MARKET OUTLETS FOR COTTON IN SOME OF THE PRINCIPAL COTTON FABRICS

Supplement I

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This publication is the second in a series on market outlets for cotton fabrics. It supplements the first report, issued in processed form, February 1950.

The study was planned and conducted under the general direction of John W. Wright, Chief, Research and Testing Division, Cotton Branch. The cooperation of cotton textile manufacturers in furnishing materials and data made the study possible. Acknowledgment is made to William J. Martin, Edgar H. Omohundro, Margaret A. McCarthy and Gladys P. Mitchell for their assistance. Credit is also due the technicians in the Cotton Branch's Fiber Laboratory at Washington, D. C. and the Spinning Laboratories at Clemson, S. C. and College Station, Tex.

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The study on which this report is based was made under the authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

SUMMARY AND CONCLUSIONS

In this study of market outlets for raw cotton, the qualities and quantities of cotton used in the manufacture of basic cotton fabrics were determined. An earlier report, by the same title, issued in February 1950 gave the results of detailed laboratory tests and other facts pertaining to 10 fabrics. This report supplements the 1950 report by giving results of tests and other determinations with respect to 15 additional fabrics as follows: Flannel, gingham, chambray, seersucker, terry toweling, huck toweling, corduroy, jacquard bedspreads, non-jacquard bedspreads, drapery, carded uniform twill, combed uniform twill, other carded twills, carded Army sateen, and tire cord.

No pronounced differentiation was found in the quality of cottons used in the fabrics studied in this report. Average grade and average staple length showed gradual increase in comparing cottons used for one of the coarser fabrics such as huck toweling with those used for a finer fabric such as combed uniform twill, as shown in the following tabulation:

Fabric	Range in grade	Average grade index all mills	Range of staple length (inches)	Average staple length all mills (32ds inch)
Flannel	LM to M	93.7	15/16 to 1-1/16	32.3
Gingham, chambray and seersucker	LM to SM	97.0	31/32 to 1-3/32	33.0
Terry toweling	LM to M	90.4	31/32 to 1-1/16	32.5
Huck toweling	SGO to SLM	84.0	31/32 to 1-1/16	32.3
Corduroy	SLM to SM	96.5	1 to 1-3/32	33.7
Bedspread, jacquard	LM to M	94.0	29/32 to 1-1/16	32.1
Bedspread, non-jacquard	LM to M	93.1	31/32 to 1-3/32	33.2
Drapery	LM to M	92.5	7/8 to 1-1/32	31.3
Carded uniform twill	SLM to M	96.6	1 to 1-1/16	33.1
Combed uniform twill	SLM to SM	97.8	1-1/32 to 1-1/8	34.4
Other carded twills	LM to M	97.1	15/16 to 1-3/32	32.3
Carded Army sateen	LM to SM	95.4	7/8 to 1-3/32	31.9
Tire cord	LM to SM	96.6	1 to 1-3/32	33.5

Of the 15 fabrics included in this report, huck toweling contained the lowest average grade, about Low Middling (grade index of 84). Several fabrics--flannel, terry toweling, bedspreads, and drapery--used cotton which averaged Strict Low Middling, or slightly lower (grade index 90.4 to 94.0). The other fabrics used cotton having an average grade of between Strict Low Middling and Middling (grade indexes 95.4 to 97.8). In the last-named group, gingham, chambray, seersucker, corduroy, uniform twill, and tire cord all used about the same average grade of cotton (grade index of about 97). These qualities will vary from year to year, depending on the availability of the various qualities of cottons and price differentials.

Average staple lengths used in the 15 fabrics ranged from about 31/32 inch for the drapery mixes to about 1-1/16 inches for combed uniform twill. The 15 fabrics grouped according to the approximate staple length of the cotton used ranged as follows:

Fabric	Staple length
Drapery	31/32 inch
Flannel, terry and huck toweling, jacquard bedspreads, Army sateen, carded twills	1 inch
Gingham, chambray, seersucker, non-jacquard bedspreads, carded uniform twill, tire cord	1-1/32 inches
Corduroy, combed uniform twill	1-1/16 inches

Average fiber properties for the cottons used in the various fabrics did not show much variation. Average tensile strength ranged from 73,000 pounds per square inch for huck toweling to 81,000 pounds per square inch for combed uniform twill. Fiber fineness varied within close limits, ranging from 4.0 micrograms per inch for non-jacquard bedspreads to 4.5 micrograms for drapery. Average maturity varied from 78 percent for flannel to 85 percent for corduroy.

The averages for the several fabrics showed, in general terms, the qualities of cottons used by manufacturers. The fabric averages, however, were composed of individual mill results which, in most cases, varied widely within the same fabric group. Average fiber properties for the 15 fabrics are shown in the following tabulation:

Fabric	Fibrograph upper half mean	Uniformity ratio	Tensile strength	Fineness (weight per inch)	Maturity
	Inches	Index	1,000 lb. per sq.in.	Micrograms	Percent
Flannel	1.03	79	78	4.2	78
Gingham, chambray and seersucker	1.06	79	77	4.4	83
Terry toweling	1.06	78	75	4.1	81
Huck toweling	1.05	77	73	4.0	79
Corduroy	1.08	79	78	4.4	85
Bedspread, jacquard ...	1.03	79	76	4.3	83
Bedspread, non-jacquard	1.09	79	81	4.0	82
Drapery	.98	79	74	4.5	82
Carded uniform twill ..	1.07	79	78	4.3	84
Combed uniform twill ..	1.08	79	81	4.4	82
Other carded twills ...	1.02	78	78	4.3	82
Carded Army sateen	1.02	79	78	4.3	83
Tire cord	1.05	78	79	4.3	80

The fact that different mills do not necessarily use nor desire the same qualities of cotton in making a particular product is one of the most important findings in this study. The quality of cotton used by an individual mill is determined not only by the fabric to be produced but also by the processing equipment used, the manufacturing organization and efficiency, labor and raw material costs, and the specific quality of the product desired. Differences in quality of the raw cotton can be compensated for to a great extent by differences in equipment and in efficiency of processing. This may result in different processing costs--that is, lower qualities of cotton are associated with increased processing costs and lower product qualities.

In consideration of the varied types of processing equipment, differences in processing efficiency, preferences of individual manufacturers, and the need for various qualities in textile products, a range of qualities is needed for the manufacture of each product. Each manufacturer must determine the optimum quality factors of the raw-cotton purchases for his own mill after consideration of equipment and techniques used and of the specific quality of product he wishes to make. Average results for the processing of representative mill mixes are shown in the following tabulation:

Fabric	Picker and card waste	Neps per 100 sq. in. of card web	Standard laboratory yarn numbers: Yarn skein strength: 22s	Yarn skein strength: Other number spun 1/	Yarn appearance grade: 22s	Yarn appearance grade: Other number spun 1/
	Percent	Number	Pounds	Pounds		
Flannel	10.1	30	108	182 (14)	B	B (14)
Gingham, chambray and seersucker	9.4	29	106	58 (36)	B	C+ (36)
Terry toweling	11.1	40	101	166 (14)	C+	B (14)
Huck toweling	12.4	59	98	162 (14)	C	B (14)
Corduroy	8.6	27	106	59 (36)	B+	C+ (36)
Bedspread, jacquard	9.8	30	102	164 (14)	B	B+ (14)
Bedspread, non-jacquard	10.1	33	113	184 (14)	B	B (14)
Drapery	10.9	37	92	156 (14)	C+	B (14)
Uniform twill, carded	8.8	25	105	174 (14)	B	B (14)
Uniform twill, combed	11.5	16	-	75 (36)	-	B (36)
Other carded twills	8.9	28	106	177 (14)	B	B (14)
Army sateen	9.2	29	103	170 (14)	B	B+ (14)
Tire cord	7.9	34	117	193 (14)	C+	B (14)

1/ The other standard yarn number spun is given in parentheses.

The quantities of cotton used annually during the last two decades for each of the 15 fabrics under consideration were estimated from Bureau of Census fabric production data. Annual per capita consumption was estimated, as well as the proportion of total consumption, with respect to each fabric. These estimates provided a basis for measuring market outlet potentialities for the various fabrics.

The quantities of raw cotton consumed in the manufacture of each fabric vary from year to year. The variations cannot always be explained but the following are considered to be some of the important causes of fluctuations in consumption: (1) Price of the fabric in relation to the general price level; (2) prices of competing products; (3) demand for the fabric; (4) industrial activity; (5) mill margins of the fabric; (6) consumer income; (7) population increase; and (8) fashion or style trends.

The effect of prices on consumption of the various fabrics could not be effectively measured because the period for which suitable price data were available was too short for an analysis. Comparable price data on the individual fabrics covered in this report were not available for years prior to 1947, in most instances.

Available consumption data for the fabrics studied in this report represented an aggregate market outlet for approximately 2 million bales of cotton in 1950, as shown in the following tabulation:

Fabric	Estimated number of bales of cotton consumed in manufacture of fabric in--				
	1939	1947	1948	1949	1950
	Thousands	Thousands	Thousands	Thousands	Thousands
Flannel	279	288	288	193	229
Gingham	18	26	33	25	35
Chambray	59	84	101	67	69
Seersucker	3	6	7	5	11
Terry toweling	188	224	206	177	231
Huck toweling	36	27	20	26	39
Corduroy	58	100	109	145	184
Woven bedspread	53	77	88	70	66
Drapery, upholstery, and tapestry	163	248	249	252	316
Carded uniform twill	NA	21	NA	26	42
Combed uniform twill	Not available				
Other carded twills	NA	222	260	252	319
Army sateen	Not available				
Tire cord	585	686	535	275	397
Total (exclusive of some military fabrics)	1,442	2,009	1,896	1,513	1,938

Of the 15 fabrics included in this report, flannel and terry toweling were the most stable with respect to the annual quantities of cotton consumed. From present indications, these fabrics should continue as steady outlets for cotton in the future. Corduroy showed a consistent upward trend as an outlet for raw cotton. In 1950, a considerable volume of cotton--184,000 bales--was used for corduroy. Bedspreads and draperies appeared to have good potentialities as uses for cotton. For tire cord, cotton now has heavy competition from rayon; nevertheless, tire cord is still one of the large outlets for raw cotton.

MARKET OUTLETS FOR COTTON IN SOME OF THE PRINCIPAL COTTON FABRICS - SUPPLEMENT I

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PURPOSE AND PLAN OF STUDY

In a publication released in February 1950 (4) 1/ results of comprehensive laboratory tests and investigations of market outlets for cotton were reported for each of 10 principal fabrics, as follows: Print cloth; wide sheeting; narrow sheeting; denim; drill; osnaburg; duck; carded broadcloth; combed broadcloth; and combed lawn.

This publication--a supplement to the 1950 report--gives the results of studies covering 15 additional fabrics, as follows: Flannel, gingham; chambray; seersucker; terry toweling; huck toweling; corduroy; jacquard bedspreads; non-jacquard bedspreads; drapery; carded uniform twill; combed uniform twill; other carded twills; carded Army sateen; and tire cord.

Another publication released in December 1950 (5) reported results of tests with respect to market outlets for products made from extra long staple cotton, and a report issued in April 1951 (6) covered results of tests and investigations pertaining to market outlets for cotton in knit goods.

The principal purpose of the study on which this publication is based was to determine the specific qualities and quantities of American upland cotton being used in the manufacture of specified cotton textile products. As a result of ascertaining the market outlets for cotton in the various fabrics, a closer connection can be established between cotton producers and merchants, on one hand, and cotton manufacturers, on the other. A better knowledge of mill requirements should help to improve the marketing system and aid cotton producers and merchandising agencies in finding profitable market outlets for the various qualities of cotton. Cotton production should be adjusted as closely as possible to mill requirements and any step in that direction would benefit cotton farmers as well as manufacturers.

1/ Underscored numbers in parentheses refer to Literature Cited, p. 77.

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In this study of market outlets for cotton, extensive tests were made of the raw cotton being used for each of the various fabrics as well as tests on manufacturing performance of the cotton and on the quality of the product. The importance of price-consumption relationships as they affect market outlets was not overlooked. The price of a fabric, and the elasticity of demand for the particular fabric are factors that have an important influence on consumption. Efforts were made to analyze variations in annual and in quarterly consumption of a fabric by relating these variations to changes in the price of the fabric, due consideration being given to changes in the general price level and in industrial activity. Such an analysis was made with respect to several fabrics covered in the 1950 report (4). At the time of this study, however, prices of individual fabrics were available only for a short period, from January 1947 to 1950, in most instances. This period was admittedly too short a one in which to obtain a correlation analysis of these variables.

To obtain needed information on qualities of cotton required for the fabrics on which this publication is based, it was necessary, as in the previous studies, to obtain from cotton mills samples representing each of the fabrics under consideration. Mills selected to represent each of the fabrics were visited to obtain raw cotton samples from bales used in mill mixes and also samples of yarn and fabric. The raw cotton samples were used for grade and staple determinations and for detailed laboratory analyses of fiber properties. After fiber analyses were made, the samples from each mix were composited and spun with the mill twist into the yarn numbers manufactured at the cooperating mill, as well as into standard laboratory yarn numbers.

Laboratory test results of the strength and appearance of standard organization yarn numbers, picker and card waste, and neps per 100 square inches of card web, and laboratory analyses of fiber properties were included to facilitate comparisons between fabric groups and with established laboratory criteria. These data may also be used by cotton manufacturers as an aid in purchasing raw materials. Results of laboratory tests on fiber and manufacturing properties of the principal varieties produced commercially by cotton improvement groups are published by the Cotton Branch each year as the harvesting season progresses (7). Laboratory test results of mill mixes may be compared with those from the cotton improvement areas by cotton manufacturers in order to locate sources of cotton of the desired qualities. In this report some of the varieties of cotton suitable for each of the various fabric groups are indicated. It should be realized, however, that each variety represents a wide range of fiber properties owing to differences

in area of growth, weather and other factors. The varieties associated with each fabric group were selected on the basis of test results from the cotton improvement areas.

The mill manufactured yarns were duplicated by the laboratory in order to provide a basis for comparison with standard criteria. Medium and coarse grade yarns produced in the laboratory were generally better in quality than those produced by mills. There are several reasons for this, such as the equipment used and the machine settings and speeds used by each; but the important difference is that mills are concerned primarily with optimum processing efficiency, whereas in small-scale controlled laboratory testing the emphasis is on optimum quality. Consequently, the laboratory may produce a stronger, higher grade yarn than that produced in a mill but at a cost that would be prohibitive on a commercial scale.

Further details of sampling procedures and bases for the interpretation of test results may be found in the 1950 report (4). The spinning test procedures used to produce standard laboratory organization yarn numbers are those of the U. S. Department of Agriculture (7).

Reports on each of the fabrics used in this study--including descriptions and uses, interpretations of the data, and general information relating to each fabric--are given in subsequent sections.

FLANNEL

Description and Uses

The term flannel commonly refers to several closely related fabrics which include outing flannel, work shirt flannel, interlining flannel, canton flannel, and flannelette. These fabrics all belong to the group known as napped fabrics which includes blankets and blanketing in addition to the fabrics mentioned. This study, however, covers only the fabrics included under the term "flannel."

The distinguishing feature of flannel is the soft nap. The nap, which gives added warmth to the fabric, is produced by a machine known as a napper. This machine consists of a large cylinder around which are arranged a number of small rollers. Each of these rollers is covered with wire teeth similar to those of a cotton carding machine. As the cotton cloth is passed over the rollers of the cylinder the wire teeth prick the threads, commonly the filling, and this results in a soft, fuzzy surface or nap. Napped goods vary greatly in the depth and quantity of nap. Some goods require only a faint trace of nap, others require a thick feltlike nap, and still others require a nap that resembles plush. There are many kinds of cotton flannel; some of the more common types are described below.

Outing flannel, in plain or twill weave, is napped on both sides. This fabric usually has stripes woven of colored yarns, but it may be piece-dyed or printed. Canton flannel is a twill-woven fabric with a soft, heavy nap on one side only--the back. Flannelette is a plain-woven, soft, lightly napped fabric. Flannelette is usually printed. Interlining flannel is napped on one side only and is woven in a plain weave with stiffer yarns than those used for other types of cotton flannel.

The several types of flannel listed are used for shirts, frocks, robes, sport coats, draperies, babies underwear, work gloves, socks, aprons, pockets, linings, vamps, shoe tongues, interlinings for shoes, linings for leggings, linings for gun cases, bed coverings, babies' blankets, dust cloths, toilet kits, first aid kits, and surgical dressings (3).

Qualities of Raw Cottons Used in Flannel

The qualities of cotton used in the manufacture of flannel are commonly the same as those used in many other fabrics. Medium qualities of cotton produced in various sections of the Cotton Belt are used. About one-fourth of the cotton used in flannel is Middling, slightly over one-half is Strict Low Middling, and the remainder is made up of lower qualities of cotton (table 1).

Table 1.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of flannel 1/

Grade of cotton	Staple length (inches)					Total
	15/16	31/32	1	1-1/32	1-1/16	
	Percent	Percent	Percent	Percent	Percent	Percent
Middling	0.9	1.0	5.8	10.4	6.1	24.2
Strict Low Middling	3.6	2.6	17.8	14.9	15.3	54.2
Low Middling	1.1	1.9	2.1	1.4	--	6.5
Middling Spotted	1.2	2.1	1.0	1.5	.9	6.7
Strict Low Middling Spotted	1.9	2.7	2.1	1.7	--	8.4
Total	8.7	10.3	28.8	29.9	22.3	100.0

1/ Small quantities falling outside the limits of the table were included.

The staple lengths used are mostly 1 inch and 1-1/32 inches. Almost 60 percent of the total cotton used in flannel was of these two lengths.

Most of the fiber properties fell within the range of "average." Maturity of fibers that averaged 78 percent, was above the average and within the range of "mature" fibers (table 2).

Among the varieties of cotton produced commercially by cotton improvement groups in 1951, Arizona 44 and Coker 100 Wilt showed average qualities similar to the qualities of cotton used by representative mills in making flannel (7). Hence, these two varieties appear to be very suitable sources of cotton for use in flannel.

Table 2.--Fiber properties and other factors of quality of cotton used in the manufacture of flannel

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	93.7	85.9 to 100.9
Staple length (32ds inch)	32.3	30.5 to 33.9
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.03	.95 to 1.09
Uniformity ratio	79	76 to 82
Tensile strength (1,000 lb. per sq. in.)	78	71 to 83
Fineness (micrograms per inch)	4.2	3.6 to 4.9
Maturity (percent)	78	69 to 85
Moisture content of raw cotton (percent)	7.0	5.7 to 7.9

Manufacturing Performance of Cottons Used in Flannel and Quality of Product

The laboratory found that average picker and card waste was about 10 percent in cotton from the flannel mixes which was somewhat higher than normal for Strict Low Middling cotton in medium staple lengths (table 3). Some variation in picker and card waste is to be expected, depending on the characteristics of the cotton. Neps per hundred square inches of card web averaged 51 for the participating mills. Although this average might be considered high for many fabrics, it is not a matter of much importance in napped fabrics such as outing flannel.

Table 4 shows the averages of tests of the flannel in process of manufacture at representative cotton mills.

Production Trends in Flannel

The annual production of flannel including outing, interlining, canton, and workshirt flannel, is probably greater than most people realize. In 1941, 296,000 bales of cotton were consumed in the manufacture of flannel. Table 5 shows the annual production of fabrics included under the term "flannel" during the last 20 years.

Table 3.--Manufacturing performance of cottons used in flannel

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	11.6	10 to 13
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	55	52 to 56
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	27.8	26 to 31
Laboratory	27.8	26 to 31
Twist multiplier--		
Mills	4.65	4.4 to 4.9
Laboratory	4.65	4.4 to 4.9
Mill filling yarn:		
Yarn number--		
Mills	13.8	12 to 17
Laboratory	13.8	12 to 17
Twist multiplier--		
Mills	3.28	3.1 to 3.6
Laboratory	3.28	3.1 to 3.6
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	10.1	8.4 to 12.1
Neps per 100 sq. in. of card web:		
Mills	51	27 to 91
Laboratory	30	18 to 49
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 28s)--		
Mills	66	50 to 80
Laboratory	80	70 to 90
Filling (converted to 14s)--		
Mills	147	110 to 180
Laboratory	155	100 to 180
Standard laboratory numbers--		
14s	182	163 to 198
22s	108	98 to 115
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	C	D to B
Laboratory	C+	C+ to B
Filling--		
Mills	C+	BG to B
Laboratory	B	C+ to B+
Standard laboratory numbers--		
14s	B	B to B+
22s	B	C+ to B+

1/ Ranges represent unconverted data.

Table 4.--Quality of flannel produced by representative cotton mills

Flannel	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	41	39 to 43
Filling	44	41 to 46
Fabric strength (pounds):		
Warp	30	28 to 34
Filling	60	45 to 78
Crimp (percent):		
Warp	5.3	3.2 to 8.2
Filling	6.3	4.5 to 9.0
Weight (oz. per sq. yd.)	3.7	3.2 to 3.9

Table 5.--Production of flannel, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by specified years, 1931-50

Year	Flannel produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	74,147	183	3.4	0.71
1933	105,183	259	4.2	.99
1935	64,993	160	2.8	.60
1937	112,907	278	3.7	1.04
1939	113,419	279	3.8	1.02
1941	120,348	296	2.8	1.07
1942	97,844	241	2.1	.86
1943	94,943	224	2.1	.82
1944	92,543	228	2.4	.79
1945	88,027	217	2.4	.75
1946	90,565	223	2.3	.76
1947	116,925	288	3.0	.96
1948	116,917	288	3.2	.95
1949	78,386	193	2.5	.62
1950	92,826	229	2.4	.72

1/ Computed from Bureau of Census data. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.32 pound flannel per linear yard, this being the average poundage for flannel per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 15.4 percent (1.182 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

Flannel production has accounted for about 2-1/2 to 3 percent of the total cotton consumption in recent years. Per capita consumption was about 3/4 pound in 1950 as compared with the total per capita consumption of about 30 pounds of cotton.

Flannel is a staple product for which there is a regular and consistent demand from the consuming public. This demand is evidenced by the rather constant quantity produced from year to year. Flannel is used essentially for clothing because of its comfort and warmth-giving qualities rather than because of its style. It is not subject to sudden shifts in style, its production continues at a more even keel than that of some other fabrics. Variations in production, however, do occur. The reasons for changes in production include the following: (1) Price; (2) demand; (3) purchasing power of money; (4) miscalculations regarding manufacturers' and dealers' inventories, such as overstocking in one period and subsequent adjustment in next period; (5) mill margins; and (6) population increase.

The price at which a commodity sells has an important bearing on the quantity that consumers will buy of it. The influence of price on consumption varies with the elasticity of demand for the particular goods under consideration. The consumption of some products that are considered essential and for which no substitutes are immediately available, varies relatively little with changes in price. The demand for such articles is said to be inelastic. On the other hand some articles of a non-essential nature, or articles for which fairly satisfactory substitutes are available, are apt to have an elastic demand. In that case an increase in price might readily induce consumers to use a substitute purchasable at a lower price. As mentioned in the introduction, comparable prices were not available for individual fabrics included in this report for a sufficient period of time to develop demand schedules or some of the other methods for studying price-consumption relationships.

The demand for cotton flannel confirms the existence of a very worthwhile market outlet for cotton in flannel. The study indicates that a consumption of at least 1/2 pound of cotton per person, and possibly as much as 1 pound per person, per annum is necessary to fulfill the Nation's requirement for flannel. Measured in bales, this would amount to approximately 200,000 to 300,000 bales of cotton per annum.

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GINGHAM, CHAMBRAY, AND SEERSUCKER

Description and Uses

Gingham, chambray, and seersucker are well-known fabrics belonging to a large group along with denim, madras, and others known as colored yarn fabrics. The distinguishing feature of this group of fabrics is that either the warp or filling, or both, is made of dyed yarn. Color in other fabrics may be the result of dyeing the fabrics after weaving or in printing, as is done in print goods, but in gingham, chambray, and seersucker color is imparted to the yarn before weaving.

Gingham is a lightweight to mediumweight fabric made with dyed yarn in stripes, checks, plaids, and solid colors. The patterns vary from simple two-color checks up to elaborate plaids in many colors. Constructions range from coarse, carded yarn types to fine lightweight combed textures. When mercerized, the better qualities of gingham have a soft, lustrous appearance, a firm body and a high sheen. Gingham is a popular fabric for summer dresses and play clothes and is also used for robes, pajamas, sportswear, men's shirts, curtains, draperies, spreads, and for many other purposes.

Chambray has colored warp yarns, usually blue, and white filling yarns. The white filling yarns impart a frosted appearance to the fabric and this is one of its distinguishing features. Carded yarns, fairly coarse, are used in chambray. The cloth is standard material for work shirts. Lighter weight fabrics from finer carded yarns are made with plain, striped, checked, and dobby designs on a chambray background (2). In the finer weaves, chambray is widely used for men's shirts, children's and women's dresses, blouses, smocks, aprons, and sportswear; in the heavier weaves, chambray is used for work shirts, linings, and mattress tickings.

Seersucker is classed with the colored yarn fabrics because it is woven from dyed yarns. One of the main characteristics of seersucker is its woven-in, permanent crinkle effect. It is woven with two warp beams on the loom. Warps from one beam are held under ordinary weaving tension whereas the warps from the other beam are woven slack. The crinkle effect is formed from the slack warp yarn.

Seersucker is woven from good quality dyed yarns, carded or combed, in stripes, checks, or plaids. Although similar in appearance to seersucker, crepe is an entirely different fabric. The crepe effect is obtained from alternately twisted yarns. Seersucker utilizes tight

and slack warp yarns rather than a high twist for the crinkle. Seersucker is used for men's and women's suits, sportswear, pajamas, sleeping ensembles, frocks, smocks, uniforms, spreads, draperies, slipcovers, blouses, garments for small children, and lampshades (3).

Qualities of Raw Cottons Used in Carded Gingham, Chambray, and Seersucker

Only carded types of gingham, chambray, and seersucker were studied in this report. In view of their similarity and because they are frequently made from the same qualities of cotton and often from the same yarn numbers, the data for these fabrics were combined.

The cotton used in the manufacture of gingham, chambray, and seersucker was of higher grade than that used in many fabrics. The principal grade used was Middling, which consistuted about 40 percent of the total (table 6). The average grade index of 97 (Middling White equals 100) was about half a grade lower than Middling.

Almost 72 percent of the total cottons used in this fabric were of the staple lengths, 1-1/32 inches and 1-1/16 inches. The average staple length was 33.0 thirty seconds inches, or 1-1/32 inches.

Table 6.--Percentage distribution of grades and staple lengths of cottons consumed in the manufacture of carded gingham, chambray and seersucker 1/

Grade of cotton	Staple length (inches)					Total
	31/32	1	1-1/32	1-1/16	1-3/32	
	Percent	Percent	Percent	Percent	Percent	Percent
Strict Middling	-	1.6	3.1	7.3	1.5	13.5
Middling	1.6	1.3	11.0	20.7	6.1	40.7
Strict Low Middling	1.4	4.0	15.0	3.1	.1	23.6
Low Middling	1.4	2.1	3.4	1.7	.1	8.7
Middling Spotted	4.8	2.2	4.6	1.8	.1	13.5
Total	9.2	11.2	37.1	34.6	7.9	100.0

1/ Small quantities falling outside the limits of the table were included.

Most of the laboratory test results of fiber properties of cottons used in gingham, chambray, and seersucker fell within the range of "average" (table 7). Maturity, which averaged 83 percent, was higher than "average" and was within the range described as "mature."

Table 7.--Fiber properties and other factors of quality for cottons used in the manufacture of carded gingham, chambray, and seersucker

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	97.0	79.3 to 104.4
Staple length (32ds inch)	33.0	30.0 to 34.8
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.06	.96 to 1.14
Uniformity ratio	79	77 to 82
Tensile strength (1,000 lb. per sq. in.)	77	70 to 81
Fineness (micrograms per inch)	4.4	3.5 to 5.3
Maturity (percent)	83	66 to 88
Moisture content of raw cotton (percent)	7.0	5.6 to 8.2

The fiber properties of the cotton used by representative mills in the production of gingham, chambray, and seersucker conform reasonably well to average fiber properties of Deltapine 15 and Acala 4-42 varieties. These two varieties were among those tested by the Department of Agriculture from commercially produced cotton (7).

Manufacturing Performance of Cottons Used in Carded Gingham, Chambray, and Seersucker and Quality of Products

Picker and card waste from cotton obtained from mill mixes as processed in the laboratory averaged 9.4 percent (table 8). In consideration of the relatively high grade of cotton (grade index of 97) the percentage of waste was slightly higher than might have been expected as compared with average laboratory results from Middling to Strict Low Middling cotton of medium length staple.

The average number of neps found in the mill card webs was rather high for good-quality dress goods. The occurrence of neps in appreciable numbers detracts from the appearance of yarns, especially when they are dyed or printed, as the neps absorb dyes differently and appear as spots on the material.

Table 8.--Manufacturing performance of cottons used in carded gingham, chambray, and seersucker

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	9.0	7 to 11
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	51	45 to 55
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	29.3	21 to 40
Laboratory	29.3	21 to 40
Twist multiplier--		
Mills	4.65	4.4 to 5.0
Laboratory	4.65	4.4 to 5.0
Mill filling yarn:		
Yarn number--		
Mills	33.5	27 to 44
Laboratory	33.5	27 to 44
Twist multiplier--		
Mills	4.03	3.7 to 4.2
Laboratory	4.03	3.7 to 4.2
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	9.4	6.6 to 15.2
Neps per 100 sq. in. of card web:		
Mills	36	17 to 79
Laboratory	29	9 to 86
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 29s)--		
Mills	63	40 to 95
Laboratory	73	45 to 110
Filling (converted to 34s)--		
Mills	53	35 to 75
Laboratory	62	40 to 85
Standard laboratory numbers--		
22s	106	92 to 119
36s	58	49 to 68
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	C+	C to B
Laboratory	C+	C to B+
Filling--		
Mills	C+	D to B
Laboratory	C+	D+ to B
Standard laboratory numbers:		
22s	B	D+ to B+
36s	C+	D+ to B

1/ Ranges represent unconverted data.

A great variety of yarn numbers, constructions (threads per inch), and other fabric characteristics are used in gingham, chambray, and seersucker.

Specifications are stipulated when an order is placed at a mill and, as fashions and consumer preferences for dress goods change rapidly, the orders may be rather small. Consequently, a mill may be working on several orders of gingham--no two of which are alike--at one time. The data in tables 9, 10, and 11 show averages of test results on fabrics that were in process when the various mills were sampled.

Table 9.--Quality of carded gingham produced by representative cotton mills

Gingham	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	73	64 to 84
Filling	59	50 to 68
Fabric strength (pounds):		
Warp	49	42 to 53
Filling	36	27 to 45
Crimp (percent):		
Warp	6.6	2.0 to 11.4
Filling	8.3	5.7 to 11.9
Weight (oz. per sq. yd.)	3.3	2.9 to 3.5

Table 10.--Quality of carded chambray produced by representative cotton mills

Chambray	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	81	64 to 93
Filling	57	49 to 67
Fabric strength (pounds):		
Warp	65	57 to 71
Filling	38	30 to 47
Crimp (percent):		
Warp	5.6	4.4 to 7.6
Filling	7.6	4.6 to 12.5
Weight (oz. per sq. yd.)	3.7	3.1 to 4.6

Table 11.--Quality of carded seersucker produced by representative cotton mills

Seersucker	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	99	75 to 110
Filling	70	58 to 80
Fabric strength (pounds):		
Warp	33	24 to 39
Filling	42	38 to 46
Crimp (percent):		
Warp--		
Tight	4.8	3.8 to 6.7
Loose	36.6	24.6 to 44.3
Filling	9.6	6.9 to 13.5
Weight (oz. per sq. yd.)	4.3	3.8 to 4.6

Production Trends in Gingham, Chambray, and Seersucker

There was a rising trend in the production of gingham (including checks and plaids) during the period for which data were available, 1939-50. In 1939 about 18,000 bales of cotton were used in gingham. In succeeding years the annual consumption increased until in 1950 about 35,000 bales were used (table 12). In 1950 per capita consumption of gingham was 0.11 pound.

Gingham is predominantly a dress fabric and has no important uses in industry; therefore, its consumption is controlled to a great extent by its popularity among women as dress material. Its popularity is affected by whims of fashion as well as by the price of the fabric in relation to prices of competing products. Gingham alone is not a large market outlet for cotton but it is an important item among cotton dress goods materials.

The quantity of cotton used in chambray (including other colored yarn shirtings) during the period 1935 to 1950 ranged from about 59,000 bales in 1939 to about 101,000 bales in 1948 (table 13). Production did not show a definite trend. Per capita consumption varied between 0.22 and 0.33 pound--the lesser amount occurring in 1939, 1949, and 1950.

Table 12.--Production of gingham, checks and plaids, number of bales used, percentage of total cotton consumption and per capita consumption in the United States, by specified years, 1939-50

Year	Gingham produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1939	7,629	18	0.3	0.07
1941	7,694	18	.2	.07
1942	11,224	27	.2	.10
1943	9,178	22	.2	.08
1944	8,090	19	.2	.07
1945	8,271	20	.2	.07
1946	8,331	20	.2	.08
1947	10,978	26	.3	.09
1948	13,977	33	.4	.11
1949	10,493	25	.3	.08
1950	14,475	35	.4	.11

1/ Computed from Bureau of Census figures. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.22 pound for each linear yard of gingham, this being the average number of pounds of gingham per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 12.9 percent (1.148 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

Seersucker is one of the minor items among the numerous cotton textile products. During the period for which data were available, 1937 to 1950, the quantity of cotton used in carded seersucker ranged from about 2,000 bales in 1937 to about 14,000 bales in 1943 (table 14). Production in 1950, requiring 11,000 bales of cotton was considerably greater than that in the few years immediately preceding, but the data on this product were insufficient to warrant a definite conclusion regarding this apparent upward trend.

The production outlook for gingham, chambray, and seersucker, as well as other dress goods, is influenced primarily by fashion or style. Price has an important influence on the quantity of any product consumed, but the predominating influence--style--has more to do with the demand for these fabrics than normal variations in price. The combined production of these three fabrics in most years ammounted to only about 1 percent of total cotton consumption; hence these fabrics are not of great importance as outlets for cotton.

Table 13.--Production of chambray and colored yarn shirtings, number of bales of cotton used, percentage of total cotton consumption and per capita consumption in the United States, by specified years, 1935-50

Year	Chambray produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1935	34,912	83	1.5	0.31
1937	34,758	83	1.1	.31
1939	24,488	59	.8	.22
1941	30,682	73	.7	.26
1942	31,014	74	.6	.26
1943	29,732	71	.7	.25
1944	31,936	76	.8	.26
1945	30,959	74	.8	.25
1946	28,266	68	.7	.23
1947	35,267	84	.9	.28
1948	42,723	101	1.1	.33
1949	27,860	67	.8	.22
1950	28,853	69	.7	.22

1/ Computed from Bureau of Census figures. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.25 pound for each linear yard of chambray, this being the average number of pounds of chambray per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of nep processing loss of 12.9 percent (1.148 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

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Table 14.--Production of seersucker, number of bales of cotton used, percentage of total cotton consumption and per capita consumption in the United States, by specified years, 1937-50.

Year	Seersucker produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1937	869	2	0.03	0.01
1939	1,214	3	.04	.01
1941	3,305	8	.08	.03
1942	4,821	12	.10	.04
1943	5,711	14	.13	.05
1944	3,870	9	.09	.03
1945	3,590	9	.10	.03
1946	5,168	12	.12	.04
1947	2,655	6	.06	.02
1948	2,862	7	.08	.02
1949	2,114	5	.06	.02
1950	4,704	11	.11	.03

1/ Computed from Bureau of Census figures. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.32 pound of seersucker per linear yard, this being the average weight of seersucker per linear yard in 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 12.9 percent (1.148 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

TOWELING

Description of Towel Fabrics

The term towel or toweling does not identify a particular fabric; it merely denotes the end use closely associated with certain fabrics. The main fabrics used for towels are terry cloth and huckaback. The term huckaback designates a particular weave, and fabrics with this weave used for towels are generally called huck towels.

Terry cloth is also known as Turkish toweling. It is a coarse, heavy pile fabric with an uncut or loop pile on one or both sides. The pile may cover the entire surface or it may appear as stripes, checks, or designs. Two warps are used, one to interweave with the filling to form the ground or main fabric and the other to form the pile loops. One of the principal characteristics of terry cloth is its capacity to absorb moisture; hence its value as toweling.

Most terry towels are woven with a plain weave foundation. Some towels are woven on a loom with dobby attachment or on a jacquard loom to produce more intricate patterns. These towels may be yarn dyed or piece dyed.

Terry towels are usually made into bath towels rather than face or hand towels. However, lightweight terry cloth is used for small towels and for washcloths. Terry cloth is also used for bath mats, bath robes, beach wear, draperies, bedspreads, and other similar uses.

Huck toweling is a firm mediumweight fabric with a plain, rough surface woven with the huckaback weave. This weave gives a rather rough, pebbly surface to the cloth. The foundation is plain weave, which gives the cloth firmness, and floating yarns add to the absorbent properties. A typical weave has two warp ends floating on the face of the fabric over five picks, and two filling yarns floating over five ends in the back (1).

Huck toweling is used primarily for hand or face towels. Huckaback fabric is also used to some extent for quilting covers, draperies, and, in lightweights, for athletic shirts.

Qualities of Raw Cottons Used in Toweling

A higher grade of cotton is used in terry toweling than in huck toweling according to the results of tests made on samples from representative mills. About 43 percent of the cotton used in terry toweling is Strict Low Middling and higher grades as compared with about 16 percent used in huck toweling (tables 15 and 16). Low Middling and Strict Low Middling Spotted are the principal grades found in huck towel mixes.

The cotton used in terry towels had an average grade index of 90.4 (Middling White = 100) and that used in huck towels had a grade index of 84.0 (table 17). Moreover, reprocessed waste can be used satisfactorily for the manufacture of huck towels and affords a means of reducing manufacturing costs and conserving raw materials.

Table 15.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of terry toweling in the United States 1/

Grade of cotton	Staple length (inches)				Total
	31/32	1	1-1/32	1-1/16	
	Percent	Percent	Percent	Percent	Percent
Middling	0.8	1.6	5.7	0.8	8.9
Strict Low Middling	4.9	3.6	21.1	4.8	34.4
Low Middling	2.7	5.9	21.4	2.8	32.8
Middling Spotted	3.2	6.7	4.0	-	13.9
Strict Low Middling Spotted	1.5	4.7	3.0	.8	10.0
Total	13.1	22.5	55.2	9.2	100.0

1/ Small quantities falling outside the limits of the table were included.

Table 16.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of huck toweling in the United States 1/ 2/

Grade of cotton	Staple length (inches)				Total
	31/32	1	1-1/32	1-1/16	
	Percent	Percent	Percent	Percent	Percent
Strict Low Middling	0.6	3.6	11.2	1.0	16.4
Low Middling	3.7	14.4	27.1	4.5	49.7
Strict Good Ordinary	2.8	1.2	4.0	-	8.0
Strict Low Middling Spotted	2.3	10.2	6.6	1.2	20.3
Strict Low Middling Tinged	3.5	2.1	--	--	5.6
Total	12.9	31.5	48.9	6.7	100.0

1/ Does not include processing waste which was added in mixes for huck toweling.

2/ Small quantities falling outside the limits of the table were included.

There was no material difference in the length of staple used in terry and huck toweling. In each case the cotton used was mainly 1 inch and 1-1/32 inches, which is within the range of lengths most commonly produced in this country. No exacting standards of tensile strength or fineness of fiber are required in the manufacture of either terry or huck toweling; and as a general thing purchases of cotton for use in towels are not covered by definite specifications with respect to tensile strength or fiber fineness.

Table 17.--Fiber properties and other factors of quality of raw cotton used in the manufacture of terry and huck toweling in the United States 1/

Cotton quality factor	Terry toweling		Huck toweling	
	Average of all mixes	Range in mill mixes	Average of all mixes	Range in mill mixes
Classification:				
Grade index	90.4	85.5 to 97.4	84.0	74.7 to 89.5
Staple length (32ds inch)	32.5	31.1 to 33.3	32.3	30.9 to 33.0
Fiber properties:				
Length (Fibrograph)--				
Upper half mean (inches)	1.06	1.02 to 1.10	1.05	.98 to 1.10
Uniformity ratio	78	75 to 80	77	75 to 79
Tensile strength (1,000 lb. per sq. in.)	75	71 to 79	73	68 to 79
Fineness (micrograms per inch)	4.1	3.4 to 4.5	4.0	3.3 to 4.5
Maturity (percent)	81	74 to 87	79	70 to 84
Moisture content of raw cotton (percent)	7.0	5.5 to 9.3	7.7	6.2 to 9.3

1/ In addition to cotton, processing waste was used in the manufacture of huck toweling.

The fiber properties of Rowden and Deltapine varieties as found in cotton tested by the Department of Agriculture from commercial production in standardized communities indicate that these two varieties are well suited for the manufacture of terry toweling (7). Likewise, Paymaster 54 and Macha varieties are among those suited for huck toweling. However, as fiber property requirements for toweling are generally not very exacting most manufacturers would probably be influenced in their purchases by price rather than by fiber quality.

Manufacturing Performance of Cottons Used in Toweling

Laboratory tests were conducted to determine the performance of the various cottons used in the production of terry and huck towelings. Picker and card waste percentages, a reflection largely of the grade of cotton used, averaged 11.1 percent for the cotton used in terry fabrics and 12.4 percent for huck towel fabrics (tables 18 and 19). These were about the percentages to be expected from the qualities represented in the respective mixes.

Neps per hundred square inches of card web averaged 107 for mill processed cotton from terry fabric mixes as compared with 117 from the huck towel mixes. Although a lower grade of cotton was used in the huck toweling, it was compensated for by the lower rate of carding and the average nep counts were about the same. Inasmuch as yarn appearance is not of great importance in either terry or huck towel fabrics, no particular significance is attached to the high nep count found in these yarns.

Specifications for toweling fabrics are determined largely by estimates of consumer preferences, and towels are manufactured for many markets. As a result, many qualities of toweling are produced. Tables 20 and 21 show averages of tests of the toweling in process of manufacture at the mills where they were sampled.

Production Trends in Terry and Huck Towel Fabrics

Annual requirements of raw cotton for terry towel fabrics have varied during the last 20 years from about 107,000 bales for the depression year of 1933 to 257,000 bales in 1941 (table 22). The heavy increase in 1941 was the result of consumer purchasing power accompanying increased commercial and industrial activity accentuated by military programs. Production decreased from the high level reached in 1941 until 1949 when only 177,000 bales of cotton were required for terry towels. Then the quantity increased to about 231,000 bales in 1950.

The quantity of cotton used in terry towel fabrics has remained at a very steady proportion of total cotton consumption. Over the 20-year period from 1931 to 1950 the proportion of total cotton consumption represented by terry towel fabrics has ranged from 1.7 percent in 1933 to 2.6 percent in 1939 (table 22). The per capita consumption of terry towel fabrics during the last two decades has ranged from 0.41 pound in 1933 to 0.93 pound in 1941 and then downward to 0.73 pound in 1950. No trend was indicated in the annual per capita consumption rates. The consumption rates, presumably, vary with prices of towels and general economic conditions.

Table 18.--Manufacturing performance of cottons used in terry toweling

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	14.0	12 to 16
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	55	50 to 65
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	15.8	12 to 18
Laboratory	15.8	12 to 18
Twist multiplier--		
Mills	4.50	--
Laboratory	4.50	--
Mill filling yarn:		
Yarn number--		
Mills	13.2	12 to 15
Laboratory	13.2	12 to 15
Twist multiplier--		
Mills	3.63	3.5 to 3.9
Laboratory	3.63	3.5 to 3.9
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	11.1	8.2 to 14.1
Neps per 100 sq. in. of card web:		
Mills	107	84 to 122
Laboratory	40	7 to 174
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 16s)		
Mills	114	90 to 180
Laboratory	141	120 to 180
Filling (converted to 13s)--		
Mills	148	120 to 190
Laboratory	175	140 to 220
Standard laboratory numbers:		
14s	166	155 to 186
22s	101	94 to 111
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	D+	BG to B
Laboratory	B	D+ to B+
Filling--		
Mills	C	D to B
Laboratory	B	C to B+
Standard laboratory numbers:		
14s	B	D to B+
22s	C+	BG to B

1/ Ranges represent unconverted data.

Table 19.--Manufacturing performance of cottons, including some processing waste, used in huck toweling

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	13.8	12 to 15
Laboratory	9.5	--
Card sliver rate (grains):		
Mills	59	56 to 65
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	14.9	13 to 16
Laboratory	14.9	13 to 16
Twist multiplier--		
Mills	4.57	4.5 to 4.7
Laboratory	4.57	4.5 to 4.7
Mill filling yarn:		
Yarn number--		
Mills	8.3	5 to 11
Laboratory	8.3	5 to 11
Twist multiplier--		
Mills	3.42	3.2 to 3.5
Laboratory	3.42	3.2 to 3.5
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	12.4	9.9 to 16.9
Neps per 100 sq. in. of card web:		
Mills	117	79 to 147
Laboratory	59	23 to 238
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 14s)--		
Mills	132	100 to 150
Laboratory	160	140 to 190
Filling (converted to 8s)--		
Mills	239	180 to 350
Laboratory	272	180 to 450
Standard laboratory numbers:		
14s	162	154 to 175
22s	98	93 to 105
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	D+	BG to C+
Laboratory	B	C+ to B+
Filling--		
Mills	C	BG to C+
Laboratory	B	D+ to B+
Standard laboratory numbers:		
14s	B	C to B+
22s	C	D to B

1/ Ranges represent unconverted data.

Table 20.--Quality of terry toweling produced by representative cotton mills

Terry toweling	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	63	20 to 82
Filling	33	27 to 36
Fabric strength (pounds):		
Warp	45	22 to 64
Filling	44	30 to 56
Crimp (percent):		
Warp	2.7	1.9 to 4.0
Filling	8.5	5.3 to 15.0
Weight (oz. per sq. yd.)	8.7	5.5 to 11.5

Table 21.--Quality of huck toweling produced by representative cotton mills

Huck toweling	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	61	40 to 79
Filling	33	25 to 41
Fabric strength (pounds):		
Warp	90	60 to 111
Filling	74	58 to 91
Crimp (percent):		
Warp	8.9	5.1 to 11.8
Filling	4.6	2.6 to 8.0
Weight (oz. per sq. yd.)	6.2	5.1 to 7.0

Table 22.--Production of terry towel fabric, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by specified years, 1931-50

Year	Terry toweling fabric produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	47,082	115	2.1	0.44
1933	44,032	107	1.7	.41
1935	51,617	126	2.2	.48
1937	65,378	159	2.1	.59
1939	77,286	188	2.6	.69
1941	105,596	257	2.4	.93
1942	92,485	225	2.0	.80
1943	91,818	224	2.1	.79
1944	73,855	180	1.9	.63
1945	75,363	184	2.0	.63
1946	85,188	207	2.1	.70
1947	91,820	224	2.3	.75
1948	84,645	206	2.3	.68
1949	72,494	177	2.2	.57
1950	94,848	231	2.4	.73

1/ Computed from Bureau of Census figures with adjustments in some instances to obtain comparability of data. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.38 pound terry toweling per linear yard, the average poundage per linear yard in 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 14.5 percent (1.169 pounds raw cotton for each pound fabric). Conversion made to bales of 480 pounds net weight.

At the present time, cotton is the only fiber used in significant quantities in terry toweling. The fiber properties of cotton, particularly its capacity for absorbency and its ability to withstand laundering and hard usage, make cotton especially suitable for bath towels. No other fabric now offers serious competition in this field. Other types of cotton fabrics, such as huckaback and plain-woven towels, are used only to a limited extent for bath towels.

Although terry toweling fabrics represent only a small percentage of total cotton consumption, that percentage is important in view of the remarkably stable proportion of total cotton consumption represented by terry towel fabrics over a long period of years. Accordingly, past consumption adjusted for increase in population offers a reasonable basis on which to predict market outlets for this fabric in the years immediately ahead. The annual consumption of cotton in terry toweling has conformed more closely to annual variations in total cotton consumption than has consumption of cotton in huck toweling (fig. 1).

The annual requirements of raw cotton for huck toweling fabrics are relatively small. The largest quantity used in any year during the last two decades was in 1931 and the consumption that year was only about 45,000 bales of cotton (table 23). The trend was largely downward through the 1930's and into the 1940's. In 1948 only 20,000 bales were used in the manufacture of huck toweling but an upturn in consumption, in 1949 and 1950, resulted in the consumption of more than 39,000 bales in 1950. The largest share of total consumption of cotton during the last two decades was 0.83 percent in 1931.

Paper has captured a sizable portion of the huck toweling market in recent years by supplying cheap one-use towels which are particularly suitable for public washrooms, for home use in kitchens, and for other one-use purposes. Paper towels appear to have an advantage in this particular field, and, as a result, consumption of paper in toweling has shown a heavy increase from year to year whereas consumption of cotton in the fabric competing with paper has shown no increase (table 24). Since 1931 the consumption of paper in toweling has increased nearly fivefold.

Production trends in huck toweling do not warrant an optimistic outlook for greatly increased outlets for this fabric. Growth in population, rising standards of living, or new uses for this fabric could enlarge the outlets in this field.

Terry and huck toweling combined offer a comparatively stable market outlet for 200,000 to 250,000 bales of medium quality cotton annually. Terry toweling appears to have a very secure hold on its markets with potentialities for expansion. Huck toweling has lost ground in its competition with paper toweling and, as a result, production of huck toweling declined during the last 20 years.

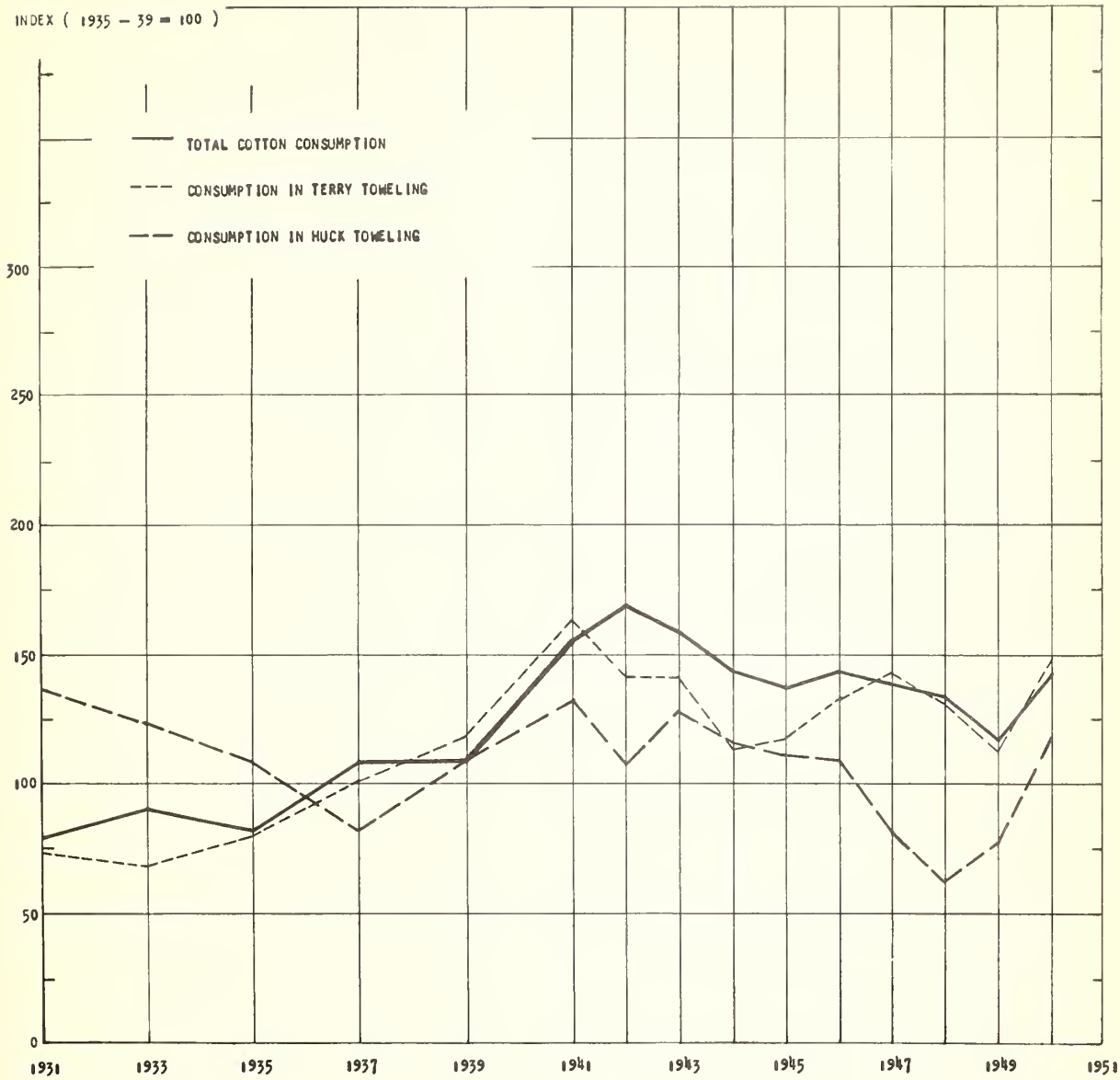

Figure 1.--Consumption of cotton in terry toweling and in huck toweling in comparison with total cotton consumption in the United States, 1931-50.

SOURCE: U. S. Bureau of Census.

Table 23.--Production of huck towel fabric, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by specified years, 1931-50

Year	Huck toweling fabric produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	18,433	45	0.83	0.17
1933	16,937	41	.66	.16
1935	14,771	36	.64	.14
1937	11,177	27	.36	.10
1939	14,868	36	.49	.13
1941	17,949	44	.42	.16
1942	14,597	36	.31	.13
1943	17,365	43	.40	.15
1944	15,592	38	.39	.13
1945	15,048	37	.40	.13
1946	14,873	36	.37	.12
1947	10,997	27	.28	.09
1948	8,293	20	.22	.07
1949	10,467	26	.33	.08
1950	16,045	39	.40	.12

1/ From Bureau of Census figures with adjustments in some instances to obtain comparability of data. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.21 pound huck toweling per linear yard, the average number of pounds of huck toweling per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 15.0 percent (1.176 pounds raw cotton for each pound of fabric). Conversion made to bales of 480 pounds net weight.

Table 24.--Comparative quantities of paper toweling and cotton huck toweling produced in specified years, 1931-50

Year	Production	
	Huck 1/	Paper 2/
	1,000 pounds	1,000 pounds
1931	18,433	107,040
1935	14,771	130,924
1941	17,949	389,680
1946	14,873	422,162
1950	16,045	527,134

1/ Computed from Bureau of Census data. Partially estimated.
2/ From the Tissue Association's Tissue Statistics, 1951. New York.

CORDUROY

Description and Uses

Corduroy is one of the well-known pile fabrics. Other pile fabrics are velvet, velveteen, plush, and terry cloth.

Corduroy is a stout, durable fabric, usually made from carded yarns, having pronounced cords or wales running warpwise. Corduroy is woven with two fillings, one for the ground and one for the pile. Loops are formed in the pile filling and these loops are cut to provide a soft surface. Corduroy is thus a filling-pile fabric as distinguished from a warp-pile fabric.

In velvet, a warp-pile fabric, the rows of short pile are so close together that they present a uniform surface, rich in appearance and soft to touch. Plush, another warp-pile fabric, is similar to velvet except that the pile is longer than in velvet and is less densely woven. Velveteen, a filling-pile fabric, is similar to corduroy except that it is smooth-surfaced, without the characteristic wales of corduroy. In terry cloth the pile is uncut in the form of loops, and is usually made of relatively coarse yarns in a rough weave suitable for toweling.

Corduroy is used for such diversified purposes as clothing, bedspreads, draperies, and upholstery. It is predominantly a clothing fabric, and is widely used in jackets, slacks, sportswear, suits, and dresses.

Qualities of Raw Cottons Used in Corduroy

Special care is necessary in selecting cotton used in the manufacture of corduroy. To get the smooth, luxuriant texture and the appealing appearance, as well as stoutness and durability required of this fabric, cottons of medium or high quality are necessary. In addition, processing procedures are more exacting than those for some other types of fabrics.

The grades of cotton used are principally Strict Middling, Middling, and Strict Low Middling, with Middling, predominating and constituting about 40 percent of the total (table 25). The grade index of 96.5 indicates an average grade about mid-value between Middling and Strict Low Middling. Staple lengths are restricted to a range of 1 inch to 1-3/32 inches; more than 63 percent of the cotton used is composed of the staple lengths 1-1/32 and 1-1/16 inches. The average staple length was 33.7 thirty-seconds inch (table 26).

Table 25.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of carded corduroy in the United States 1/

Grade of cotton	Staple length (inches)				Total
	1	1-1/32	1-1/16	1-3/32	
	Percent	Percent	Percent	Percent	Percent
Strict Middling	10.2	4.6	1.0	0.9	16.7
Middling	7.1	6.4	14.7	11.4	39.6
Strict Low Middling	2.4	14.9	15.5	1.7	34.5
Middling Spotted	2.5	4.2	2.0	.5	9.2
Total	22.2	30.1	33.2	14.5	100.0

1/ Small quantities falling outside the limits of the table were included.

Table 26.--Fiber properties and other factors of quality for cotton used in the manufacture of carded corduroy

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	96.5	92.8 to 100.2
Staple length (32ds inch)	33.7	32.9 to 34.7
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.08	1.04 to 1.12
Uniformity ratio	79	78 to 80
Tensile strength (1,000 lb. per sq. in.)	78	71 to 82
Fineness (micrograms per inch)	4.4	3.9 to 4.6
Maturity (percent)	85	80 to 87
Moisture content of raw cotton (percent)	6.7	6.1 to 7.1

Manufacturers have to select cotton for use in corduroy with more care than is necessary for many other fabrics. The fiber qualities found in the cottons used by corduroy manufacturers are not difficult to obtain, however. Five well-known varieties, Acala 4-42, Coker 100 Wilt, Deltapine 15, Empire, and Stoneville 2B, according to tests made by the Department of Agriculture from commercial production, have average fiber qualities similar to cottons found in corduroy mixes from representative mills. If manufacturers can select the specific qualities desired from among varieties known to be suitable, they can obtain more uniform results.

Manufacturing Performance of Cottons Used in Carded Corduroy and Quality of the Yarn

The laboratory picker and card waste from the mixes used in the manufacture of corduroy was not so high as that for many other fabrics, because of the relatively high grades of cotton used in corduroy (table 27). The number of neps in the mill card webs--28 per 100 square inches of card web--was low, considering the relatively heavy card sliver produced by the mills. This was accounted for by the rather slow rate of carding used by the corduroy mills sampled. Neps are objectionable in a fabric such as corduroy in which softness and smoothness are essential.

Table 28 shows averages of the quality of corduroy in the process of manufacture at representative cotton mills.

Production Trends in Corduroy

There has been a definite upward trend in the production of corduroy during the last 20 years (table 29). In 1950 about 184,000 bales of cotton were used in the manufacture of carded corduroy. This was the largest quantity of cotton consumed in that fabric for any year on record. Only 26,000 bales of cotton were used in carded corduroy in 1931.

The use of corduroy has increased to a greater extent during the last 5 years than at any other time. For the decade and a half prior to 1946 the per capita consumption of corduroy averaged about 0.2 pound, and it fell as low as 0.1 pound in 1931. In 1950 the per capita consumption was nearly 0.6 pound. The proportion of total cotton consumption for corduroy increased steadily over the years from 0.47 percent in 1931 to 1.90 percent in 1950. This increasing trend in production makes corduroy a market outlet of considerable importance. Corduroy and other similar pile fabrics have very distinctive characteristics that have a wide appeal in many types of clothing and in other uses. Also of importance is the fact that corduroy is almost exclusively a cotton fabric; no other fiber has been used successfully in large volume in the manufacture of corduroy.

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Table 27.--Manufacturing performance of cottons used in carded corduroy

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	8.9	7 to 10
Laboratory	9.5	--
Card sliver rate (grains):		
Mills	53	48 to 57
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	29.7	28 to 31
Laboratory	29.7	28 to 31
Twist multiplier--		
Mills	4.36	4.2 to 4.5
Laboratory	4.36	4.2 to 4.5
Mill filling yarn:		
Yarn number--		
Mills	22.5	19 to 28
Laboratory	22.5	19 to 28
Twist multiplier--		
Mills	3.52	3.0 to 4.0
Laboratory	3.52	3.0 to 4.0
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	8.6	6.8 to 10.7
Neps per 100 sq. in. of card web:		
Mills	28	17 to 45
Laboratory	27	17 to 61
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 30s)--		
Mills	65	60 to 75
Laboratory	71	60 to 85
Filling (converted to 22s)--		
Mills	93	65 to 115
Laboratory	102	80 to 120
Standard laboratory numbers:		
22s	106	88 to 113
36s	59	48 to 65
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	C+	C to B
Laboratory	B	C+ to B+
Filling--		
Mills	B	C to B+
Laboratory	B	B to B+
Standard laboratory numbers--		
22s	B+	C to B+
36s	C+	D+ to B

1/ Ranges represent unconverted data.

The trend in corduroy production followed that of total cotton consumption rather closely for the period 1931 to 1945 (fig. 2). The decided upward turn in corduroy production since 1945 is in contrast to the somewhat downward trend in total cotton consumption. This upward trend in production of corduroy is evidence of its increasing popularity among consumers.

Consumption of corduroy in the years ahead will be governed to a large extent by the same factors that affect total cotton consumption, that is, general economic conditions, consumer incomes, purchasing power of money and other factors affecting consumption in general. However, the manufacture of corduroy offers a very promising market outlet for cotton especially since to date consumer appeal has not been fully exploited. Promotional campaigns, capitalizing on its distinctive characteristics could result in greatly increased consumption over the years. However, as corduroy is a luxury item in many of its uses it is susceptible to rapid curtailment in consumption.

Table 28.--Quality of corduroy produced by representative cotton mills

Corduroy	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	87	78 to 91
Filling	146	132 to 176
Fabric strength (pounds):		
Warp	74	61 to 82
Filling	173	155 to 199
Crimp (percent):		
Warp	3.5	2.6 to 4.3
Filling	7.3	6.0 to 8.8
Weight (oz. per sq. yd.)	7.6	7.3 to 8.9

Table 29.--Production of carded corduroy, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by specified years, 1931-50

Year	Carded corduroy produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	10,487	26	0.47	0.10
1933	15,972	39	.63	.15
1935	20,452	50	.89	.19
1937	19,974	49	.66	.18
1939	23,657	58	.79	.21
1941	38,340	94	.89	.34
1942	29,740	73	.64	.26
1943	28,780	70	.66	.25
1944	24,026	59	.61	.20
1945	21,997	54	.59	.18
1946	29,528	72	.74	.24
1947	40,964	100	1.05	.33
1948	44,468	109	1.20	.36
1949	59,035	145	1.83	.47
1950	74,968	184	1.90	.58

1/ Computed from Bureau of Census figures. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.62 pound corduroy per linear yard, this being the average number of pounds of corduroy per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 14.9 percent (1.175 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

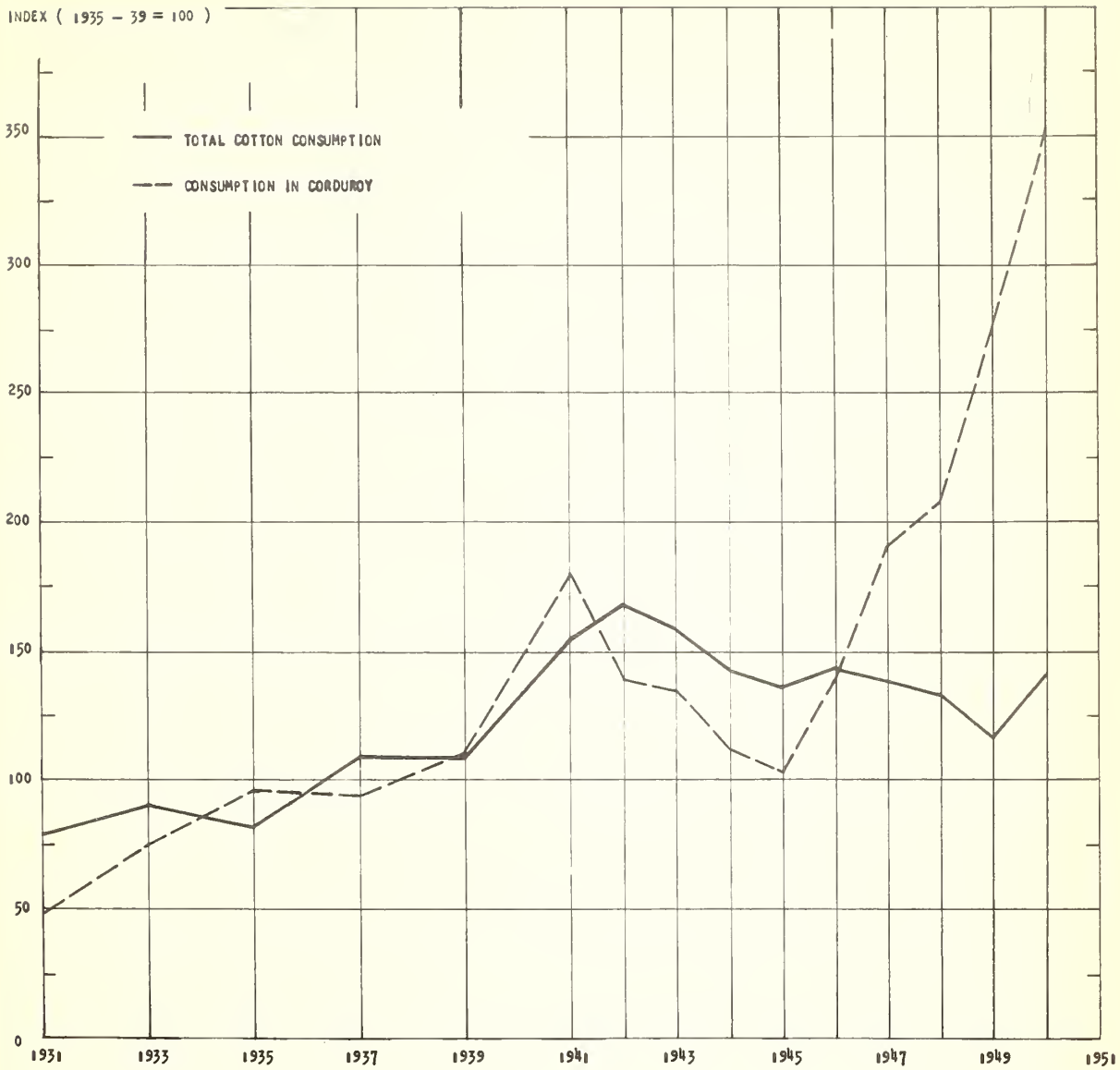

Figure 2.--Consumption of cotton in corduroy in comparison with total cotton consumption in the United States, 1931-50.

SOURCE: U. S. Bureau of Census.

BEDSPREADS

Description of Fabrics

Materials used for bedspreads may be grouped into three classes: (1) Fabrics on which designs or decorations have been placed, known as tufted spreads; (2) fabrics having weaves and constructions designed especially for bedspreads, known as woven bedspreads; and (3) fabrics usually associated with other uses but suitable for bedspreads.

Tufted bedspreads have single tufts or continuous running tufts. The tufts are made by adding floating yarns on the base fabric and then clipping the floating yarns to form the tufts. Originally this work was done by hand, but now it is mostly a machine process. In many cases the tufts are formed from a second or top warp beam that is placed in the loom with the weaving of the base fabric. "Candlewick," "hobnail," and "chenille" are terms frequently employed in trade terminology to distinguish different types of tufted spreads.

Woven bedspreads consist of "jacquard woven" and "non-jacquard woven" according to the classification used by the Bureau of the Census and accepted trade usage. Jacquard spreads are produced in many styles and patterns on jacquard looms which permit intricate designs to be woven into the fabric. Non-jacquard woven spreads are produced in plain and crinkle construction on dobby or on conventional looms.

The third group of materials used for bedspreads includes a large number of fabrics. In fact, most of the wide woven constructions are used to some extent for bedspreads. In checking a partial list of cotton fabrics with a textile dictionary (2), it was found that bedspread was listed as an important use for the following fabrics: Broadcloth, corduroy, covert, damask, dimity, lawn, organdy, oxford cloth, percale, pique, sateen, satin, seersucker, sheeting, terry cloth, velvet, velveteen, voile, and others.

This study dealt primarily with woven bedspreads. Tests were made with jacquard-woven spreads and non-jacquard-woven spreads. The dobby loom produces designs similar in appearance, although of less intricate patterns, to those produced on the jacquard loom. The crinkle spread is a form of seersucker and it is produced with a second warp which is allowed to be slack while the first or bottom warp is held at usual tension.

Qualities of Raw Cottons Used in Jacquard and Non-Jacquard Bedspreads

The cotton used in the manufacture of jacquard bedspreads was about equal in grade to that used in non-jacquard spreads (tables 30 and 31). Strict Low Middling was the principal grade of cotton used for each; however, in non-jacquard spreads larger proportions of Middling and

Low Middling were used and smaller proportions of Strict Low Middling and Middling Spotted. In addition, some mills making jacquard spreads used small quantities of processing waste in their mixes.

Table 30.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of jacquard bedspreads 1/ 2/

Grade of cotton	Staple length (inches)						Total
	29/32	15/16	31/32	1	1-1/32	1-1/16	
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Middling	-	0.3	-	2.4	8.5	4.0	15.2
Strict Low Middling	2.8	3.5	10.5	7.0	16.2	9.7	49.7
Low Middling	.6	.3	.3	1.1	4.0	4.4	10.7
Middling Spotted	1.9	5.7	7.9	3.2	5.4	.3	24.4
Total	5.3	9.8	18.7	13.7	34.1	18.4	100.0

1/ Does not include small quantities of processing waste used by some mills in manufacturing jacquard spreads.

2/ Small quantities falling outside the limits of the table were included.

Table 31.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of woven bedspreads other than jacquard 1/

Grade of cotton	Staple length (inches)					Total
	31/32	1	1-1/32	1-1/16	1-3/32	
	Percent	Percent	Percent	Percent	Percent	Percent
Middling	-	6.3	6.9	13.9	1.4	28.5
Strict Low Middling	1.4	8.3	8.5	18.7	2.9	39.8
Low Middling	4.1	.7	6.7	8.9	1.1	21.5
Middling Spotted	3.5	2.8	1.8	1.4	.7	10.2
Total	9.0	18.1	23.9	42.9	6.1	100.0

1/ Small quantities falling outside the limits of the table were included.

The staple lengths in the jacquard spreads averaged about 1/32 inch shorter than those used in non-jacquard spreads. The range of staple lengths for the jacquard spreads was from 29/32 inch to 1-1/16 inches, the most frequent being 1-1/32 inches; the range for the non-jacquard spreads was from 31/32 inch to 1-3/32 inches, 1-1/16 inches being the principal length.

The fiber used in non-jacquard bedspreads was somewhat stronger and finer than that used in jacquard bedspreads (table 32).

Table 32.--Fiber properties and other factors of quality for cotton used in the manufacture of jacquard and other than jacquard bedspreads

Cotton quality factor	Jacquard		Other than jacquard	
	Average of all mixes	Range in mill mixes	Average of all mixes	Range in mill mixes
Classification:				
Grade index	94.0	85.0 to 100.4	93.1	87.4 to 100.3
Staple length (32ds inch)	32.1	29.5 to 33.9	33.2	31.6 to 34.3
Fiber properties:				
Length (Fibrograph)--				
Upper half mean (inches)	1.03	.95 to 1.12	1.09	1.01 to 1.13
Uniformity ratio	79	78 to 80	79	78 to 80
Tensile strength (1,000 lb. per sq. in.)	76	71 to 80	81	78 to 87
Fineness (micrograms per in.)	4.3	3.7 to 4.5	4.0	3.4 to 4.3
Maturity (percent)	83	74 to 86	82	74 to 86
Moisture content of raw cotton (percent)	6.9	5.8 to 7.5	6.3	5.8 to 9.9

Among the commercially produced varieties of cotton tested by the Department, Rowden, Lankart 57, and Arizona 44 have average qualities similar to the qualities used by mills in manufacturing jacquard bedspreads. For the non-jacquard type of bedspread, Deltapine 15, Stoneville 2B, and Bobshaw 1-A varieties produce cotton having average qualities conforming to the standards found in mill mixes.

Manufacturing Performance of Cotton Used for Jacquard and Other than Jacquard Bedspreads and Quality of Products

There was a picker and card waste of about 10 percent for cottons from each of the two groups of representative mills manufacturing jacquard and non-jacquard bedspreads. This was about in line with the waste generally obtained from the qualities of cotton used (tables 33 and 34).

Neps per hundred square inches of card web averaged 57 and 91 from jacquard and non-jacquard, respectively, in the mill card webs. The excessive neps of the non-jacquard group can be attributed to faster carding, heavier card slivers, and the longer, finer fiber used. This degree of neppiness would be considered high for cotton used in some types of fabric, but in bedspreads, where smoothness is not essential neps are not important. Coarse yarns designed to impart a rough, heavy appearance to the spreads are used in many cases, particularly in jacquard fabrics.

For the non-jacquard spreads, yarn numbers averaged 19.3 and 20.8 for the warp and filling yarns, respectively, but both were converted to 20s. Both the mills and laboratory spun relatively stronger filling than warp yarns, with twist multipliers of 3.70 and 4.73, respectively.

Bedspreads are made into a wide variety of styles and qualities. Consequently, the results shown below in tables 35 and 36 do not represent a particular standard type or quality but an average of the qualities being produced at the mills when the fabrics were sampled.

Production Trends in Woven Cotton Bedspreads

During the 20-year period, from 1931 to 1950, woven bedspreads, consisting of jacquard and other than jacquard woven fabrics, have required quantities of raw cotton varying from about 41,000 bales in 1931 to about 88,000 bales in 1948 (table 37). No definite trend was indicated. The quantities of cotton used varied with general economic conditions and with conditions peculiar to the industry. The drop from 71,000 bales in 1944 to 46,000 bales in 1945 and the increase back to about 71,000 bales in 1946 showed unusual variations. Contributing causes might have been overaccumulation of inventories in 1944 and the subsequent depletion and reaccumulation.

The quantity of cotton used in woven bedspreads has held to fairly constant proportions of total consumption during the last two decades. It varied from about 1/2 percent to about 1 percent of total cotton consumption, averaging about 3/4 of 1 percent (table 37). Per capita consumption likewise remained fairly constant--about 1/4 pound for most years.

The record of cotton consumption in bedspreads does not of itself afford a basis for optimism with respect to market outlets for raw cotton in woven bedspreads. Consumption in recent years has averaged about

Table 33.--Manufacturing performance of cottons used in jacquard bedspreads

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	11.6	9 to 14
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	53	50 to 60
Laboratory	40	--
Mill warp yarn:		
Yarn number --		
Mills	15.0	10 to 20
Laboratory	15.0	10 to 20
Twist multiplier --		
Mills	4.43	4.4 to 4.5
Laboratory	4.43	4.4 to 4.5
Mill filling yarn:		
Yarn number --		
Mills	7.2	4 to 12
Laboratory	7.2	4 to 12
Twist multiplier --		
Mills	3.77	3.3 to 4.5
Laboratory	3.77	3.3 to 4.5
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	9.8	7.2 to 12.6
Neps per 100 sq. in. of card web:		
Mills	57	34 to 126
Laboratory	30	16 to 82
Yarn skein strength (pounds):		
Mill yarn numbers --		
Warp (converted to 15s) --		
Mills	123	90 to 230
Laboratory	155	110 to 270
Filling (converted to 7s) --		
Mills	277	180 to 450
Laboratory	324	190 to 530
Standard laboratory numbers --		
14s	164	152 to 194
22s	102	91 to 116
Yarn appearance grade:		
Mill yarn numbers --		
Warp --		
Mills	C+	D to B
Laboratory	C+	C to B
Filling --		
Mills	B+	B to B+
Laboratory	B	C+ to B+
Standard laboratory numbers --		
14s	B+	B to B+
22s	B	C to B+

1/ Ranges represent unconverted data.

Table 34.--Manufacturing performance of cottons used in woven bedspreads other than jacquard

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	12.8	11 to 14
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	58	52 to 64
Laboratory	40	--
Mill warp yarn:		
Yarn number --		
Mills	19.3	8 to 26
Laboratory	19.3	8 to 26
Twist multiplier --		
Mills	4.73	4.5 to 4.9
Laboratory	4.73	4.5 to 4.9
Mill filling yarn:		
Yarn number --		
Mills	20.8	17 to 24
Laboratory	20.8	17 to 24
Twist multiplier --		
Mills	3.70	3.6 to 3.8
Laboratory	3.70	3.6 to 3.8
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	10.1	5.7 to 11.4
Neps per 100 sq. in. of card web:		
Mills	91	54 to 115
Laboratory	33	19 to 49
Yarn skein strength (pounds):		
Mill yarn numbers --		
Warp (converted to 20s) --		
Mills	85	50 to 220
Laboratory	120	80 to 290
Filling (converted to 20s) --		
Mills	88	70 to 110
Laboratory	121	100 to 150
Standard laboratory numbers --		
14s	184	164 to 198
22s	113	105 to 123
Yarn appearance grade:		
Mill yarn numbers --		
Warp --		
Mills	D+	D to C+
Laboratory	B	C+ to B+
Filling --		
Mills	D	BG to D+
Laboratory	C+	C+ to B
Standard laboratory numbers --		
14s	B	B to B+
22s	B	C+ to B

1/ Ranges represent unconverted data.

75,000 bales of cotton with no indication at present of an enlargement of outlets. As a potential source of increased consumption of cotton, however, bedspreads deserve a high place.

Table 35.--Quality of jacquard bedspread produced by representative cotton mills

Jacquard bedspread	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	63	50 to 90
Filling	37	21 to 65
Fabric strength (pounds):		
Warp	70	50 to 82
Filling	75	50 to 83
Crimp (percent):		
Warp	3.2	1.5 to 5.0
Filling	6.0	3.0 to 9.8
Weight (oz. per sq. yd.)	6.5	5.2 to 7.2

Table 36.--Quality of woven bedspreads other than jacquard produced by representative cotton mills

Bedspread other than jacquard	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	54	46 to 76
Filling	46	33 to 66
Fabric strength (pounds):		
Warp	36	22 to 65
Filling	45	23 to 66
Crimp (percent):		
Warp	5.8	2.6 to 17.1
Filling	7.9	4.5 to 17.4
Weight (oz. per sq. yd.)	4.4	3.0 to 6.9

Table 37.--Production of woven bedspreads, jacquard and other than jacquard, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by specified years, 1931-50

Year	Woven bedspreads produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	16,498	41	0.75	0.16
1933	16,601	41	.66	.16
1935	16,657	41	.72	.15
1937	18,654	46	.62	.17
1939	21,646	53	.72	.20
1941	28,934	71	.67	.26
1942	32,346	80	.70	.28
1943	30,238	74	.70	.26
1944	28,832	71	.73	.25
1945	18,783	46	.51	.16
1946	28,993	71	.73	.24
1947	31,493	77	.81	.26
1948	35,868	88	.97	.29
1949	28,434	70	.89	.23
1950	26,689	66	.68	.21

1/ Computed from Bureau of Census figures. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.99 pound fabric per linear yard, the average number of pounds of fabric per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 15.3 percent (1.181 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

Bedspreads appear to be a good possibility as a market outlet for cotton, for several reasons. In the first place, cotton is peculiarly suitable for a fabric requiring the hard usage imposed on bedspreads. Cotton has durability and launderability along with style adaptation. Another advantage from the market outlet standpoint is that a bedspread requires a relatively large quantity of cotton. A single bedspread may require as much as 2 pounds of cotton. Furthermore, the price of cotton for the qualities used in bedspreads is relatively low in comparison with prices of other competing materials.

DRAPERY AND UPHOLSTERY FABRICS

Description of Fabrics

Practically every known kind of cloth, from burlap to the finest silk, is used for drapery and, to some extent, for upholstery. However, a few cotton fabrics generally are used as material for drapery or upholstery. Among these are: Bomber cloth; brocade; brocatelle; chintz; crash; cretonne; frieze, jaspe cloth; monk's cloth; sateen, tapestry; velour; and jacquard woven drapery and upholstery fabrics.

In this study, tests were made of only jacquard and plain-woven drapery and upholstery fabrics made of carded yarns. These fabrics are also used for wall hangings, cushion covers, and table runners.

Qualities of Raw Cottons Used in Jacquard and Plain-Woven Drapery Fabrics

The manufacture of jacquard and plain-woven draperies does not require cottons of as high qualities as those used in many other fabrics. The principal grades of cotton used were Middling Spotted, representing about 43 percent of the total (table 38) and Strict Low Middling and Low Middling, each representing about 25 percent of the total. The staple lengths ranged from 7/8 inch to 1-1/32, with more than half of the cotton falling within the range of 1 inch to 1-1/32 inches in staple length.

Table 38.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of drapery and upholstery fabrics 1/

Grade of cotton	Staple length (inches)			Total
	7/8 - 29/32	15/16 - 31/32	1 - 1-1/32	
	Percent	Percent	Percent	Percent
Middling	3.8	0.9	0.8	5.5
Strict Low Middling	1.8	4.5	19.9	26.2
Low Middling	--	3.8	21.8	25.6
Middling Spotted	14.8	17.0	10.9	42.7
Total	20.4	26.2	53.4	100.0

1/ Small quantities falling outside the limits of the table were included.

Average tensile strength of 74,000 pounds for cotton used in these fabrics was slightly below "average" or "fair" (table 39). Fibers of this strength are satisfactory for many types of drapery. A maturity of 82 percent for cotton used in drapery and upholstery fabrics was above the average maturity usually found for upland cotton. Some manufacturers of draperies lay special emphasis on maturity of fiber, testing each bale for maturity. Maturity is emphasized because the chemical affinity of cotton to dyes varies with the maturity of the fibers.

Table 39.--Fiber properties and other factors of quality for cotton used in the manufacture of drapery and upholstery fabrics 1/

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	92.5	85.6 to 97.2
Staple length (32ds inch)	31.3	28.7 to 33.4
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	.98	.87 to 1.07
Uniformity ratio	79	77 to 83
Tensile strength (1,000 lb. per sq. in.)	74	70 to 78
Fineness (micrograms per inch)	4.5	4.0 to 5.0
Maturity (percent)	82	78 to 86
Moisture content of raw cotton (percent)	6.7	5.8 to 8.5

1/ In addition to raw cotton, processing waste is used in the manufacture of drapery and upholstery fabrics.

No exacting specifications with respect to the fiber qualities are used in selecting cotton for drapery fabrics. In general, price is the controlling factor rather than special fiber properties, in the purchase of cotton for draperies. However, because of its effect on dyeing, maturity is emphasized by some manufacturers. Cotton of the qualities used by manufacturers may be obtained from Hibred and Lockett 140 varieties, among others.

Manufacturing Performance and Processing Waste of Cottons Used in Drapery and Upholstery Fabrics

Such a wide range of yarn numbers and constructions are used in drapery and upholstery fabrics that it was difficult to find mills making the same or similar fabrics.

Picker and card waste averaged 10.9 percent which was reasonably well in line with past experience for the average quality of cotton used for these mixes (table 40). Neps per hundred square inches of card web were relatively high with an average count of 93. As these fabrics are usually of a rough texture, the presence of some additional neps is not considered a disadvantage. The rapid rate of mill carding indicates that not much concern is given to neps.

Cotton from the drapery mixes was spun into 14s and 22s yarn, according to standard processing procedure in the laboratory. The skein strength of the 14s was 156 pounds and that of the 22s was 92 pounds. "Average" quality yarns for general purposes would range from 165 to 179 pounds in skein strength for 14s and from 100 to 108 pounds for 22s. The yarns spun from the drapery mixes would not be of acceptable strength for many purposes, but they were satisfactory for drapery fabrics of medium qualities.

Because of variations in fabric constructions used for drapery and upholstery, fabric data are not included.

Production Trends in Cotton Drapery, Upholstery, and Tapestry Fabrics

Census data on drapery fabrics are combined with upholstery and tapestry fabrics; hence drapery fabrics are not treated separately in this report. Drapery and allied fabrics require a significant volume of cotton. Annual consumption of cotton in these fabrics during the last 20 years ranged from about 77,000 bales in 1931 to about 316,000 in 1950 (table 41). Although the increase during this period was not consistent, the trend was decidedly upward and the last year for which data were available, 1950, was the year of largest consumption.

In addition to drapery and allied fabrics which were made wholly or principally of cotton, similar fabrics were made of part cotton, wool or rayon comprising the principal fiber. In the aggregate, fabrics which individually require only a small proportion of cotton provide a market outlet for a large volume of cotton.

In 1950 draperies and associated fabrics represented about 3-1/2 percent of the total cotton consumption as compared with slightly less than 1-1/2 percent 20 years earlier. Per capita consumption increased from about 1/3 pound in 1931 to almost 1 pound for each of the last 5 years.

Table 40.--Manufacturing performance of cottons and processing waste used in drapery and upholstery fabrics

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	12.9	9 to 16
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	54	50 to 60
Laboratory	40	--
Mill warp yarn:		
Yarn number --		
Mills	10.7	5 to 14
Laboratory	10.7	5 to 14
Twist multiplier --		
Mills	4.53	4.5 to 4.6
Laboratory	4.53	4.5 to 4.6
Mill filling yarn:		
Yarn number --		
Mills	9.4/2	8/2 to 10/2
Laboratory	9.4/2	8/2 to 10/2
Twist multiplier --		
Mills	3.75	3.5 to 4.3
Laboratory	3.75	3.5 to 4.3
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	10.9	6.8 to 19.1
Neps per 100 sq. in. of card web:		
Mills	93	30 to 500
Laboratory	37	18 to 150
Yarn skein strength (pounds):		
Mill yarn numbers --		
Warp (converted to 11s) --		
Mills	157	110 to 390
Laboratory	196	150 to 450
Filling (converted to 9/2) --		
Mills	411	300 to 550
Laboratory	481	400 to 580
Standard laboratory numbers --		
14s	156	138 to 183
22s	92	82 to 108
Yarn appearance grade:		
Mill yarn numbers --		
Warp --		
Mills	C+	C to B
Laboratory	B+	B to B+
Filling --		
Mills	--	--
Laboratory	--	--
Standard laboratory numbers --		
14s	B	D to B+
22s	C+	BG to B+

1/ Ranges represent unconverted data.

Table 41.--Production of drapery, upholstery, and tapestry fabrics, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by years, 1931-50.

Year	Drapery, upholstery and tapestry produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	31,000	77	1.4	0.30
1933	38,953	97	1.6	.37
1935	44, 655	112	2.0	.41
1937	51,218	128	1.7	.47
1939	65,237	163	2.2	.60
1941	106,363	266	2.5	.94
1942	117,702	294	2.6	1.04
1943	64,996	162	1.5	.57
1944	70,910	177	1.8	.61
1945	56,996	142	1.6	.48
1946	123,742	309	3.1	1.04
1947	99,365	248	2.6	.83
1948	99,414	249	2.7	.81
1949	100,846	252	3.2	.80
1950	126,285	316	3.3	.99

1/ Computed from Bureau of Census figures. The data for years 1941-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.78 pound fabric per linear yard, the average number of pounds of fabric per linear yard for the year 1947.

2/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 16.7 percent (1.200 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

The possibilities for continued large market outlets for cotton in drapery material appear good. Stylish and colorful draperies appeal particularly to home owners, as draperies are now considered in the nature of a semipermanent improvement to the home. With increased home ownership, investments in cotton draperies are increasing although other fibers will continue to take a considerable part of this market. If cotton draperies are produced in conformity with prevailing style trends, and if they have the advantage of promotional campaigns comparable to those given some other fabrics, they should at least hold their present position on the market.

UNIFORM TWILL

Description of the Fabric

In general, the term "twill" applies to all fabrics woven with a twill weave. In a more restricted sense, twill consists of gray cotton fabrics made with three or four harnesses, such as drills, jeans, and uniform twill. In a twill weave each warp yarn floats over or under at least two consecutive filling yarns and the points of interlacing move one thread outward and one upward (or downward) on succeeding picks (2). The twill weave is very useful in bringing out ornamental effects in fabrics and, as it affords a close setting of ends and picks, a fabric of weight and firmness can be produced.

In the earlier publication in this series (4), a section was devoted to the type of twill fabric known as drill. In this publication, attention is directed primarily to four-leaf twill of the type usually described as uniform twill, although often called Army twill because of its widespread use in Army shirts and other military garments, particularly trousers and blouses for summer uniforms. Both carded and combed uniform twills are included. The construction is approximately the same for each, 108 by 56 threads per square inch. However, singles yarns are used in the carded and plied yarns in the combed uniform twills.

Qualities of Raw Cottons Used in Uniform Twill, Carded and Combed

Combed uniform twill utilized better qualities of cotton than did carded uniform twill, according to tests made on samples from mixes of representative mills. Carded uniform twill used grades of cotton consisting principally of Middling and Strict Low Middling. Combed twill used about one-fifth Strict Middling, nearly one-half Middling, and the balance Strict Low Middling (tables 42 and 43).

Staple lengths ranging from 1 inch to 1-1/16 inches were used in carded uniform twills; more than 50 percent consisted of cotton 1-1/32 inches in staple length. Longer staples ranging from 1-1/32 to 1-1/8 inches were used for combed uniform twill. Nearly equal proportions of 1-1/16 and 1-3/32 inches in staple length were used.

Table 42.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of carded uniform twill 1/

Grade of cotton	Staple length (inches)			Total
	1	1-1/32	1-1/16	
	Percent	Percent	Percent	Percent
Middling	7.0	23.5	10.9	41.4
Strict Low Middling	6.8	22.5	14.8	44.1
Middling Spotted	3.3	8.2	3.0	14.5
Total	17.1	54.2	28.7	100.0

1/ Small quantities falling outside the limits of the table were included.

Table 43.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of combed uniform twill, Type I, 3/1, right 1/

Grade of cotton	Staple length (inches)				Total
	1-1/32	1-1/16	1-3/32	1-1/8	
	Percent	Percent	Percent	Percent	Percent
Strict Middling	4.5	7.9	6.1	1.8	20.3
Middling	4.8	19.6	19.5	4.0	47.9
Strict Low Middling	2.9	10.9	15.1	2.9	31.8
Total	12.2	38.4	40.7	8.7	100.0

1/ Small quantities falling outside the limits of the table were included.

The fiber properties of the cottons from the combed uniform twill mixes were similar to those from carded twill mixes (tables 44 and 45), although a stronger fiber was used in the combed yarns.

Table 44.--Fiber properties and other factors of quality for cotton used in the manufacture of carded uniform twill

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	96.6	93.0 to 100.0
Staple length (32ds inch)	33.1	32.4 to 33.5
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.07	1.05 to 1.11
Uniformity ratio	79	78 to 80
Tensile strength (1,000 lb. per sq. in.)	78	73 to 82
Fineness (micrograms per inch)	4.3	3.9 to 4.5
Maturity (percent)	84	81 to 87
Moisture content of raw cotton (percent)	7.0	6.5 to 7.6

Table 45.--Fiber properties and other factors of quality for cotton used in the manufacture of combed uniform twill, Type I, 3/1, right

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	97.8	93.5 to 103.2
Staple length (32ds inch)	34.4	33.3 to 35.4
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.08	1.05 to 1.11
Uniformity ratio	79	77 to 82
Tensile strength (1,000 lb. per sq. in.)	81	76 to 89
Fineness (micrograms per inch)	4.4	4.1 to 4.6
Maturity (percent)	82	76 to 87
Moisture content of raw cotton (percent)	6.7	5.8 to 7.1

Some manufacturers having Government contracts for uniform twill were known to have considered varietal characteristics carefully in selecting raw cottons for use in uniform twill. Among the varieties tested by the Department of Agriculture, Coker 100 Wilt, Deltapine 15, and Acala 4-42 generally have average fiber properties that fall closely within the range of qualities of cotton used in carded uniform twill. For combed uniform twill, Acala 4-42, Coker 100 Staple, Deltapine 15, Paula, and Stoneville 2B appear to be the most suitable varieties.

Manufacturing Performance of Cottons Used in Carded Uniform Twill and Quality of Product

Picker and card waste was 8.8 percent for the laboratory processed cotton (table 46). Neps per hundred square inches of mill card web averaged 45, which was relatively high for the production of smooth high-grade yarn. The yarn appearance grades of the mill yarn were satisfactory--B and C+ for the warp and filling, respectively.

The carded uniform twill specification for construction of gray goods was 108 by 56 (table 47). Tests showed the average threads per inch to be 107 for the warp and 57 for the filling.

Manufacturing Performance of Cottons Used in Combed Uniform Twill, 3/1, Type I, and Quality of Product

Picker and card waste for the combed mixes as processed in the laboratory at a card rate of 3.5 pounds per hour was 11.5 percent, or about in line with expectations for the quality of cotton and card rate used (table 48). Comber waste from laboratory-processed cotton averaged 17.1 percent. Neps per hundred square inches of card web averaged 16 for the laboratory and 31 for the mills.

The construction specifications for the combed uniform twill, Type I, 3/1, right, called for a thread count of 108 by 56 for gray goods (table 49). Fabric analyses revealed an average of 109 warp threads per inch and 58 filling threads.

Table 46.--Manufacturing performance of cotton used in carded uniform twill

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	11.5	10 to 14
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	58	52 to 68
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	14.7	14 to 15
Laboratory	14.7	14 to 15
Twist multiplier--		
Mills	4.76	4.6 to 4.9
Laboratory	4.76	4.6 to 4.9
Mill filling yarn:		
Yarn number--		
Mills	14.8	14 to 16
Laboratory	14.8	14 to 16
Twist multiplier--		
Mills	3.66	3.5 to 3.8
Laboratory	3.66	3.5 to 3.8
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	8.8	7.9 to 9.8
Neps per 100 sq. in. of card web:		
Mills	45	35 to 60
Laboratory	25	14 to 43
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 15s)--		
Mills	143	130 to 160
Laboratory	156	150 to 170
Filling (converted to 14s)--		
Mills	156	120 to 180
Laboratory	172	140 to 180
Standard laboratory numbers--		
14s	174	169 to 181
22s	105	99 to 109
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	B	C+ to B
Laboratory	B+	B to B+
Filling--		
Mills	C+	C+ to B
Laboratory	B+	C+ to B+
Standard laboratory numbers--		
14s	B	C+ to B+
22s	B	C+ to B+

1/ Ranges represent unconverted data.

Table 47.--Quality of carded uniform twill, 108 by 56, produced by representative cotton mills

Carded uniform twill	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	107	100 to 109
Filling	57	56 to 59
Fabric strength (pounds):		
Warp	201	188 to 215
Filling	94	72 to 118
Crimp (percent):		
Warp	12.6	11.3 to 13.8
Filling	3.1	2.6 to 3.3
Weight (oz. per sq. yd.)	9.1	8.7 to 9.6

Production Trends in Combed and Carded Uniform Twills

Census data were not available on the production of combed uniform twill, as data on this fabric are included with other combed twills in the production statistics collected by the Census Bureau.

Production data on carded uniform twill are available only for some recent years. Estimates based on Census Bureau production data indicate that relatively small quantities of cotton were used in this fabric for certain years, as follows: Estimated quantity used in 1946, 70,000 bales; 1947, 21,000 bales; 1948, not available; 1949, 26,000 bales; and, 1950, 42,000 bales.

Production data on fabrics used primarily for military purposes vary with military requirements and not in accordance with the usual economic factors controlling fabrics used mainly for nonmilitary purposes.

Table 48.--Manufacturing performance of cottons used in combed uniform twill, Type I, 3/1, right

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	7.0	5 to 9
Laboratory	3.5	--
Card sliver weight (grains):		
Mills	49	42 to 57
Laboratory	36	--
Mill warp yarn:		
Yarn number	35.8/2	35/2 to 36/2
Twist multiplier--		
Singles yarn	4.00	3.7 to 4.5
2 ply yarn	3.73	3.0 to 4.4
Mill filling yarn:		
Yarn number	23.8/2	23/2 to 24/2
Twist multiplier--		
Singles yarn	3.73	3.2 to 4.2
2 ply yarn	3.63	3.0 to 4.2
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	11.5	10.1 to 13.3
Comber waste (percent):		
Mills	--	--
Laboratory	17.1	14.6 to 18.7
Neps per 100 sq. in. of card web:		
Mills	31	7 to 54
Laboratory	16	10 to 34
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp--		
Singles (converted to 36s)--		
Mills	66	60 to 75
Laboratory	75	70 to 80
Ply (converted to 36/2)--		
Mills	153	140 to 175
Laboratory	170	165 to 180
Filling--		
Singles (converted to 24s)--		
Mills	108	100 to 125
Laboratory	121	115 to 135
Ply (converted to 24/2)--		
Mills	242	220 to 280
Laboratory	269	265 to 290
Standard laboratory numbers--		
60s	38	34 to 42
80s	26	23 to 28
Yarn appearance grade:		
Mill yarn numbers--		
Warp (singles)--		
Mills	C+	C to B+
Laboratory	B	C+ to B+
Filling (singles)--		
Mills	B	C+ to B+
Laboratory	B	C+ to B+
Standard laboratory numbers--		
60s	B	C+ to B
80s	C+	C+ to B

1/ Ranges represent unconverted data.

Table 49.--Quality of combed uniform twill, Type 1, 3/1 right, produced by representative cotton mills

Combed uniform twill	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	109	106 to 112
Filling	58	57 to 59
Fabric strength (pounds):		
Warp	200	188 to 208
Filling	134	127 to 140
Crimp (percent):		
Warp	17.2	15.6 to 19.1
Filling	4.5	2.7 to 10.0
Weight (oz. per sq. yd.)	8.8	8.4 to 9.4

OTHER CARDED TWILLS

Description of the Fabric

Other carded twills are similar to carded uniform twills. The carded twills include three- and four-leaf herringbone twill and three- and four-leaf regular twill. The herringbone twill weave is formed by reversing the twill from right-hand twill to left-hand twill at intervals. The herringbone effect is primarily for ornamentation.

Carded twills are used for a great variety of purposes. They are probably best known for their widespread use in work shirts, trousers, and bags. These fabrics are used for some of the same purposes as those for which uniform twills are used. However, the carded twills other than uniform twill are of lighter weight and coarser construction than uniform twills and therefore are not appropriate for uses in which the strongest and highest quality products are required.

Qualities of Raw Cotton Used

The cottons used in the manufacture of carded twills consisted of about 1/3 Middling and 1/3 Strict Low Middling and the remainder principally of Middling Spotted and Low Middling (table 50). The staple lengths were predominantly 1 inch and 1-1/32 inches.

The grade index for other carded twills, 97.1, was slightly higher than that for carded uniform twills, but average staple length for carded uniform twill was significantly longer than the average length of 32.3 thirty-seconds inch reported for other carded twills (table 51).

Suitable varieties of cotton for use in the carded twills other than uniform twill include Arizona 44, Coker 100 Wilt, Deltapine 15 and Empire. These varieties, according to tests made by the Department of Agriculture, have average qualities similar to those found in tests of mill mixes for carded twills. The quality factors of cotton from a given variety may differ somewhat from the characteristic quality elements of the variety because of differences in growing conditions and purity of the seed. Hence a considerable range of qualities may be found in different lots from a given variety of cotton.

Table 50.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of carded twills 1/

Grade of cotton	Staple length (inches)			Total
	15/16 to 31/32	1 to 1-1/32	1-1/16 to 1-3/32	
	Percent	Percent	Percent	Percent
Middling	2.7	20.0	10.0	32.7
Strict Low Middling	3.5	20.5	8.5	32.5
Low Middling	1.4	8.3	2.1	11.8
Middling Spotted	7.2	14.6	1.2	23.0
Total	14.8	63.4	21.8	100.0

1/ Small quantities falling outside the limits of the table were included.

Table 51.--Fiber properties and other factors of quality of cotton used in the manufacture of carded twills

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	97.1	91.9 to 101.9
Staple length (32ds inch)	32.3	29.8 to 33.8
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.02	.94 to 1.07
Uniformity ratio	78	73 to 82
Tensile strength (1,000 lb. per sq. in.)	78	72 to 83
Fineness (micrograms per inch)	4.3	4.0 to 4.6
Maturity (percent)	82	75 to 86
Moisture content of raw cotton (percent)	7.0	5.6 to 8.7

Manufacturing Performance of Cottons Used in Carded Twills Other Than Uniform Twill and Quality of Product

The warp yarns used in carded twills other than uniform twill averaged about 15s or practically the same as those used in carded uniform twill. The filling yarns, averaging 12.2s, were coarser than the filling yarn used in uniform twill (table 52). There were no significant differences between test results for the two types of carded twill with respect to picker and card waste, neps, yarn appearance grades and the other measures of quality.

The main points of difference between carded uniform twill and other carded twills were in construction and weight. The average construction for the several types of other carded twills was 87 by 47 (table 53). This compared with a specification of 108 by 56 for carded uniform twill. The weight of uniform carded twills averaged about 9.1 ounces per square yard as compared with only 7.9 ounces for other carded twills.

Production Trends in Carded Twills

Separate data on the production of carded twills other than uniform twill were available only for a few recent years but data on total carded twills, including uniform twill, were available for the period 1942 to 1950.

During this period the several types of carded twills, including uniform twill, consumed quantities of raw cotton ranging downward from about 429,000 bales in 1945 to 222,000 bales in 1947 (table 54). In 1945 the production of carded twills represented nearly 5 percent of total cotton consumption for the year. In 1950 about 319,000 bales were consumed in the manufacture of carded twills or about 3-1/2 percent of the total cotton consumption for the year. During the period 1942 to 1950 annual per capita consumption of carded twills ranged downward from about 1-1/2 pounds in 1945 to 3/4 pound in 1947. The high rate of consumption in 1945 probably is accounted for by the increased military requirements.

The quantity of cotton consumed in carded twill ranks with the quantity consumed in other leading fabrics--print cloth, wide sheeting, narrow sheeting, denim, and tire cord.

Table 52.--Manufacturing performance of cottons used in carded twill other than uniform twill

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	11.9	9 to 14
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	55	50 to 60
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	15.1	10 to 20
Laboratory	15.1	10 to 20
Twist multiplier--		
Mills	4.58	4.4 to 4.8
Laboratory	4.58	4.4 to 4.8
Mill filling yarn:		
Yarn number--		
Mills	12.2	9 to 17
Laboratory	12.2	9 to 17
Twist multiplier--		
Mills	3.67	3.5 to 3.8
Laboratory	3.67	3.5 to 3.8
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	8.9	8.0 to 10.4
Neps per 100 sq. in. of card web:		
Mills	53	30 to 70
Laboratory	28	9 to 56
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 15s)--		
Mills	138	100 to 170
Laboratory	161	120 to 220
Filling (converted to 12s)--		
Mills	173	110 to 230
Laboratory	199	150 to 250
Standard laboratory numbers--		
14s	177	148 to 205
22s	106	91 to 121
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	C+	C to B
Laboratory	B	B to B+
Filling--		
Mills	C+	C to B
Laboratory	B	C+ to B+
Standard laboratory numbers--		
14s	B	C+ to B+
22s	B	C+ to B+

1/ Ranges represent unconverted data.

Table 53.--Quality of carded twill, other than uniform twill, produced by representative cotton mills

Carded twill	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	87	65 to 110
Filling	47	35 to 60
Fabric strength (pounds):		
Warp	156	110 to 200
Filling	94	40 to 160
Crimp (percent):		
Warp	10.1	3.1 to 11.6
Filling	4.7	2.9 to 7.8
Weight (oz. per sq. yd.)	7.9	5.4 to 9.7

Table 54.--Production of carded twills, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by years, 1942-50 1/

Year	Carded twills produced 2/	Raw cotton used		
		Bales 3/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1942	150,496	349	3.1	1.24
1943	130,450	302	2.8	1.06
1944	129,284	300	3.1	1.04
1945	184,996	429	4.7	1.47
1946	141,701	328	3.3	1.12
1947	95,987	222	2.3	.74
1948	112,373	260	2.9	.86
1949	108,909	252	3.2	.82
1950	137,514	319	3.3	1.01

1/ Includes uniform twill.

2/ Computed from Bureau of Census figures. The data for years 1942-46 and 1948-50 were converted from linear yards to pounds by allowance of 0.41 pound for each linear yard of twill, the average number of pounds of twill per linear yard for the year 1947.

3/ Pounds of fabric converted to equivalent raw cotton by allowance of net processing loss of 10.1 percent (1.112 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

ARMY SATEEN

Description of Fabric

Army sateen is used for military purposes. Sateen derives its name from the type of weave--the sateen or satin weave--that is used in making this fabric as distinguished from two other basic weaves--plain weave and twill weave. The sateen weave may be defined as a weave that does not form diagonal lines in the cloth. In the sateen weaves the points of interlacing are widely distributed. Sateens are divided into two groups, those having the filling effect, characteristic of sateens, and those having the warp effect as found in satins. The term sateen, however, is usually applied to fabrics having either the filling or the warp effect.

In a filling-effect sateen, a filling yarn passes under one warp yarn and then floats over a number of warp yarns to again weave under one warp yarn, and so forth. In a warp sateen, the warp passes under one filling yarn and then over a number of filling yarns and again under one filling yarn (1).

Sateen is extensively used in military garments and, along with uniform twill, is frequently referred to as a "military" fabric. Carded sateen as a military fabric is used for work clothes, fatigue uniforms, and to some extent for bags. These fabrics, however, have many nonmilitary uses--for work clothing, as a base for coating, and other purposes.

Qualities of Raw Cotton Used in Carded Army Sateen

A wide range of qualities was used in mixes for Army sateen. In white grades, Strict Middling to Low Middling were used, Strict Low Middling most frequently (table 55). About one-fourth of the cotton used in Army sateen mixes was Middling Spotted. Staples ranged from 7/8 inch to 1-3/32 inches, more than half falling in the 1-inch and 1-1/32 inches group. The average staple length was 31.9 thirty-seconds inch.

The fiber qualities of cotton used in the manufacture of Army sateen can be found in a number of varieties. Fiber properties found in Rowden and Northern Star varieties, however, conform more nearly to the qualities used in these fabrics than those of most other varieties. In considering qualities of particular varieties, it should be remembered that differences in growing conditions and in purity of seed result in differences in fiber qualities within the same variety.

Table 55.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of carded Army sateen 1/

Grade of cotton	Staple length (inches)				Total
	7/8 to 29/32	15/16 to 31/32	1 to 1-1/32	1-1/16 to 1-3/32	
	Percent	Percent	Percent	Percent	Percent
Strict Middling	0.4	1.6	7.7	--	9.7
Middling	.2	1.4	18.2	2.6	22.4
Strict Low Middling	1.3	4.3	20.2	7.6	33.4
Low Middling	.2	1.1	6.9	3.6	11.8
Middling, Spotted	5.6	8.5	7.3	1.3	22.7
Total	7.7	16.9	60.3	15.1	100.0

1/ Small quantities falling outside the limits of the table were included.

Table 56 shows the average fiber properties for cottons used in carded Army sateen.

Table 56.--Fiber properties and other factors of quality for cotton used in the manufacture of carded Army sateen

Cotton quality factor	Average of mill mixes	Range in mill mixes
Classification:		
Grade index	95.4	90.6 to 101.9
Staple length (32ds inch)	31.9	28.4 to 33.4
Fiber properties:		
Length (Fibrograph)--		
Upper half mean (inches)	1.02	.89 to 1.12
Uniformity ratio	79	78 to 80
Tensile strength (1,000 lb. per sq.in.)	78	70 to 87
Fineness (micrograms per inch)	4.3	3.8 to 4.6
Maturity (percent)	83	80 to 85
Moisture content of raw cotton (percent)	6.7	6.2 to 7.5

Manufacturing Performance of Cottons Used in Carded Army Sateen

Picker and card waste averaging 9.2 percent was in conformity with past experience for the average grade of cotton used in these mixes, about Strict Low Middling (table 57).

Neps per hundred square inches of card web averaged 53 at the mill and 29 at the laboratory. This difference may be partially accounted for by the different rates of carding--11.6 pounds per hour at the mill and 9.5 pounds per hour at the laboratory--and by the different sliver weights--56 and 40 grains at the mill and laboratory, respectively. The slower rate used in the laboratory permits more thorough cleaning, forms less neps, and the neps are more dispersed in the card web of the lighter laboratory card sliver.

Yarns used in carded sateen were relatively coarse, averaging 14.1s for warp and 9.2s for filling.

The construction specifications for the Army sateen sampled in this study were 80 by 56 threads per inch. Actual tests gave an average of 79 warp threads and 56 filling threads per inch (table 58).

The weight of the fabric was 9.2 ounces per square yard or approximately the same weight as the carded uniform twill. Army sateen, however, is of coarser construction than the carded uniform twill.

Production Trends in Army Sateen

Production and price data on Army sateen were not immediately available, but since production of this fabric like that of uniform twill is dependent more on military activity than on economic forces, an economic analysis of production trends would have little meaning.

Table 57.--Manufacturing performance of cottons used for carded Army sateen

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	11.6	10 to 12
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	56	50 to 60
Laboratory	40	--
Mill warp yarn:		
Yarn number--		
Mills	14.1	13 to 15
Laboratory	14.1	13 to 15
Twist multiplier--		
Mills	4.7	4.5 to 4.8
Laboratory	4.7	4.5 to 4.8
Mill filling yarn:		
Yarn number--		
Mills	9.2	8 to 10
Laboratory	9.2	8 to 10
Twist multiplier--		
Mills	3.8	3.7 to 3.8
Laboratory	3.8	3.7 to 3.8
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	9.2	6.7 to 10.7
Neps per 100 sq. in. of card web:		
Mills	53	18 to 165
Laboratory	29	16 to 44
Yarn skein strength (pounds):		
Mill yarn numbers--		
Warp (converted to 14s)--		
Mills	156	130 to 170
Laboratory	173	160 to 180
Filling (converted to 9s)--		
Mills	250	220 to 270
Laboratory	264	240 to 290
Standard laboratory numbers--		
14s	170	144 to 188
22s	103	87 to 116
Yarn appearance grade:		
Mill yarn numbers--		
Warp--		
Mills	B	C to B+
Laboratory	B+	B to B+
Filling--		
Mills	B	C+ to B+
Laboratory	B+	B to B+
Standard laboratory numbers--		
14s	B+	B to A
22s	B	C+ to B+

1/ Ranges represent unconverted data.

Table 58.--Quality of carded Army sateen produced by representative cotton mills

Army sateen	Average quality of gray goods	Range in mill mixes
Construction (threads per inch):		
Warp	79	77 to 80
Filling	56	55 to 57
Fabric strength (pounds):		
Warp	143	132 to 155
Filling	137	130 to 157
Crimp (percent):		
Warp	7.5	5.6 to 8.8
Filling	5.2	4.5 to 6.3
Weight (oz. per sq. yd.)	9.2	8.8 to 9.7

TIRE CORD

Developments in Tire Cord Manufacture

The increasing use of the automobile over the last half century has been of great importance to the textile industry because of the large quantities of textile materials required in the manufacture of tires. For a number of years previous to 1948 more cotton was used in tire cord and tire fabrics than in any other single use. In 1947 a record quantity of over 850,000 bales of cotton was used in tire cord and other tire fabrics. In the last few years, however, the increasing use of rayon and nylon in tire cord has changed the outlook for cotton consumption in tire cord. As incredible as it might have appeared only a few years ago, more rayon than cotton is now being used in tire cord. As a result, more attention than ever before is being paid to the textile materials that go into a tire.

In the earlier days of the automobile, particularly in the first decade or more of the present century, tires were of the fabric type. In that type of tire and in the high-pressure cord type which followed, high carcass strength was a prime requirement and only the highest quality of long staple cottons, domestic and imported, were used in order to get high yarn st ength. The advent of the low-pressure cord or balloon type of tire for passenger cars, in the 1920's brought about a change in carcass requirements. The low-pressure, balloon tire has a greater volume than that of other tires and as a result the stress on the tire walls is greatly reduced; hence yarn strength in the cord became less important than resiliency of the cord. Ability in the tire cord yarn, used in the low-pressure balloon tire, to withstand sharp flexing, was of primary importance.

This change in the tire brought about a rapid shift to the shorter, less expensive cottons for tire cord yarn for passenger cars. The tendency to increase the carried loads, the speed of travel, and the distance traveled by trucks increased the demand for truck tires of greater carcass strength. Such tires require the use of long-staple high-quality cottons.

As a result, two fairly distinct types of cotton cords were in use: High-strength cords made from the longer staple cotton, for use in medium- and heavy-duty truck and bus tires, and lower-strength cords made from the medium length staples, for use principally in passenger car tires. 2/

2/ Dupree, Mason, Jr. 1946. Cotton Tire Cords: Present and Future Uses. Address before the 20th Annual Conference of the Nat'l Assn. of Ind. Tire Dealers, Los Angeles, Cal., Oct. 16, 1946. Southern Regional Research Laboratory, New Orleans, La.

Prior to 1937 cotton was the only fiber used in commercial tire production. Silk, flax, hemp, ramie, and other kinds of fiber had been tried and had been found inferior to cotton. Cotton's monopoly of the tire cord business was challenged in 1937 with the appearance of a satisfactory rayon cord. Since that time rayon (together with nylon, in limited quantities, in recent years) has gained steadily in popular approval for tire cord.

Many of the advantages, such as launderability and durability, that cotton possesses over rayon in other types of textile products do not exist with respect to cotton tire cord, particularly tire cord for heavy-duty truck and bus tires.

The tests made in this study pertained to cotton tire cord only. The results of tests made with respect to cotton from tire cord mixes, and tests on yarn and cord are presented in succeeding portions of this section of the report.

Qualities of Raw Cottons Used in Tire Cord

A relatively good grade of cotton is used in the manufacture of tire cord. About 74 percent of the cotton used is Middling and Strict Low Middling--about 45 percent of the former grade and about 29 percent of the latter (table 59).

The staple lengths used in tire cord mixes were largely 1-1/32 inches and 1-1/16 inches, about 48 percent and 34 percent, respectively, of each. Formerly, longer lengths were required for high-grade tires but, as explained previously, medium lengths, 1-1/32 to 1-1/16 inches, now are deemed entirely adequate for most purposes.

Most of the fiber properties in cottons from tire cord mixes tested in this study were within the range described as "average" (table 60), although, as with most fabrics, a wide range of qualities was used. An inspection of test results revealed some wide differences; for example, individual mill-mix averages of fiber tensile strength ranged from 71,000 pounds to 85,000 pounds per square inch, and fiber fineness ranged from 3.8 micrograms to 4.6 micrograms per inch. This situation prevailed, to some extent, with respect to all fabrics studied and tended to confirm the opinion that many different qualities of raw cotton are needed for the manufacture of each product, depending on the particular processing equipment and techniques used, and on the grade or quality of the product.

Manufacturers of cotton tire cord are constantly searching for varieties of cotton best suited for the rather exacting specifications required in cotton used in tire cord. The fiber qualities found in mill mixes in tire cord plants can be matched successfully in Acala 4-42, Acala 1517, Coker 100 Staple, Delfos 9169, and Stoneville 2B.

Table 59.--Percentage distribution of grades and staple lengths of cotton consumed in the manufacture of tire cord 1/

Grade of cotton	Staple length (inches)				Total
	1	1-1/32	1-1/16	1-3/32	
	Percent	Percent	Percent	Percent	Percent
Strict Middling	2.2	3.9	0.5	0.8	7.4
Middling	3.1	21.4	14.5	5.6	44.6
Strict Low Middling	.7	13.8	13.7	1.2	29.4
Low Middling	2.2	2.3	1.5	.4	6.4
Middling Spotted	1.5	6.2	4.1	.4	12.2
Total	9.7	47.6	34.3	8.4	100.0

1/ Small quantities falling outside the limits of the table were included.

Table 60.--Fiber properties and other factors of quality for cotton used in the manufacture of tire cord

Cotton quality factor	Average of all mixes	Range in mill mixes
Classification:		
Grade index	96.6	90.1 to 101.0
Staple length (32ds inch)	33.5	32.3 to 34.7
Fiber properties:		
Length (Fibrograph)--		
Upper half mean length (inches)	1.05	1.00 to 1.11
Uniformity ratio	78	72 to 85
Fiber tensile strength (1,000 lb. per sq. in.)	79	71 to 85
Fiber fineness (micrograms per inch)	4.3	3.8 to 4.6
Fiber maturity (percent)	80	71 to 85
Moisture content of raw cotton (percent)	6.2	5.0 to 7.2

Manufacturing Performance of Cottons Used in Tire Cord

Picker and card waste for the tire cord mixes averaged 7.9 percent (table 61). Nep counts per hundred square inches of card web--60 for the mill-processed tire cord and 34 for the laboratory-processed tire cord--were relatively high. However, appearance grades--C for mill yarn and B for laboratory yarn--were satisfactory. Cord strength, adjusted to 1,050 yards per pound, was 18.4 pounds for mill-processed cord and 18.1 for laboratory-processed cord. Percent of elongation at 10-pound load was 6.8 for mill cord and 5.2 for laboratory cord. Elongation is a desirable characteristic in tire cord as it affects the flexing quality of the cord which determines to a large extent the life of a tire.

Production Trends in Cotton Tire Cord

The quantities of tire cord produced each year in the United States have been steadily increasing since the beginning of the automobile industry about 50 years ago. Notwithstanding the improvements in tire construction, resulting in more mileage per tire, the ever-expanding use of automobiles and trucks has brought about the need for greater quantities of tires.

Until 1937 the expanding requirements for fiber for tire cord and tire fabrics were met wholly by additional quantities of cotton. The use of rayon as a textile fiber in tires started in 1937, reached sizeable proportions about 1943 and by 1948 rayon had become a dominant fiber for tire cord (fig. 3).

The quantity of cotton used in tire cord during the 20-year period from 1931 to 1950 ranged from 243,000 bales in 1933 to 686,000 bales in 1947 (table 62). The quantity dropped in 1948 and 1949 and increased in 1950 to about 397,000 bales.

The rise in cotton tire cord consumption in 1950 reflected the increasing demand for tires brought about by the military programs, the general high level of business activity, and the short supplies of high-tenacity rayon cord at that time.

Tires made with cotton or rayon tire cord require a significant quantity of cotton for the chafer fabric used in side walls. The chafer fabric required in tire manufacture is estimated at about 10 to 15 percent of the quantity of tire cord material used.

Table 61.--Manufacturing performance of cottons used in tire cord

Cotton	Average of mill mixes	Range in mill mixes 1/
PROCESSING SPECIFICATIONS		
Card rate (pounds per hour):		
Mills	10.4	9 to 12
Laboratory	9.5	--
Card sliver weight (grains):		
Mills	57	52 to 61
Laboratory	40	--
Mill yarn number:		
Singles	12.6	10 to 14
Cord equivalent	1.43	1.2 to 1.6
Twist multiplier:		
Singles	3.91	3.5 to 4.1
Ply (2 to 4)	8.55	8.0 to 9.3
Cable (2 to 4)	9.40	7.7 to 11.5
PROCESSING RESULTS		
Picker and card waste (percent):		
Mills	--	--
Laboratory	7.9	6.2 to 11.0
Neps per 100 sq. in. of card web:		
Mills	60	36 to 79
Laboratory	34	14 to 57
Yarn skein strength (pounds):		
Mill yarn numbers (converted to 12s)-		
Mills	198	160 to 215
Laboratory	223	180 to 240
Standard yarn numbers--		
14s	193	177 to 216
22s	117	106 to 129
Yarn appearance grade:		
Mill yarn numbers--		
Mills	C	D+ to B
Laboratory	B	C+ to B+
Standard yarn numbers--		
14s	B	C+ to B+
22s	C+	C to B+
Cord data (stretched):		
Weight (yards per pound)--		
Mills	1024	970 to 1070
Laboratory	1094	1010 to 1180
Cord strength (pounds)--		
Observed --		
Mills	18.5	17.2 to 20.5
Laboratory	17.3	16.0 to 19.9
Converted to 1050 yds./lb.--		
Mills	18.4	16.4 to 21.2
Laboratory	18.1	16.6 to 20.7
Percent elongation at 10-lb. load--		
Mills	6.8	4.1 to 8.0
Laboratory	5.2	3.6 to 8.1
Gauge (inch)--		
Mills	.0311	.0296 to .0331
Laboratory	.0297	.0278 to .0318

1/ Ranges represent unconverted data.

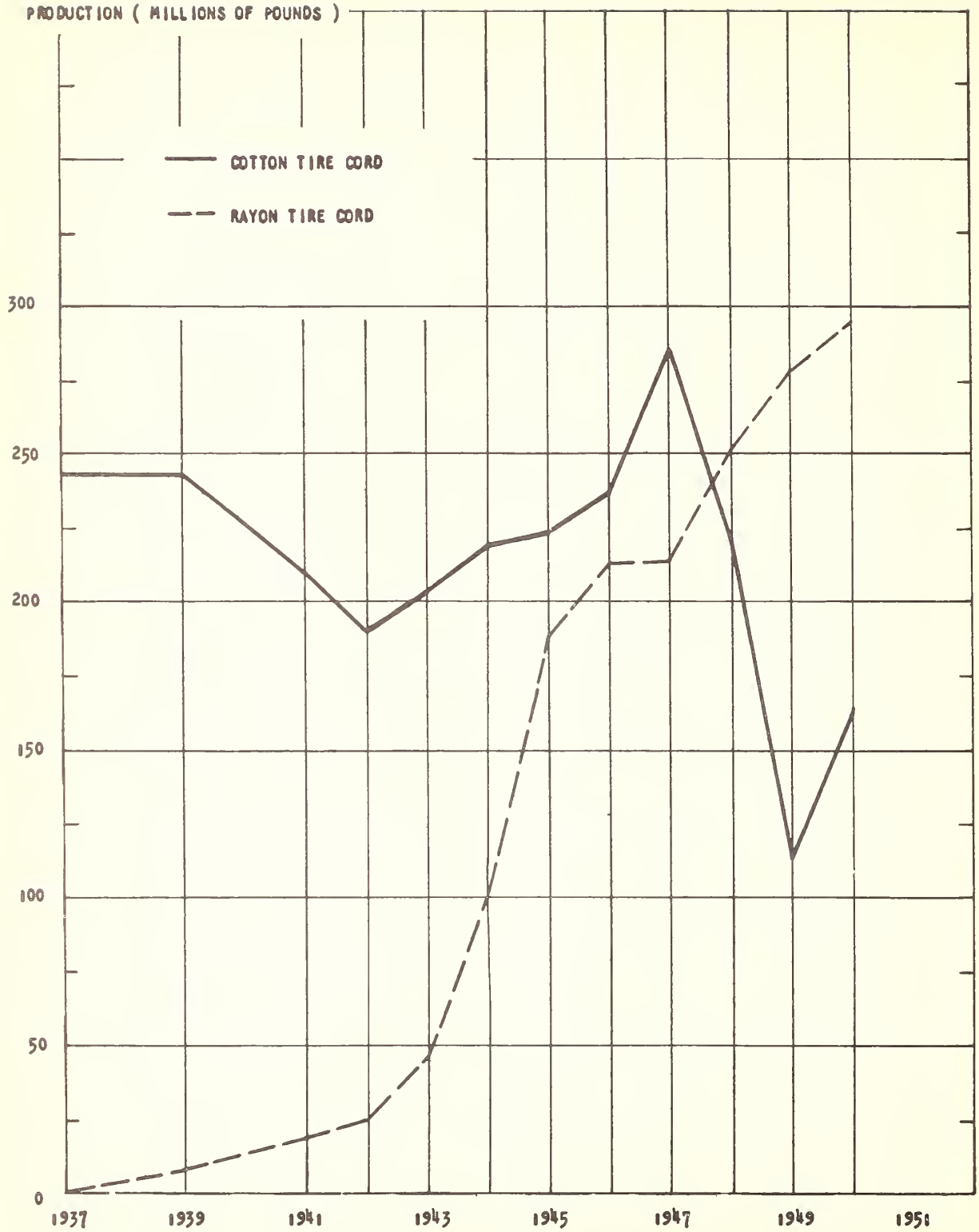

Figure 3.--Quantities of cotton and rayon tire cord produced in the United States, 1937-50.

SOURCE: U. S. Bureau of Census.

Table 62.--Production of cotton tire cord, number of bales of cotton used, percentage of total cotton consumption, and per capita consumption in the United States, by specified years, 1931-50

Year	Tire cord produced 1/	Raw cotton used		
		Bales 2/	Percentage of total U. S. cotton consumption	Per capita consumption
	1,000 pounds	Thousands	Percent	Pounds
1931	118,000	284	5.2	1.10
1933	101,000	243	3.9	.93
1935	105,000	253	4.5	.95
1937	243,000	585	7.9	2.18
1939	243,000	585	7.9	2.15
1941	210,000	506	4.8	1.82
1942	190,000	458	4.0	1.63
1943	203,000	489	4.6	1.72
1944	220,000	530	5.5	1.84
1945	224,000	539	5.9	1.86
1946	237,000	571	5.8	1.94
1947	285,000	686	7.2	2.29
1948	222,000	535	5.9	1.76
1949	114,000	275	3.5	.88
1950	165,000	397	4.1	1.26

1/ From Bureau of Census figures.
2/ Pounds of cord converted to equivalent raw cotton by allowance of processing loss of 13.5 percent (1.156 pounds of raw cotton per pound of fabric). Conversion made to bales of 480 pounds net weight.

Price trends of cotton and of rayon have favored the use of rayon in tires. Since 1938, when rayon was first used in large quantities in tire cord, prices of high-tenacity rayon filament yarn have not advanced as much as have cotton prices (table 63). The 1950 price of Middling 1-1/16 inch cotton, Memphis territory growth, landed mills, averaged about 371 percent of the 1939 price. The price of rayon, high tenacity 1150 denier, in 1950 averaged only 133 percent of its 1939 price. Furthermore, rayon prices have not fluctuated from day to day as have prices of cotton. As rayon is manufactured by only a few large firms, it has been possible for prices to be established with a view to stabilizing them at levels calculated to encourage wider use of rayon products. This is an advantage that an agricultural commodity such as cotton does not have in its competition with a manufactured commodity like rayon. Individual producers of manufactured commodities may, as in the case of rayon, exercise some control over prices of these products and of the quantities they manufacture.

Table 63.--Comparative prices for Middling 1-1/16 inch cotton, Memphis territory growth, landed mills, and for high-tenacity filament rayon, 1150 denier, landed mills, by years 1939-50

Year	Cotton		Rayon	
	Price per pound	Percentage of 1939 price	Price per pound	Percentage of 1939 price
	Cents	Percent	Cents	Percent
1939	10.81	100	45.00	100
1940	11.64	108	45.00	100
1941	15.91	147	43.00	96
1942	22.39	207	43.00	96
1943	23.41	217	43.00	96
1944	24.12	223	43.00	96
1945	24.95	231	43.00	96
1946	32.77	303	49.00	109
1947	37.19	344	54.00	120
1948	37.55	347	57.00	127
1949	34.78	322	56.00	124
1950	40.06	371	60.00	133

The total market for tire cord, including that made of cotton as well as that made from other fibers, is based on a number of economic factors, including: (1) Commercial and industrial activity; (2) consumers' incomes; (3) commodity prices; (4) population increase; and (5) increase in the use of automobiles. Market outlets for cotton in tire cord will be governed to some extent by the choice that consumers exercise in their selection of tires. The preferences of consumers, guided to a considerable extent by sales campaigns of competing manufacturers, will be controlled by their appraisal of the relative merits of the competing materials as compared with the cost of tires having different types of tire cord.

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