity index. M = mature, Av. = average, I = immature, VI = very immature.  
 (b) Number of neps over 100 sq. in. of card web. L = low, Av. = average, H = high, VH = very high.

4. In addition to the use of fiber test data what other methods did you use in locating cotton of desired qualities?  
 Experience ☐ Make early season spinning tests ☐ Have own buyers in areas ☐ Buy from cotton imp. ass'n ☐ Obtain samples of cotton from different areas ☐ Other (specify) \_\_\_\_\_
5. In testing cotton for fineness  
 a. How many tests are made per sample? \_\_\_\_\_  
 b. Which of the following testing procedures is used?  
 Average of 2 sides ☐ Test only low grade or staple side ☐  
 Test both sides and record lowest ☐ Other (specify) \_\_\_\_\_
6. In testing cotton for length does the Fibrograph  
 a. Give you consistently more accurate measurement than classer? Yes ☐ No ☐  
 b. Of what value, if any, is the Fibrograph uniformity index? \_\_\_\_\_  
 c. Of what value, if any, is the Suter Webb Sorter uniformity index? \_\_\_\_\_
7. Do you use check test samples for calibrating instruments? Yes ☐ No ☐  
 If yes, indicate frequency of check on instruments. \_\_\_\_\_
8. What do you estimate the actual cost of fiber testing per bale for  
 Fineness? \_\_\_\_\_¢ Strength? \_\_\_\_\_¢ Fibrograph? \_\_\_\_\_¢ Maturity? \_\_\_\_\_¢  
 Nonlint content? \_\_\_\_\_¢ Color? \_\_\_\_\_¢ Other tests (specify) \_\_\_\_\_
9. From the standpoint of texture of yarns going into end products, into which class does your mill fall?  
 Class I - Fine to very fine yarns for use in products meeting rigid strength and appearance requirements, such as, very fine yarn, combed broadcloths, lawns, dress materials and other fine fabrics.  
 Class II - Medium to fine yarns for use in such products as print cloth, good quality sheeting and shirting, drills, poplins, chambray, sateens, knit heavy underwear, and hosiery yarns.  
 Class III - Coarse to medium yarns for use in such products as twines, tire cord and fabrics, medium quality sheeting, ticking, duck, denim, twills, calicos, and bags.  
 Class IV - Coarse yarn for use in such products as coarse or lower quality sheeting, ticking, duck, denim, jeans, drills, osnaburgs, and nap goods.  
 Class V - Very coarse yarns for use in such products as low quality twine, mops, and batting.
10. Quality of cotton used by this mill last season

| Bales | Grade | Staple length |
|-------|-------|---------------|
|       |       |               |
|       |       |               |
|       |       |               |
|       |       |               |

11. In your cotton mill operations last season what was the estimated waste?

|        |       |   |
|--------|-------|---|
| Opener | _____ | % |
| Picker | _____ | % |
| Card   | _____ | % |
| Other  | _____ | % |
| Total  | _____ | % |

12. Yarn numbers purchased or spun for processing?

\_\_\_\_\_

13. About what percent of your cotton purchases last season came from Tennessee?

\_\_\_\_\_ %

14. What difference would it make in your cotton mill operations if you discontinued the use of fiber tests for:

- a. Fineness? \_\_\_\_\_
- b. Strength? \_\_\_\_\_
- c. Fibrograph? \_\_\_\_\_
- d. Maturity? \_\_\_\_\_
- e. Color? \_\_\_\_\_
- f. Nonlint? \_\_\_\_\_
- g. Other tests (specify) \_\_\_\_\_

15. Equipment and employment

- a. Ring spindles \_\_\_\_\_
- b. Twister spindles \_\_\_\_\_
- c. Throwing spindles \_\_\_\_\_
- d. Slubbers \_\_\_\_\_
- e. Cards \_\_\_\_\_
- f. Combs \_\_\_\_\_
- g. Looms \_\_\_\_\_
- h. Sewing machines \_\_\_\_\_
- i. Knitting machines \_\_\_\_\_
- j. Braiders \_\_\_\_\_
- k. Dye plant \_\_\_\_\_ boilers \_\_\_\_\_
- l. Bleaching equipment \_\_\_\_\_
- m. Finishing equipment \_\_\_\_\_
- n. Employment \_\_\_\_\_ persons