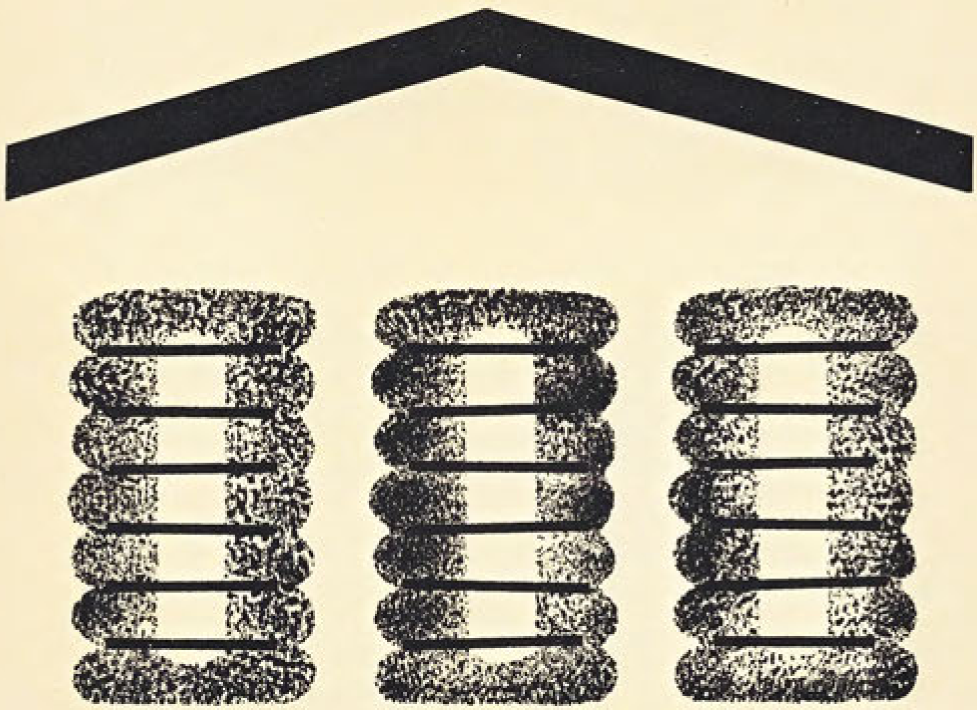
Marketing Research Report No. 645

Changes in Quality and Value of Cotton Bales and Samples During Storage



U.S. DEPARTMENT OF AGRICULTURE / ECONOMIC RESEARCH SERVICE / AGRICULTURAL MARKETING SERVICE

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SUMMARY AND CONCLUSIONS

Deterioration of quality of baled cotton stored for extended periods in commercial warehouses results, on the average, in substantial losses in market value and creates added risks for merchants and mills. Also, since changes in samples drawn at gins or upon receipt at warehouses may not reflect changes in the stored cotton, resampling after storage is frequent, with a corresponding increase in cost for extra handling.

Results of a study of cotton stored for 2 years in four widely separated geographic areas indicate that deterioration in quality of cotton grown in relatively dry areas can be reduced by storing it in the area of growth rather than storing it in more humid areas. The study also showed that extra samples drawn at the time bales are placed in storage will, on the average, accurately reflect changes in grade and value of the bales for up to 6 months if the samples are stored under the same conditions as the bales. Since a major part of the crop generally is sold to the mill consumer within 6 months of first storage, drawing extra original samples can substantially reduce the cost of resampling after storage.

The study included 10 lots of cotton of 100 bales each. Five of the lots were from California--two composed of standard density gin bales and three of gin flat bales. Two of the gin flat bale lots were compressed to standard density immediately after receipt at the warehouse. The one lot of flat cotton and one each of the gin standard density and compress standard density lots were stored in California. One each of the standard density lots were stored in the Houston, Tex., area

Three lots were composed of gin flat bales from the Texas High Plains, one of which was stored as flat cotton in Lubbock, Texas. The remaining two were compressed to standard density shortly after arrival at the warehouse, and one was stored in Lubbock and one at Houston.

Two lots were gin flat bales from the Delta area of Mississippi. One lot was compressed to standard density upon arrival at the warehouse; both lots were stored in the Delta area.

The market value of Texas High Plains cotton stored in Lubbock and Houston for 2 years declined an average of $6.55 and $9.40 per bale, respectively. Mississippi cotton stored in Greenwood, Miss., declined an average of $1.05 per bale during the same 2-year period. Cotton produced in the San Joaquin Valley of California and stored in Houston for 2 years declined in value an average of $2.75 per bale, whereas for similar bales stored in Bakersfield, Calif., average value increased $2 per bale.

Changes in yellowness were primarily responsible for both the positive and negative changes in market value of bales during storage. Increases in yellowness were sufficiently large over the 2-year period to adversely affect the grade color classification and reduce the average value for several lots. For other lots, increases in yellowness were just enough to make the cotton more creamy in appearance and to improve the average grade.

Length of time in storage was closely correlated with the changes in yellowness; as time in storage increased, yellowness increased. Storage location also significantly affected the change in yellowness of stored bales of similar origin and quality. Changes in yellowness of lots stored in Houston were 50 to 100 percent greater than the changes which occurred in lots at the other three locations. The degree of change also varied somewhat with the type of bale (bale density) and the initial grade (grade classification before storage).

Changes in staple and fiber length, percent nonlint and manufacturing waste, fiber and yarn strength, micronaire, neps, yarn appearance, and spinning potential were minor and inconsistent for a majority of the 10 lots during storage for 2 years. The declines in lightness and the increases in yellowness of raw cotton during storage did not affect gray yarns but did reduce the quality index for both bleached and dyed yarns.

Stored samples for all lots combined did not differ significantly from freshly cut samples for use in evaluating cotton held in storage up to approximately 6 months. After both 1 and 2 years of storage, grade was significantly lower and yellowness significantly deeper on stored samples than on fresh samples. However, value differences were very small--only 10 cents per bale at the end of the first year and only 95 cents per bale at the end of the second year. For other major quality factors, including staple and fiber length, fineness, fiber and yarn strength, and neps, differences between stored and fresh samples were generally inconsistent and not significant after 2 years of storage.

Changes in Quality and Value of Cotton Bales and Samples During Storage

by

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and Zolon M. Looney 1/

A large proportion of each year's cotton crop is stored from a few months to more than a year before it is moved to the opening rooms of textile mills. 2/ Although storage is necessary, because the bulk of the crop is harvested during a 2- to 3-month period in the fall whereas mills operate on a year-round schedule, it is generally alleged by the cotton trade that the quality of baled cotton deteriorates during storage. This reduction in quality results in a loss to all segments of the cotton industry in the competitive effort to obtain a greater share of the textile market. Further, the associated monetary loss in value is a risk which must be borne directly by the owners of stored cotton.

The contention that the quality of baled cotton deteriorates during storage is well supported by the findings of previous studies based on small samples and limited quantities of cotton (15). 3/ However, in most previous research the temperature and relative humidity of storage facilities were controlled, or differed materially in some other respect from commercially operated warehouses in the United States. Although results of these studies are indicative of the effects of storage on quality, more information is needed for evaluating the risks involved in the commercial storing of cotton bales for extended periods of time. Changes in quality of commercially stored bales need to be more thoroughly examined with regard to the effects of such factors as origin of cotton, type or density of bale, storage location, initial grade, 4/ and length of time in storage.

Closely related and equally important is the need for more information as a basis for evaluating the possible use of stored original samples throughout

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2/ The volume of cotton carried over on August 1 of each year is evidence that a large number of bales are stored for more than a year. For the last 10 years the carryover has ranged from 7.2 to 14.5 million bales, and it has not been less than 2.3 million bales since 1925. Econ. Res. Serv., U.S. Dept. Agr. The Cotton Situation. Nov. 1962, p. 20.

3/ Underscored figures in parentheses refer to items in References, p. 35.

4/ Initial grade, as used throughout this report, refers to the grade classification of a bale determined soon after ginning and prior to storage.

the marketing process. 5/ Because of the belief that cotton deteriorates during storage, many cotton marketing firms insist on freshly cut samples for determining the quality and value of stored bales. As a result, many bales are sampled three or more times before they arrive at the mill (17).

This repeated sampling is costly because of the labor and equipment involved, the loss of the cotton removed, and the contamination of the exposed portion of the bale. To reduce these costs, a few firms are experimenting with the possibility of storing original samples and then using them for subsequent merchandising purposes. Other firms, however, are skeptical of this practice because of the possibility that changes in quality of stored bales may not parallel the changes in quality indicated by stored samples, especially if the cotton has been stored for several months.

A study was initiated in the fall of 1959 to obtain basic information on the storability of baled cotton in commercial storage facilities, and the possibility of using original samples throughout the marketing process. The specific objectives of the study were to determine (1) the changes in grade, staple length, and color; in fiber, processing, and dyeing properties; and in value of baled cotton during storage; (2) the extent to which original cut samples, stored under the same conditions as bales, reflect changes in quality and value which occur in commercially stored bales; and (3) the effects of origin of cotton, storage location, initial grade, type of density of bale, and length of time in commercial storage on the quality changes in stored bales and samples.

Review of Previous Research

One of the most apparent effects of storage on cotton quality is the change in color, one of three major quality factors considered in grading cotton. In a study of the influences which the quantity and quality of certified stocks have on spot-futures price spreads, Howell concluded that, "Although cotton is considered to be relatively nonperishable, its grade does change when stocks are kept in storage for extended periods, particularly in a warm, humid climate. The most noticeable effect of such storage is the tendency of the yellowness of cotton to increase" (8).

In a study dealing with problems of selecting and preserving cottons to be used for grade standards, Nickerson reported in 1953 that the prevention of excess yellowing of cotton from the time it was selected until the boxes were made up had been a constant problem in cotton grade standardization (13). In another study, sets of samples of six different varieties were prepared in boxes similar to those used for grade standards. They were stored in 15 locations from Massachusetts to California (11). After 2 years of storage, change in color was significant for only one variety, but after 5 years the change was significant for all six cottons. Also, samples stored in Gulf Coast cities changed more than those stored in El Paso, Tex., Massachusetts, and California.

5/ As used in this study, the term "original sample" refers to cut samples drawn soon after ginning and prior to placing the bales in permanent storage.

Another study conducted by Nickerson was based on small samples obtained weekly throughout the season from the 1931 and 1932 crops of five cotton-growing States, and stored at room temperature in Washington, D. C. (12). After 2 years of storage, yellowness of the samples had increased significantly, the increase being greater for high grades than for low grades. After 17 years, there was a very marked change in yellowness; however, there was no indication that fiber length or strength had changed significantly. Research based on duplicate samples of the Texas cotton included in this study was reported in 1936 by Grimes (6). The color changes of these samples, stored in a vault at College Station, Tex., were in general agreement with color changes of samples stored in Washington. However, there was a major difference in the change in fiber strength between the two locations. Whereas there was no apparent change in strength after storage in Washington for 17 years, Grimes reported strength losses ranging from 7 to 18 percent after 1 year, and from 26 to 33 percent after 2 years of storage in Texas (6).

Several studies of the effects of storage on quality have been made on Indian cotton. Nayak reported in 1936 that up to 3-1/2 years of storage in the laboratory had no effect on the length, weight, or strength of Dharwar cotton (10). In the same year, Ahmad reported that 18 months of storage in the open and inside a shed at Karachi had no effect on fiber length or average weight per inch, but that there was a general discoloration of fiber (1). Cottons stored in the open had poorer spinning performance than those stored in sheds for 6- 12-, and 18-month periods. In 1937, Gulati reported that damage to, and discoloration of fibers of Broach Palej cotton stored in Bombay resulted primarily from fungi which thrived in the warm, humid atmosphere (7).

Another investigation in India was carried out "with a view to ascertaining the effects produced on the lint quality when cotton is stored in a bale form in a commercial godown at Bombay and at the place of growth of a cotton" (9). The authors concluded that storage for more than 1-1/2 years adversely affected the color of the cotton. However, the same cotton stored in a "drier place" was affected to a lesser extent in color than that stored in Bombay. Variety, as well as storage location, was a significant factor affecting fiber strength. Waste losses were not affected after 2-1/2 years of storage, and storage for 4 years did not adversely affect the quality of yarn.

A more recent U.S. study reports the preliminary results of tests to establish specifications of temperature and humidity for holding cotton in storage to prevent or retard change in color (15). Changes in color were reported for several sets of samples from grade standards bales stored in 1956 under 14 conditions of temperature and humidity. On the basis of their findings the authors recommended "that 50° F., 50% R.H. (with reasonably wide tolerances) be specified as the conditions to be maintained for storage of standards between conferences, and that dehumidification facilities be installed to keep the relative humidity at no more than 50% in space in which standards bales are stored after purchase" (15). Such specifications "should succeed in holding color changes to a satisfactory minimum for at least 2 or 3 years" (15). Based on some of the same sets of samples, no significant change was found in sugar or pH during storage at 100° temperature and 90 percent humidity, and no strength loss was found even for samples that had shown the greatest change in sugar, pH, and yellowing (16).

Method of Study

Ten lots of cotton of 100 bales each were selected for this study at time of ginning in the fall of 1959, and were held in storage until the fall of 1961. Half of these 1,000 bales were selected from two gins in the San Joaquin Valley of California, 200 bales from one gin in the Mississippi Delta, and 300 bales from one gin in the Texas High Plains. Two hundred of the bales were gin standard density bales selected from one California gin; the other 800 bales were originally packaged as gin flat bales.

In addition to origin, the type or density of bale and the storage location of the bales were the major criteria for differentiating among the 10 lots. Five of the original eight lots of gin flat bales were compressed to standard density for storage. The other three lots of gin flat bales, one from each of the three origins, and the two lots of gin standard density bales were stored at their original densities.

The two lots of Mississippi cotton were stored in Greenwood, Miss. Two of the three Texas lots were stored in Lubbock, Tex., and one was stored in Houston, Tex. Two of the California lots were stored in Houston, and the other three lots in Bakersfield, Calif. The origin, storage location, and type of bale for each lot were as follows:

Origin	Storage Location	Type of Bale
Mississippi Delta	Greenwood, Miss.	Flat
Mississippi Delta	Greenwood, Miss.	Compress standard
Texas High Plains	Lubbock, Tex.	Flat
Texas High Plains	Lubbock, Tex.	Compress standard
Texas High Plains	Houston, Tex.	Compress standard
California, San Joaquin	Houston, Tex.	Compress standard
California, San Joaquin	Houston, Tex.	Gin standard
California, San Joaquin	Bakersfield, Calif.	Gin standard
California, San Joaquin	Bakersfield, Calif.	Compress standard
California, San Joaquin	Bakersfield, Calif.	Flat

To include bales of various qualities in each lot, half of the bales were selected during the early part of the ginning season and the remainder during the latter half. To minimize quality differences among lots of the same origin, but stored in different locations or at different densities, bales were selected one at a time and in succession for the lots involved. For example, as Mississippi bales were removed from the gin press, every other bale was chosen for the lot which was stored as gin flat bales, and the "in-between" bales, for the lot of compressed bales. When three lots were being selected at the same time, each successive third bale went into each of the three lots.

After compressing the 500 bales to standard density, five cut samples were drawn from them and from the 500 bales stored either as gin flat or gin standard bales. One of these five samples from each bale was used to determine initial grade, staple length, reflectance, and yellowness of bales at the beginning of the 2-year storage period. These samples were designated as "control" or "before storage" classification samples and were evaluated within a few days after they were obtained. The other four samples were packed in sample sacks and stored with the bales in the selected storage locations.

After the bales and samples had been in storage for 3 months, a fresh sample was cut from each bale. This sample and one of the original stored samples from each bale were submitted to appropriate classing offices of the U.S. Department of Agriculture for grade, staple length, and color evaluations. The same procedure was repeated after 6, 12, and 24 months of storage.

All samples were classed by the U.S. Department of Agriculture in accordance with Universal Standards. Regardless of storage location, all samples were classed in the classing office serving the area from which the cotton originated. In each of the three areas of origin, the same classer classified all samples for the individual period; however, in most instances, different classers were used for different periods. The samples were classed at random, and the classers were not informed that half of the samples were freshly cut and that half were stored duplicates from the same bales.

The classification and color data based on samples cut from the bales after 3, 6, 12, and 24 months of storage were compared with similar data based on control samples, to measure the changes effected by time in storage on grade, staple length, and color of stored bales. The data based on samples which were stored with the bales for 3, 6, 12, and 24 months were compared with data based on corresponding freshly cut samples to determine the extent to which stored samples reflect changes in grade, staple length, and color of stored bales.

Data for evaluating the effects of storage on fiber, processing, and dyeing properties of baled cotton were based primarily on six bales randomly selected from each of the 10 lots. Three of the bales for each lot were selected from early-season cotton and three from late-season bales. Spinning samples were obtained from each of these 60 bales before placing the bales in storage. A complete fiber and spinning analysis was conducted on each sample shortly after it was obtained, to establish the fiber and spinning properties of the bales before they had been subjected to storage.

Similar spinning samples were obtained from the same bales after they had been in storage for 2 years, and the same fiber and spinning tests were made. A comparison of the "after storage" results to the data based on the "before storage" samples provided an estimate of the effects of 2 years of storage and various storage conditions on the fiber and spinning properties of the 60 selected bales.

Fiber and spinning tests were also made on composited samples that were cut and classified before storage and on those cut and composited after 2 years of storage. These data provided an additional measure of the effects of 2 years of storage on the fiber, processing, and dyeing properties of baled cotton.

To determine the extent to which stored samples reflect changes in fiber, processing, and dyeing properties of stored bales, results of tests based on composited samples stored with the bales were compared with results of similar tests based on composited freshly cut samples.

Analyses of variance and other appropriate statistical techniques were used to determine the extent to which changes and differences in quality and value were significant, and whether origin of cotton, type of density of bale, initial grade, storage location, and time in storage significantly affected changes in quality and value of commercially stored bales and stored samples.

CHANGES IN QUALITY OF BALED COTTON DURING STORAGE

The changes in grade, staple length, other quality characteristics, and value of baled cotton during storage, and the effects of origin, storage location, initial grade, type of bale, and length of time in storage on these changes are analyzed in this section.

Grade and Staple Length Classification

All 200 bales originating in Mississippi were assigned White grades before storage and also at the end of both the 3- and 6-month storage periods (table 1). After both 1 and 2 years of storage, approximately 23 to 29 percent of these bales were assigned Light Spotted grades.

Approximately 80 percent of the 300 Texas bales were classed as White and 20 percent as Light Spotted at the beginning of storage. The proportion classed as White dropped to about 75 percent after 3 months of storage, and at the end of the 6-month storage period over 70 percent remained White.

At the end of the first year of storage, there was a sharp decrease in the proportion of Texas bales assigned White grades. Slightly over 50 percent of the flat bales and about 10 percent of the bales in the two compressed lots remained White. Over 75 percent of the bales in the latter two lots were classed as Light Spotted, and about 12 percent as Spotted. After 2 years of storage, less than 2 percent of the Texas bales remained White, and between 15 and 34 percent were classed as Spotted, Tinged, and Stained.

All California bales were classed White prior to storage, and with only a very few exceptions, the 300 California bales stored in Bakersfield remained White at the end of all four storage periods. Almost all of the 200 California bales stored in Houston kept their assigned White grades up through 1 year of storage. However, after 2 years of storage, 36 to 58 percent of these bales were classed as Light Spotted.

In addition to grade color classifications remaining fairly constant for all lots during the first 6 months of storage, many bales in several lots were assigned higher grades at the end of both the 3- and 6-month storage periods. For example, after 6 months in storage, from 15 to 26 percent of the bales in the Texas lots were classed as Strict Middling, whereas prior to storage only about 3 percent were Middling Plus or higher (appendix table 14). Similarly, the proportion of California bales stored in Bakersfield and classed Strict Middling after 2 years of storage was considerably greater than the proportion assigned this grade before storage.

Table 1.--Grade color of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop 1/

Origin, storage location, type of bale, and time in storage	Grade color						
	Gray	Light Gray	White	Light Spotted	Spotted	Tinged	Stained
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
MISSISSIPPI							
Greenwood-flat:							
Before storage........	--	--	100	--	--	--	--
After storage for--							
3 months...........	--	--	100	--	--	--	--
6 months...........	--	--	100	--	--	--	--
12 months..........	--	--	75	25	--	--	--
24 months..........	--	--	64	36	--	--	--
Greenwood-compressed:							
Before storage........	--	--	100	--	--	--	--
After storage for--							
3 months...........	--	--	100	--	--	--	--
6 months...........	--	--	100	--	--	--	--
12 months..........	--	--	78	22	--	--	--
24 months..........	--	--	78	22	--	--	--
TEXAS							
Lubbock-flat:							
Before storage........	--	--	81	19	--	--	--
After storage for--							
3 months...........	--	--	92	8	--	--	--
6 months...........	--	--	74	26	--	--	--
12 months..........	--	--	52	44	4	--	--
24 months..........	--	--	--	85	15	--	--
Lubbock-compressed:							
Before storage........	--	3	78	19	--	--	--
After storage for--							
3 months...........	--	2	71	27	--	--	--
6 months...........	--	3	68	27	2	--	--
12 months..........	--	--	6	80	13	1	--
24 months..........	--	--	5	69	21	5	--
Houston-compressed:							
Before storage........	--	2	80	18	--	--	--
After storage for--							
3 months...........	1	23	62	13	1	--	--
6 months...........	1	6	71	18	4	--	--
12 months..........	--	--	9	76	12	2	1
24 months..........	--	--	--	66	26	5	3

Origin, storage location, type of bale, and time in storage	Grade color		
	Light Gray	White	Light Spotted
	Pct.	Pct.	Pct.
CALIFORNIA			
Houston-compressed:			
Before storage........	--	100	--
After storage for--			
3 months...........	--	100	--
6 months...........	--	100	--
12 months..........	--	100	--
24 months..........	--	64	36
Houston-gin standard			
Before storage........	--	100	--
After storage for--			
3 months...........	--	100	--
6 months...........	--	100	--
12 months..........	--	96	4
24 months..........	--	42	58
Bakersfield-gin standard			
Before storage........	--	100	--
After storage for--			
3 months...........	1	99	--
6 months...........	--	100	--
12 months..........	--	100	--
24 months..........	--	100	--
Bakersfield-compressed			
Before storage........	--	100	--
After storage for--			
3 months...........	1	99	--
6 months...........	2	98	--
12 months..........	--	100	--
24 months..........	--	100	--
Bakersfield-flat			
Before storage........	--	100	--
After storage for--			
3 months...........	--	100	--
6 months...........	--	100	--
12 months..........	--	100	--
24 months..........	--	100	--

1/ Summarized from appendix table 14.

These changes in grade classifications resulted in statistically significant changes in average grade value per pound 6/ for a majority of the lots at the end of each storage period (table 2). Based on the average grade differentials for 1-inch cotton in the 1960-61 season in the 14 spot markets designated by the Secretary of Agriculture, the average grade value for almost all lots increased through the first 6 months of storage. At the end of 2 years of storage, the adverse effects of lower color classifications were reflected by declines in average grade value for 6 of the 10 lots.

For all lots combined, the average grade value had declined 0.31 cent per pound by the end of the 2-year storage period. The grade value of Texas bales declined an average of 1.32 cents per pound, compared with an average decline of 0.10 cent per pound for Mississippi bales and practically no change in grade value for California cottons.

Grade value increased an average of 0.33 cent per pound for bales stored in Bakersfield for 2 years, whereas for bales stored in the other three locations grade values declined an average of 0.10 to 1.11 cents per pound. The average grade value of flat bales of California cotton which were compressed to standard density increased 0.07 cent per pound, while comparable gin standard density bales declined 0.15 cent per pound.

The effects of length of time in storage, storage location, type of bale, and initial grade on changes in grade (grade value) were analyzed for the 10 lots. Considered individually, these four sources of variation had significant effects on the average grade of stored Texas cotton (appendix tables 15 and 16). The interaction of storage location and length of time stored was also significant for these bales, as well as for California gin standard bales.

Type of bale did not significantly affect the average grade of Mississippi cotton stored in Greenwood and California cotton stored in Bakersfield, whereas time in storage and initial grade had significant effects on average grades of these cottons.

After storage for 2 years, several of the bales in the Mississippi and Texas lots were assigned shorter staple lengths than they were assigned before storage. For example, half or more of the bales in each of the three Texas lots were classed as 1 inch or longer before storage, but after 2 years of storage only about one-fourth of the bales in each lot were assigned staple lengths of 1 inch or longer (appendix table 17). In contrast, the staple lengths assigned to a few of the California bales were slightly longer at the end of the 2-year storage period.

The average staple length of the Mississippi cotton was 0.1 to 0.2 of 1/32 of an inch shorter after storage for 2 years, and for the Texas lots, the declines averaged 0.3 to 0.4 of 1/32 of an inch (table 3). Statistically, these declines in average staple length were significant. From a practical point of view, however, these declines were less than half the smallest difference, 1/32 of an inch, for which market prices are quoted and for which classers are expected to distinguish under normal classing conditions.

6/ As used in this study, grade value per pound indicates the effect that grade alone had on value, with staple length being held constant at 1 inch.

Table 2.--Grade value per pound of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, and type of bale	Average grade value per pound 1/					Change in value after storage for --			
	Before storage	After storage for --							
		3 months	6 months	12 months	24 months	3 months	6 months	12 months	24 months
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
MISSISSIPPI:									
Greenwood-flat	29.77	29.90	30.07	29.47	29.56	.13**	.30**	-.30**	-.21**
Greenwood-compressed ...	29.72	29.90	29.80	29.44	29.72	.18**	.08	-.28**	.00
TEXAS:									
Lubbock-flat	29.73	30.24	30.34	29.75	28.74	.51**	.61**	.02	-.99**
Lubbock-compressed	29.60	29.83	30.05	28.55	28.36	.23**	.45**	-1.05**	-1.24**
Houston-compressed	29.65	29.88	30.06	28.80	27.92	.23**	.41**	-.85**	-1.73**
CALIFORNIA:									
Houston-compressed	30.99	31.08	31.00	31.27	30.72	.09**	.01	.28**	-.27**
Houston-gin standard ...	30.78	31.17	31.09	31.11	30.09	.39**	.31**	.33**	-.69**
Bakersfield-gin standard	30.92	31.11	30.93	31.18	31.31	.19**	.01	.26**	.39**
Bakersfield-compressed..	30.98	30.99	30.97	31.03	31.39	.01	-.01	.05	.41**
Bakersfield-flat	31.09	31.02	31.02	31.30	31.30	-.07**	-.07**	.21**	.21**
ALL LOTS	30.22	30.51	30.53	30.19	29.91	.29**	.31**	-.03	-.31**
By origin:									
Mississippi	29.74	29.90	29.94	29.45	29.64	.16**	.20**	-.29**	-.10*
Texas	29.66	29.98	30.15	29.03	28.34	.32**	.49**	-.63**	-1.32**
California	30.95	31.07	31.00	31.18	30.96	.12*	.05	.23**	.01
By storage location:									
Greenwood...............	29.74	29.90	29.94	29.45	29.64	.16**	.20**	-.29**	-.10*
Lubbock	29.66	30.04	30.20	29.15	28.55	.38**	.54**	-.51**	-1.11**
Houston	30.47	30.71	30.72	30.39	29.58	.24**	.25**	-.08	-.89**
Bakersfield	31.00	31.04	30.97	31.17	31.33	.04	-.03	.17**	.33**
By type of bale:									
Flat	30.20	30.39	30.48	30.17	29.87	.19**	.28**	-.03	-.33**
Compressed	30.19	30.34	30.38	29.82	29.62	.15**	.19**	-.37**	-.57**
Gin standard	30.85	31.14	31.01	31.14	30.70	.29**	.16**	.29**	-.15**

1/ Average grade value per pound was based on the grade of each bale, with staple length held constant at 1 inch, and on the 1960-61 14-market average premiums and discounts; Middling White, 1 inch = 30.96 cents.

* and ** indicate changes in average grade value per pound were significant at the 5 percent and 1 percent levels, respectively.

Table 3.--Staple length of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

(In 32ds of an inch)

Origin, storage location, and type of bale	Average staple length					Change in staple length after storage for --			
	Before storage	After storage for --							
		3 months	6 months	12 months	24 months	3 months	6 months	12 months	24 months
MISSISSIPPI:									
Greenwood-flat	34.0	34.0	33.7	33.1	33.9	.0	-.3**	-.9**	-.1**
Greenwood-compressed	34.2	34.0	33.8	33.0	34.0	-.2**	-.4**	-1.2**	-.2**
TEXAS:									
Lubbock-flat	31.2	31.5	31.6	30.4	30.9	.3**	.4**	-.8**	-.3*
Lubbock-compressed	31.5	31.6	31.7	30.4	31.2	.1	.2*	-1.1**	-.3**
Houston-compressed	31.3	31.1	31.1	30.4	30.9	-.2**	-.2*	-.9**	-.4**
CALIFORNIA:									
Houston-compressed	34.0	34.0	34.1	34.0	34.0	.0	.1**	.0	.0
Houston-gin standard	34.0	34.2	34.2	34.0	34.0	.2**	.2**	.0	.0
Bakersfield-gin standard	34.0	34.0	34.0	34.0	34.1	.0	.0	.0	.1**
Bakersfield-compressed	34.0	34.1	34.1	34.0	34.0	.1**	.1**	.0	.0
Bakersfield-flat	34.0	34.0	34.0	34.0	34.1	.0	.0	.0	.1**
ALL LOTS	33.2	33.2	33.2	32.7	33.1	.0	.0	-.5**	-.1*
By origin:									
Mississippi	34.1	34.0	33.8	33.0	34.0	-.1*	-.3**	-1.1**	-.1*
Texas	31.3	31.4	31.5	30.4	31.0	.1	.2**	-.9**	-.3**
California	34.0	34.1	34.1	34.0	34.0	.1*	.1*	.0	.0
By storage location:									
Greenwood	34.1	34.0	33.8	33.0	34.0	-.1*	-.3**	-1.1**	-.1*
Lubbock	31.4	31.6	31.6	30.4	31.0	.2**	.2**	-1.0**	-.4**
Houston	33.1	33.1	33.1	32.8	33.0	.0	.0	-.3**	-.1*
Bakersfield	34.0	34.0	34.0	34.0	34.1	.0	.0	.0	.1
By type of bale:									
Flat	33.1	33.2	33.1	32.5	33.0	.1*	.0	-.6**	-.1*
Compressed	33.0	33.0	33.0	32.4	32.8	.0	.0	-.6**	-.2**
Gin standard	34.0	34.1	34.1	34.0	34.0	.1	.1	.0	.0

* and ** indicate changes in average staple length were significant at the 5 percent and 1 percent levels, respectively.

Compared to the changes in average grade, the change in average staple length for all lots combined after 2 years of storage was relatively minor. However, for bales of the same origin, storage location, and type, the relative amount of change in average staple length closely paralleled the changes in average grade. Average staple length declined more for bales originating in Texas than for those coming from Mississippi and California. The decline in staple was considerably greater for bales stored in Lubbock than for bales stored in the other three locations, and the decline was greater for compressed bales than for flat or gin standard bales.

At the end of the first year of storage the average staple lengths of the Mississippi and Texas lots were considerably below the averages before storage and also below those at the end of the 2-year storage period. Rather than these differences being an effect of storage, it would appear that the classers who evaluated these lots at the end of the first year were approximately 1/32 of an inch low in their classing of staple length for several bales. It would also appear that the larger differences in average lengths for the Texas lots, as compared with those in the California lots, may have been primarily due to the greater difficulty of consistently classing the wide range of staple lengths characteristic of High Plains cotton. The minor increases in the average staple lengths of the lots of California cotton as compared with the decreases in the Mississippi lots may also have been almost entirely due to differences in classing levels among the classers rather than being actual differences due to storage.

Reflectance and Yellowness

Color, leaf, and preparation (the degree of smoothness or roughness and the relative neppiness or nappiness of the ginned lint) are the major quality factors considered in grading cotton. Theoretically, the changes in grade which occurred in the stored bales had to be due to changes in color, since the actual leaf or foreign matter content and the preparation could not vary during storage. The color of cotton is described in terms of hue, lightness (percent reflectance R_d), and chroma (degree of yellowness [Hunter's +b factor]), and all three attributes are recognized in grading cotton. "The major color differences are those related to the change in chroma, as between the classes of White, Spotted, Tinged, Yellow Stained, and Gray. . . The minor color differences are those that occur between grades of any single color class, as between Middling White and Strict Low Middling White, or within a single grade, as the difference between the brightest and dullest samples of Strict Low Middling. These minor differences are chiefly in degree of lightness; the higher grades being lighter in color than the lower grades" (4).

Chroma and lightness are referred to as yellowness and reflectance, respectively. An increase in the latter indicates an improvement in grade, but an increase in yellowness may have either a beneficial or an adverse effect on grade, depending on the initial degree of yellowness. For example, an increase in yellowness may change Middling White to Strict Middling White as a result of a more creamy appearance in color. In other instances, an increase in yellowness may reduce the color classification from White to Light Spotted, or from Spotted to Tinged.

After 3 months of storage, average reflectance (percent R_d) had increased significantly for each of the 10 lots (table 4). For most of the lots, these increases in lightness of color for several bales resulted in a higher grade within the White color class. At the end of the 6-month storage period, average reflectance for the five Mississippi and Texas lots had declined by 1.3 to 2.0 R_d units below the lot averages at the beginning of storage. For four of the five California lots, average reflectance was greater after 6 months of storage than at the beginning of storage, but less than their 3-month averages.

For a majority of the lots, some of the changes in reflectance at the 3-, 6-, and 12-month storage intervals may have been due to sampling and testing variations rather than to time in storage. This seems evident by the fact that after 2 years of storage the changes in average reflectance were less than they were at the 1-year interval for more than half of the lots. After 1 year of storage, changes in reflectance were statistically significant for nine lots, whereas after 2 years of storage, changes were significant for only six lots.

The declines in reflectance for Texas bales, after 2 years of storage, were almost double the declines which occurred in bales from the other two States. However, there was a general tendency for cottons in all lots, regardless of origin, to become less light as time in storage increased. For Mississippi and Texas bales, this decline in lightness became evident between the 6- and 12-month storage periods, whereas the definite decline in lightness of California cotton did not occur until sometime after 1 year of storage.

Without regard to the effects of other variables, the effect of length of time in storage on reflectance was statistically significant (appendix tables 18 and 19). Storage location had a significant effect on the reflectance of gin standard bales stored in Bakersfield and Houston, but was not significant for Texas compressed bales stored in Lubbock and Houston. The interaction of the factors of length of time stored and storage location for Texas compressed bales stored in Lubbock and Houston, and for California gin standard bales stored in Bakersfield and Houston, were significant at the 1 percent level. This indicates that although reflectance changed significantly over a period of time for a majority of the lots, the change for Houston-stored bales was more pronounced than for bales stored in the other locations. The changes in average reflectance after 2 years of storage revealed that cottons stored in Houston declined 1.2 R_d units, whereas cottons stored in the other three locations declined from only 0.1 to 0.4 R_d units (table 4).

Without regard to other sources of variation, the effect of type of bale (flat versus compressed) on reflectance was significant for Mississippi cotton stored in Greenwood and for California cotton stored in Bakersfield, but was not significant for Texas cotton stored in Lubbock (appendix table 19). However, interactions of the factors of length of time stored and type of bale were not significant for any of the three comparisons, indicating that changes in reflectance associated with time were about the same for both flat and compressed bales.

Average yellowness had increased significantly for all lots at the end of the 3-month storage period, and with minor exceptions, continued to steadily increase as time in storage increased (table 5). After 2 years of storage, average yellowness for all 10 lots combined was 1.7 +b units greater than at the beginning of storage.

Table 4.--Reflectance percentage (R_d) of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, and type of bale	Before storage	Average reflectance of lots: After storage for -- 3 months	6 months	12 months	24 months	Changes in reflectance after storage for -- 3 months	6 months	12 months	24 months
MISSISSIPPI:									
Greenwood-flat	74.6	75.2	73.3	73.7	74.3	.6**	-1.3**	-.9**	-.3
Greenwood-compressed	75.1	75.8	73.1	74.2	74.4	.7**	-2.0**	-.9*	-.7**
TEXAS:									
Lubbock-flat	74.8	75.5	73.4	73.9	74.5	.7**	-1.4**	-.9**	-.3*
Lubbock-compressed	74.5	75.8	73.0	73.6	74.2	1.3**	-1.5**	-.9**	-.3
Houston-compressed	75.1	75.7	73.7	73.8	73.7	.6**	-1.4**	-1.3**	-1.4**
CALIFORNIA:									
Houston-compressed	78.2	79.0	78.2	77.9	76.8	.8**	.0	-.3**	-1.4**
Houston-gin standard	78.0	79.5	78.7	78.2	77.2	1.5**	.7**	.2	-.8**
Bakersfield-gin standard	78.0	79.4	78.7	79.3	78.2	1.4**	.7**	1.3**	.2
Bakersfield-compressed	77.9	79.1	78.2	78.6	77.4	1.2**	.3**	.7**	-.5**
Bakersfield-flat	77.1	78.2	77.4	78.3	77.3	1.1**	.3*	1.2**	.2
ALL LOTS	76.3	77.3	75.7	76.2	75.8	1.0**	-.6**	-.1	-.5**
By origin:									
Mississippi	74.8	75.5	73.2	74.0	74.4	.7**	-1.6**	-.8**	-.4*
Texas	74.8	75.7	73.4	73.8	74.1	.9**	-1.4**	-1.0**	-.7**
California	77.8	79.0	78.0	78.5	77.4	1.2**	.2	.7**	-.4*
By storage location:									
Greenwood	74.8	75.5	73.2	74.0	74.4	.7**	-1.6**	-.8**	-.4*
Lubbock	74.6	75.6	73.2	73.8	74.4	1.0**	-1.4**	-.8**	-.2
Houston	77.1	78.1	76.9	76.6	75.9	1.0**	-.2	-.5**	-1.2**
Bakersfield	77.7	78.9	78.1	78.7	77.6	1.2**	.4*	1.0**	-.1
By type of bale:									
Flat	75.5	76.3	74.7	75.3	75.4	.8**	-.8**	-.2	-.1
Compressed	76.2	77.1	75.2	75.6	75.3	.9**	-1.0**	-.6**	-.9**
Gin standard	78.0	79.4	78.7	78.8	77.7	1.4**	.7**	.8**	-.3

* and ** indicate changes in reflectance were significant at the 5 percent and 1 percent levels, respectively.

Table 5.--Yellowness (Hunter's +b factor) of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, and type of bale	Average yellowness of lots					Changes in yellowness after storage for --			
	Before storage	After storage for -- 3 months	6 months	12 months	24 months	3 months	6 months	12 months	24 months
MISSISSIPPI:									
Greenwood-flat	8.4	8.9	9.2	9.3	9.5	.5**	.8**	.9**	1.1**
Greenwood-compressed	8.3	8.7	9.0	9.0	9.2	.4**	.7**	.7**	.9**
TEXAS:									
Lubbock-flat	8.4	8.9	9.4	9.6	10.0	.5**	1.0**	1.2**	1.6**
Lubbock-compressed	8.2	8.6	8.8	9.3	9.7	.4**	.6**	1.1**	1.5**
Houston-compressed	8.3	8.7	8.9	9.8	10.6	.4**	.6**	1.5**	2.3**
CALIFORNIA:									
Houston-compressed	7.8	8.5	8.2	9.2	10.2	.7**	.4**	1.4**	2.4**
Houston-gin standard	8.0	8.7	8.5	9.7	10.5	.7**	.5**	1.7**	2.5**
Bakersfield-gin standard	8.1	8.7	8.5	8.8	9.7	.6**	.4**	.7**	1.6**
Bakersfield-compressed	7.9	8.5	8.1	8.4	9.2	.6**	.2**	.5**	1.3**
Bakersfield-flat	8.0	8.6	8.5	8.5	9.6	.6**	.5**	.5**	1.6**
ALL LOTS	8.1	8.7	8.7	9.2	9.8	.6**	.6**	1.1**	1.7**
By origin:									
Mississippi	8.4	8.8	9.1	9.2	9.4	.4**	.7**	.8**	1.0**
Texas	8.3	8.7	9.0	9.6	10.1	.4**	.7**	1.3**	1.8**
California	8.0	8.6	8.4	8.9	9.8	.6**	.4**	.9**	1.8**
By storage location:									
Greenwood	8.4	8.8	9.1	9.2	9.4	.4**	.7**	.8**	1.0**
Lubbock	8.3	8.8	9.1	9.4	9.8	.5**	.8**	1.1**	1.5**
Houston	8.0	8.6	8.5	9.6	10.4	.6**	.5**	1.6**	2.4**
Bakersfield	8.0	8.6	8.4	8.6	9.5	.6**	.4**	.6**	1.5**
By type of bale:									
Flat	8.3	8.8	9.0	9.1	9.7	.5**	.7**	.8**	1.4**
Compressed	8.1	8.6	8.6	9.1	9.8	.5**	.5**	1.0**	1.7**
Gin standard	8.0	8.7	8.5	9.2	10.1	.7**	.5**	1.2**	2.1**

* and ** indicate changes in yellowness were significant at the 5 percent and 1 percent levels, respectively.

The changes in yellowness which occurred from one time period to the next, such as 3 to 6 months and 12 to 24 months, were also highly significant for most individual lots. Hence, time in storage was a major contributing factor to the progressive yellowing of the stored bales, regardless of storage location, type of bale, or origin.

The rate of yellowing during specific intervals of storage varied among lots, however. Approximately three-fourths of the total 2-year increases in yellowness of the two Mississippi lots occurred during the first 6 months of storage (fig. 1). At the other extreme, more than half of the yellowing of lots stored in Bakersfield occurred during the second year of storage. Data which might explain these contrasts in rates of yellowing were not obtained in this study.

For the three lots stored in Houston, about 40 to 50 percent of the total increases in yellowness occurred during the second 6-month storage interval. This interval included the months of May through October, the period of highest temperatures and humidities for Houston. Although it appeared that summer climatic conditions of the second 6-month period were associated with increased yellowing of Houston-stored bales, they did not appear to be particularly relevant for lots stored in the other locations.

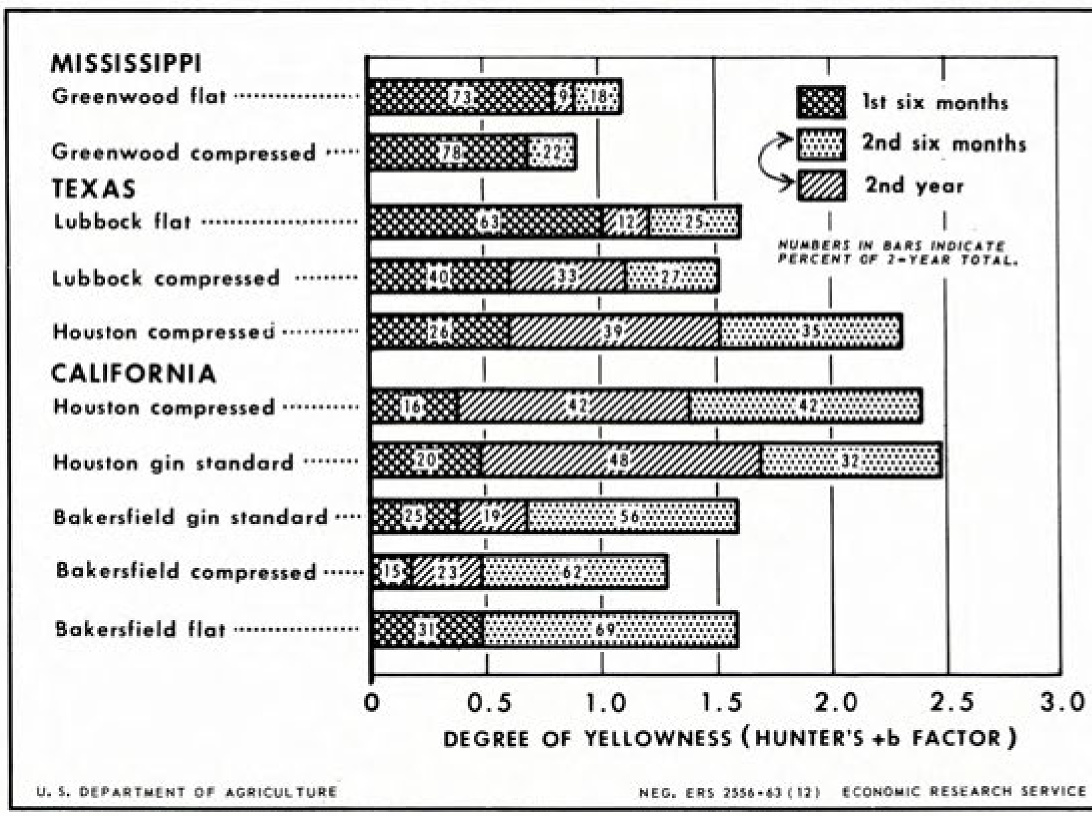

Figure 1.--Total and proportional increases in yellowness of cotton during storage for specific intervals of time, by origin, storage location, and type of bale, 1959 crop.

Storage location was a major factor affecting both the magnitude and rate of yellowing of stored cotton. For example, 2-year increases in yellowness of Houston-stored lots were more than double the increases for Greenwood-stored lots, and about 50 percent greater than the increases for lots stored in Bakersfield and Lubbock (fig. 1). Without regard to any other factor, differences in storage location between Lubbock and Houston had a highly significant effect on the change in yellowness of Texas compressed bales (appendix table 20). Also, storage in Bakersfield, compared with storage in Houston, had a highly significant effect on the yellowness of California gin standard bales. The interactions of the factors of storage location and length of time stored, and of storage location and initial grade were also significant for these two comparisons. In contrast, storage location was not a significant factor contributing to the differences in yellowness between California compressed bales stored in Bakersfield and those stored in Houston.

The increases in yellowness during 2 years of storage were slightly greater for lots of flat bales than for comparable lots of compressed bales stored in the same location. Statistically, the effect of type of bale on yellowness, without regard to other sources of variation, was significant (appendix table 21). The interactions of type of bale and length of time stored were not significant for the two lots stored in Lubbock and for the two stored in Bakersfield, but were significant for the two lots stored in Greenwood. This indicates that the rate of change in yellowness over time at Lubbock and Bakersfield was about the same for both types of bales, whereas the rate of change in yellowness between flat and compressed bales stored in Greenwood differed appreciably.

There was only one comparison involving bales of different origins but of the same type and stored in the same location. This was between the compressed bales from Texas and California stored in Houston. There was a very marked difference in initial grades and degrees of yellowness of the bales in these two lots. However, during 2 years of storage, average yellowness increased 2.3 and 2.4 units for the Texas and California lots, respectively. The difference in amount of increase was not significant.

Differences in initial grade among bales of similar lots did not greatly affect the rate or magnitude of change in yellowness during the 2 years of storage. Ignoring the effects of other variables, differences in initial grade among bales alone did not significantly affect the yellowness of California flat and compressed bales. In addition, the interactions of initial grade with each of the other variables--length of time, storage location, and type of bale--were not significant for these bales.

For the other lot comparisons, the effects of differences among initial grades were not great but were statistically significant. However, the interactions of the initial grade and length of time factors were not significant. Thus, differences in initial grade among bales did not significantly affect the rate or magnitude of changes in yellowness of the lots over time. For most of the lots, differences in yellowness between two extremes in grade were no greater after 2 years of storage than they were before storage. The differences between grades at the end of the shorter storage intervals were also similar in magnitude. Initial grade and type of bale had very little effect on changes in yellowness and hence on grade classification, compared to the effects of time in storage and storage location.

Although reflectance and yellowness were analyzed separately, and each analysis provided useful information relative to color changes of stored cotton, they must be considered together to determine the net effect of color on changes in grade classification. The color charts in figure 2 show the combined effects of changes in reflectance and yellowness on changes in grade during 2 years of storage. For the two Mississippi lots, the chart suggests that some of the bales which were Middling and Strict Low Middling White before storage were classed as Middling Light Spotted after storage for 2 years. Several bales remained classed as Middling White. For the two lots of Texas bales stored in Lubbock, the chart indicates that many of the bales which were Middling and Strict Low Middling White before storage were classed as Strict Middling and Middling Light Spotted after storage.

For the California lots stored in Houston, it appeared that yellowness increased for some bales to the extent that they were assigned Light Spotted grades, while for other bales the increase in yellowness was beneficial, increasing their grade from Middling White to Strict Middling White. For the Texas lot stored in Houston, the increase in yellowness, along with the decline in reflectance, had an appreciably adverse effect on the grade classification of a majority of the bales. The chart suggests that several of these bales which were classed as White before storage were classed as Middling Light Spotted and Spotted after storage. For the California bales stored in Bakersfield, it appeared that many bales originally classed Middling White were classed as Strict Middling White at the end of the 2-year storage period.

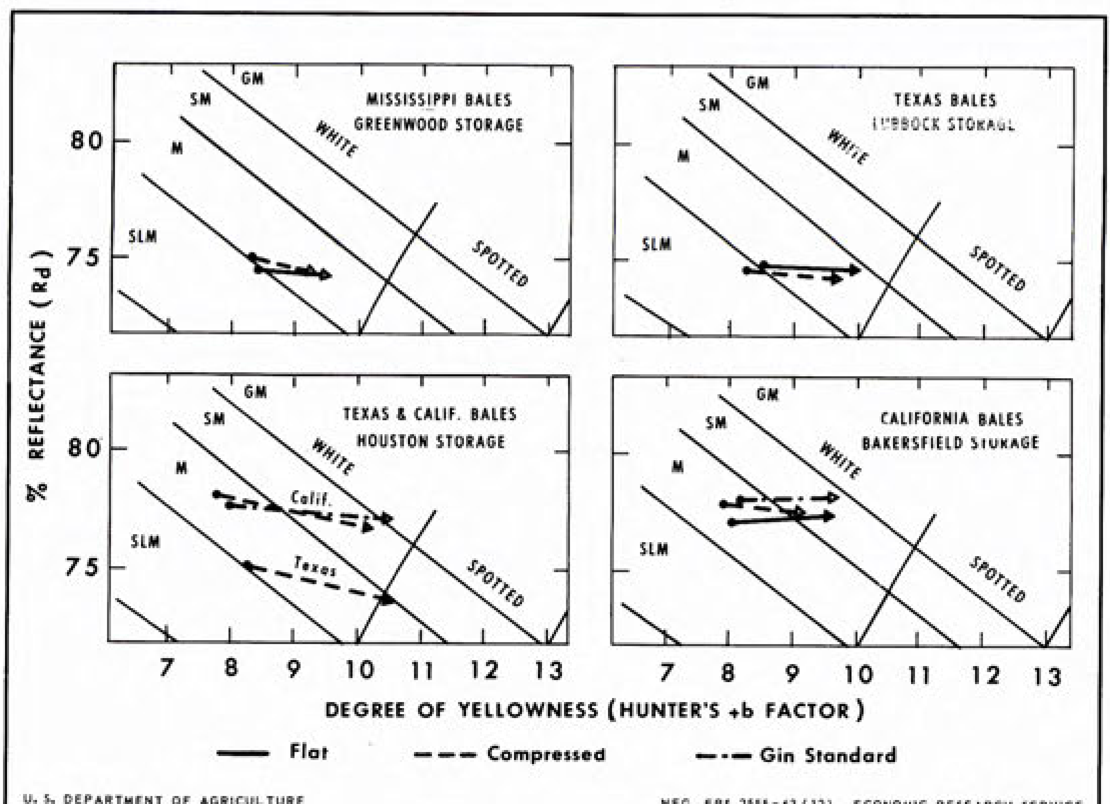

Figure 2.--Color of cotton before storage and after storage for 2 years, by origin, storage location, and type of bale, 1959 crop.

A comparison of changes in grade, indicated by these color charts, with changes in distribution of actual grades assigned (appendix table 14), reveals generally close agreement for all 10 lots. Thus, increases in average yellowness were economically, as well as statistically significant for all 10 lots. The statistically significant changes in average reflectance were also of economic importance, but to a much lesser extent than were the changes in yellowness.

Fiber, Processing, and Dyeing Properties

In general, 2 years of storage did not appreciably affect the fiber, processing, and dyeing properties of the cotton. For some properties, the results based on spinning samples from 6 bales were contradictory to results based on composited classification samples from all the bales in the lots. In addition, the 2-year change for many properties was no greater than the standard errors computed by the Cotton Division in establishing reproducibility of test results (2). These small and inconsistent differences indicate that at least part of the change for some properties was due to "chance" variations associated with sampling and testing, rather than to the effects of storage.

The 2-year changes in fiber and manufacturing properties for all lots combined are summarized in table 6. Changes which occurred for individual lots, based on both spinning samples and composited classification samples, are summarized in appendix tables 22, 23, 24, and 25.

For all lots combined, average nonlint content was slightly higher after 2 years of storage. In contrast, average picker and card waste was slightly lower. This contradiction in test results is an additional indication that much of the difference was probably due to chance variation rather than to effects of storage. Changes in micronaire, fiber strength, and acid-alkaline value were not statistically significant for a large majority of the lots. Average sugar content increased for 7 of the 10 lots during the 2 years of storage; however, the percentage of sugar for 6 of them had not increased beyond the critical level of approximately 0.3 percent (2).

Changes in upper half mean length and upper quartile length, determined by the Fibrograph and Suter-Webb sorter, respectively, provide a partial check on the changes in staple length of stored bales. Both of these measures of length may vary from staple length because they do not measure a "typical portion" of fiber, as required for staple length designations.

If the length of fibers actually changed during the 2-year storage period, it would have been reflected by consistent and significant changes in the upper half mean, upper quartile, and related length measurements, and in fiber length distribution. However, changes in these properties were not statistically significant, and were too small to be of economic importance. Furthermore, for some lots the directions of these minor changes were not consistent with the direction of change in average staple length classifications. On the basis of these several measures of length, it did not appear that storage appreciably affected fiber length, although it is possible that storage may have affected the "pull" or "feel" of the fiber in such a manner as to affect the classers' staple length designations.

Table 6.-- Fiber, processing, and dyeing properties of 1,000 bales of cotton before storage and after storage for 2 years, 1959 crop 1/

Fiber, processing, and dyeing property	Unit	Before storage	After storage
Nonlint content	Percent	2.1	2.3
Micronaire	Reading	4.4	4.4
Fiber strength:			
"0" gauge	1,000 p.s.i.	87	85
1/8" gauge	grams/tex	24.1	24.0
Sugar content	Percent	.1	.2
Acid-alkaline	pH	7.1	6.9
Fibrograph data:			
Upper half mean	Inches	1.04	1.04
Mean length	Inches	.84	.83
Uniformity ratio	Percent	81	80
Array data:			
Upper quartile	Inches	1.17	1.17
Mean length	Inches	.97	.97
Coefficient of variation	Percent	29	29
Fiber over 1 inch	Percent	55	56
Fiber 1/2 to 1 inch	Percent	35	35
Fibers less than 1/2 inch	Percent	10	9
Picker and card waste	Percent	7.07	6.74
Neps/100 sq. inch card web	Number	18	20
Yarn strength, 22's	Pounds	121	120
Yarn strength, 50's	Pounds	45	47
Break factor, 22's and 50's	Number	2492	2488
Yarn appearance	Index	104	102
Spinning potential 2/	Yarn no.	55	60
Yarn color:			
Gray yarn:			
Reflectance	R_d	71.3	70.1
Yellowness	+b	11.4	12.9
Index	Number	99	102
Bleached yarn:			
Reflectance	R_d	83.5	82.0
Yellowness	+b	3.0	2.7
Index	Number	102	100
Bleached and dyed yarn:			
Reflectance	R_d	26.2	27.2
Blueness	-b	26.6	26.4
Index	Number	108	105

1/ Summarized from appendix tables 22 and 24.
2/ Spinning potential was summarized from appendix table 23.

The number of neps per 100 square inches of card web remained the same or had declined slightly for five lots at the end of 2 years of storage, and increased for the other five lots. For two of the latter lots, the number of neps was 36 percent greater--a highly significant increase. However, for all lots combined, the increase in neps was not significant.

The change in yarn strength during 2 years of storage was not significant for all lots combined and was significant for only one lot. The average break factor for this lot, stored in Lubbock, declined from 2144 before storage to 2049 after storage. In contrast, there was a slight increase in break factor for seven of the nine remaining lots. Yarn appearance grade was slightly lower for all lots combined after 2 years of storage. The change in yarn appearance index was not statistically significant for seven lots, and the largest change in index value for any lot was less than the 10-point intervals among yarn appearance grades.

On the basis of the results of spinning potential tests, it was possible to spin a slightly finer yarn number from the bales after 2 years of storage. This was especially true of the lots with a longer, more uniform staple length produced in California and Mississippi.

For each lot, dyeing comparisons were made for gray, bleached, and dyed (dyed after bleaching) yarns spun from the cottons before storage and after storage for 2 years. Color measurements, similar to those made on raw stock, were reported in terms of diffuse reflectance--ranging from 0 to 100 percent--and in terms of degrees of yellowness for gray and bleached yarns and blueness for blue-dyed yarns. For differences in these attributes of yarn color to be of practical significance, they must be clearly visible. The following differences were reported in a previous study (3) as being easily distinguishable under good viewing conditions:

Type of yarn	Reflectance, R_d units	Yellowness & blueness, + or - b units
Gray	2.0	1.8
Bleached	2.0	1.8
Dyed, after bleaching	1.0	1.8

Considered individuallly, reflectance and yellowness (or blueness) provide useful information relative to the effects of storage on the dyeing properties of yarn. However, since these two attributes of color are not independent of each other, they must be considered together in an over-all interpretation of the effects of storage on yarn color. Nickerson and Newton converted these two measurements of yarn color into grade indexes (Middling equals 100, Good Ordinary equals 70) for gray yarn, bleached yarn, and yarn dyed blue after bleaching (14). These indexes provide a single measure of color, and greatly simplify the analysis of the effects of storage of cotton on the dyeing properties of yarn.

After 2 years of storage, the changes which had occurred in reflectance and yellowness for gray yarn agreed fairly closely to the changes which occurred for the raw cotton; reflectance had declined for all lots and yellowness increased for all lots. However, the declines in reflectance exceeded 2.0 R_d units for only two lots, and the increases in yellowness exceeded 1.8 +b units for only three lots. These lots with excessively large changes in color were stored in Houston.

When these two color measurements were combined in the yarn grade index and considered collectively, it was found that 2 years of storage resulted in small improvements in grade for 7 of the 10 lots of gray yarn, and no change for the other 3 lots. However, the color changes which occurred in raw cotton during 2 years of storage, and which were reflected by similar changes in the individual dimensions of reflectance and yellowness of gray yarn, were too small to have any practical or economically important effect on the appearance of gray yarn.

In bleached, as in gray yarn, reflectance declined for all lots. For the two lots of Mississippi cotton and the two lots of gin standard density bales from California, the declines were clearly visible, exceeding 2.0 units. But for the bleached yarn, in contrast to the gray yarn, yellowness was the same or slightly less for all lots after 2 years of storage. The index based on these two factors of color was slightly lower after 2 years of storage for all except one lot, indicating that the decline in lightness and the yellowing of raw cotton during storage were not entirely offset by bleaching.

The adverse effects of color deterioration of raw cotton during storage were clearly evidenced by the differences in color measurements of yarns dyed blue after bleaching. Reflectance increased for all 10 lots over the 2-year period. For dyed yarns this is a detrimental rather than a beneficial effect (3). The increases exceeded 1.0 unit for all Mississippi and Texas lots, and for one California lot. The ability to absorb or take blue dye was also less for seven of the lots, as indicated by small declines in blueness. As a result, the dyed yarn grade index after 2 years of storage was less than before storage for 9 of the 10 lots, indicating that storage of bales adversely affects the dyeing as well as the bleaching properties of cotton.

Economic Implications of Changes in Quality

Changes in quality, especially color, of the magnitudes found for stored bales included in this study are of economic significance to the U.S. cotton industry. Although the average increases in yellowness during the first 6 months of storage were beneficial for almost all lots, the continuous yellowing as time in storage increased eventually resulted in adverse effects on grade classification and market value, and also on end-use value.

Based on 1960-61 average price differentials for the 14 designated markets (19), the value of Mississippi cotton stored in Greenwood declined an average of 0.21 cent per pound or $1.05 per bale during 2 years of storage (table 7). Although this is less than 1 percent of the total value of a bale, many bales are bought and sold each year on commissions or profit margins of $1 or less per bale.

Table 7.--Value per pound of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, and type of bale	Average value of lots 1/					Change in value after storage for --			
	Before storage	After storage for -- 3 months	6 months	12 months	24 months	3 months	6 months	12 months	24 months
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
MISSISSIPPI:									
Greenwood-flat	31.06	31.23	31.23	30.20	30.72	.17**	.17	-.86**	-.34**
Greenwood-compressed ...	31.04	31.24	31.02	30.11	30.95	.20**	-.02	-.93**	-.09
TEXAS:									
Lubbock-flat	29.29	29.91	30.07	28.64	28.08	.62**	.78**	-.65**	-1.21**
Lubbock-compressed	29.30	29.52	29.86	27.54	27.90	.22*	.56**	-1.76**	-1.40**
Houston-compressed	29.22	29.27	29.46	27.84	27.34	.05	.24*	-1.38**	-1.88**
CALIFORNIA:									
Houston-compressed	32.42	32.53	32.46	32.75	32.14	.11**	.04*	.33**	-.28**
Houston-gin standard ...	32.20	32.69	32.60	32.56	31.38	.49**	.40**	.36**	-.82**
Bakersfield-gin standard	32.36	32.57	32.36	32.65	32.84	.21**	.00	.29**	.48**
Bakersfield-compressed..	32.41	32.46	32.42	32.48	32.89	.05	.01	.07*	.48**
Bakersfield-flat	32.54	32.47	32.46	32.79	32.80	-.07**	-.08**	.25**	.26**
ALL LOTS	31.18	31.39	31.39	30.76	30.70	.21**	.21**	-.42**	-.48**
By origin:									
Mississippi	31.05	31.24	31.12	30.16	30.84	.19**	.07	-.89**	-.21**
Texas	29.27	29.57	29.80	28.01	27.77	.30**	.53	-1.26**	-1.50**
California	32.38	32.54	32.46	32.65	32.41	.16**	.08	.27**	.03
By storage location:									
Greenwood	31.05	31.24	31.12	30.16	30.84	.19**	.07	-.89**	-.21**
Lubbock	29.30	29.72	29.96	28.09	27.99	.42**	.66**	-1.21**	-1.31**
Houston	31.28	31.50	31.51	31.05	30.29	.22**	.23**	-.23**	-.99**
Bakersfield	32.44	32.50	32.41	32.64	32.84	.06	-.03	.20**	.40**
By type of bale:									
Flat	30.96	31.20	31.25	30.54	30.53	.24**	.29**	-.42**	-.43**
Compressed	30.88	31.00	31.04	30.14	30.24	.12*	.16**	-.74**	-.64**
Gin standard	32.28	32.63	32.48	32.60	32.11	.35**	.20**	.32**	-.17**

1/ Average value of each lot was based on the grade and staple length of each bale and the appropriate price as computed from the 14-market average premiums and discounts for the 1960-61 season.

* and ** indicate changes in value were significant at the 5 percent and 1 percent level, respectively.

The value of High Plains cotton stored in Lubbock declined an average of $6.05 a bale in 1 year of storage, and $6.55 in 2 years. Similar cotton stored in Houston had declined $6.90 and $9.40 per bale after storage for 1 and 2 years, respectively. If losses of this size, or even half this size, occur repeatedly year after year, merchants, mills, and other owners must make allowance for them in determining pricing policies and operating practices. Thus, these losses during storage, which are a cost to the firm, must be passed back toward producers in the form of lower prices or forward toward consumers in the form of higher prices, or a combination of the two.

Of equal economic significance to handlers of California cotton was the finding that storage of California cotton in Bakersfield did not adversely affect bale value. Even after 2 years of storage, the value of these bales was $2 above their initial value, whereas, for similar bales stored in Houston, average value had declined $2.75 per bale. However, a majority of these bales were initially Middling or better, and the effects of storage in either location on lower grade White and Spotted California cottons were not ascertained.

The lack of consistency in magnitude and direction of change in average value for some lots suggests that part of the change may be attributable to normal and unavoidable sampling and classing variation. However, after making reasonable allowances for these variations, it was obvious that value continued to change as time in storage increased.

This was even more pronounced when the changes in value were based on the relatively wide price differences which existed in 1957-58 (18). On the basis of these differences, changes in value after 2 years of storage exceeded $4 per bale for 6 of the 10 lots, and were as great as $9 to $16 per bale for the 3 Texas lots (appendix table 26).

Considered alone, the effect of storage location on changes in value during storage was not statistically significant (appendix table 27). However, the interactions of the factors of storage location and length of time in storage were significant for Texas compressed bales and for California gin standard bales, but not for California compressed bales.

Type of bale, considered alone, had no significant effect on changes in value during storage (appendix table 28). Interaction of the factors of length of time stored and type of bale was not significant, whereas the interaction of the factors of initial grade and type of bale was significant for Mississippi and Texas cottons stored in Greenwood and Lubbock, respectively.

The effect of initial grade on value changes, disregarding the effects of all other variables, was significant at the 1 percent level. Also, the interaction of the factors of initial grade and length of time stored was significant for California compressed bales stored in Bakersfield and Houston, and for Mississippi cotton stored in Greenwood.

In addition to having an adverse effect on market value for a majority of the lots, increases in yellowness were reflected by adverse changes in the grade color indexes of both bleached and dyed yarns, thereby reducing the value of finished and semifinished end products.

There are many uses for which color finishing is only a minor consideration, however. Fiber length and strength, yarn strength and appearance, neps, fineness, and percent nonlint and manufacturing waste are other properties which may be more important than color in the manufacture of some products. The fact that storage for 2 years did not appreciably and consistently change these properties is of great practical significance to the cotton industry. Stored bales may be just as desirable as new-crop cotton for uses in which these properties are major determinants of product quality. When this is so, it could be possible for mills to make more efficient use of the available supply of raw cotton and possibly increase the utilization of stored cottons.

STORED VERSUS FRESH SAMPLES FOR EVALUATING QUALITY OF STORED BALES

Fresh samples are generally used as a basis for making quality and pricing decisions in merchandising stored cotton. Hence, they were used in this study as a standard for judging the usefulness of stored samples for determining the grade, staple length, and other quality characteristics of baled cotton stored for 3, 6, 12, and 24 months.

Grade and Staple Length Classification

After 3 months of storage, grade based on stored samples was the same as that assigned to freshly cut samples for 80 percent or more of the bales in 9 of the 10 lots. For all lots combined, grade based on stored samples did not differ significantly from that based on freshly cut samples (table 8). The greatest difference in average grade value (see footnote 6 p. 8) between these two types of samples for any lot was 0.14 cent per pound. This difference and the differences for two other lots were statistically significant, although they amounted to less than $0.75 per bale.

As time in storage increased beyond 3 months, there was a slight reduction in the proportion of bales for which the same grade was assigned to stored samples and corresponding fresh samples. However, in some instances the stored sample rated a higher grade and in about the same number of instances, the freshly cut sample rated the higher grade. After 6 months of storage, differences in average grade value between types of samples were statistically significant for only one lot. For all lots combined, the difference in average grade value between stored and fresh samples was equivalent to only $0.05 per bale, and differences in average grade values for lots of the same origin, same storage location, or same type of bale were not significant. Considering the possibility that some of the differences may have been due to classing variation, samples stored for 6 months were as dependable as freshly cut samples for determining grade of stored bales.

At the end of 1 year of storage, differences in average grade value between stored and fresh samples were significant at the 1 percent level for five of the lots. Differences were almost $2 per bale for two lots, but less than $1 per bale for seven lots. Average grade value based on stored samples was higher for six lots, and lower for the other four lots. Differences were significant at the 5 percent level for the bales of Texas origin, and also for the bales stored in Houston and Bakersfield. For all lots combined, however, the the difference was not significant.

Table 8.--Grade value per pound of stored samples and of fresh samples cut from stored bales, by origin, storage location, type of bale, and length of time in storage, 1959 crop 1/

Origin, storage location, and type of bale	3 months		6 months		12 months		24 months	
	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
MISSISSIPPI:								
Greenwood-flat	29.90	29.91	30.07	30.06	29.47	29.62	29.56	29.73**
Greenwood-compressed	29.90	29.76**	29.80	29.70	29.44	29.48	29.72	29.39**
TEXAS:								
Lubbock-flat	30.24	30.20	30.34	30.25	29.75	29.36**	28.74	28.33**
Lubbock-compressed	29.83	29.76	30.05	29.94	28.55	28.77**	28.36	28.00**
Houston-compressed	29.88	29.89	30.06	29.98	28.80	28.62*	27.92	27.70*
CALIFORNIA:								
Houston-compressed	31.08	30.98**	31.00	31.02	31.27	31.14**	30.72	30.52
Houston-gin standard	31.17	31.07	31.09	31.14	31.11	30.99	30.08	29.59**
Bakersfield-gin standard	31.11	31.24**	30.93	31.11**	31.18	31.25*	31.31	31.31
Bakersfield-compressed	30.99	30.98	30.97	30.99	31.03	31.38**	31.39	31.38
Bakersfield-flat	31.02	31.02	31.02	31.03	31.30	31.40**	31.30	31.33
ALL LOTS	30.51	30.48	30.53	30.52	30.19	30.20	29.91	29.73**
By origin:								
Mississippi	29.90	29.84*	29.94	29.88	29.46	29.55	29.64	29.56
Texas	29.98	29.95	30.15	30.06	29.03	28.92*	28.34	28.01**
California	31.07	31.06	31.00	31.06	31.18	31.23	30.96	30.83*
By storage location:								
Greenwood	29.90	29.84*	29.94	29.88	29.46	29.55	29.64	29.56
Lubbock	30.04	29.98	30.20	30.10	29.15	29.06	28.55	28.16**
Houston	30.71	30.65	30.72	30.71	30.39	30.25*	29.57	29.27**
Bakersfield	31.04	31.08	30.97	31.04	31.17	31.34*	31.33	31.34
By type of bale:								
Flat	30.39	30.38	30.48	30.45	30.17	30.13	29.87	29.80
Compressed	30.34	30.27	30.38	30.33	29.82	29.88	29.62	29.40**
Gin standard	31.14	31.16	31.01	31.12	31.14	31.12	30.70	30.45**

1/ Average grade value per pound was based on the grade of each bale with staple length held constant at 1 inch, and the 1960-61 14-market average premiums and discounts; Middling White, 1 inch = 30.96 cents.

* and ** indicate differences between stored and fresh samples were statistically significant at the 5 percent and 1 percent levels, respectively.

After 2 years of storage, differences in average grade value between the two sets of samples were statistically significant for six individual lots and for all lots combined. Grade values based on stored samples were lower than those based on fresh samples for seven lots, and for six of these lots the differences ranged from $1 to almost $2.50 per bale. Although some of the differences in average grade values may logically be attributed to classing variation, there was a general tendency for the magnitude of the differences between the two types of samples to increase as time in storage increased beyond 6 months. Hence, grade based on samples stored for a year or more as compared with grade based on freshly cut samples, may not be an accurate reflection of the grade of stored bales. However, the findings were inconclusive as to whether stored samples will consistently rate a higher or lower grade.

Samples stored for 2 years were as reliable as fresh samples for evaluating the staple length of all 10 lots. Differences in average staple length between the two sets of samples, which did not exceed 0.1 of 1/32 of an inch for any lot, were not statistically significant (table 9). At the 3-, 6-, and 12-month storage intervals, differences in average staple length between the two sets of samples were statistically significant for a few lots. However, since differences of these magnitudes were not prevalent after 2 years of storage, they were attributed to classing variation.

Reflectance and Yellowness

For all lots combined, differences in average reflectance between stored and fresh samples were not significant for any storage period (table 10). Differences were statistically significant for a few individual lots for each time period but were not consistent. After 2 years of storage, differences in reflectance for seven of the lots were statistically significant. For half the lots, average reflectance based on samples stored for 2 years was less than that based on corresponding fresh samples, and was the same or higher for the other five lots. Because of this inconsistency, it may be that variation in sampling and testing procedures partly accounted for some of the difference rather than there being an actual difference in reflectance between stored and fresh samples.

Differences in average yellowness after 3 and 6 months of storage were small and not statistically significant for all lots combined nor for a large majority of the lots when considered separately (table 11). After 1 year of storage, yellowness based on stored samples was from 0.1 to 0.3 unit greater than yellowness based on fresh samples for 6 of the 10 lots. Although these differences were statistically significant, they were not clearly visible, hence were of little practical significance. There was a small but not significant difference between averages of all lots combined.

After storage for 2 years, differences in average yellowness between stored and fresh samples were generally greater than after storage for 1 year, and were statistically significant for nine of the lots. However, differences in yellowness for the individual Mississippi and Texas lots, which did not exceed 0.3 unit, were too small to be of any practical significance. For the five California lots, average yellowness of stored samples was 0.3 to 0.5

Table 9.--Staple length of stored samples and of fresh samples cut from stored bales, by origin, storage location, type of bale, and length of time in storage, 1959 crop

(In 32ds of an inch)

Origin, storage location, and type of bale	3 months		6 months		12 months		24 months	
	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples
MISSISSIPPI:								
Greenwood-flat	34.00	33.90**	33.66	33.53	33.06	32.94*	33.90	33.85
Greenwood-compressed ...	34.00	34.00	33.83	33.78	32.95	32.93	33.97	33.92
TEXAS:								
Lubbock-flat	31.54	31.36	31.60	31.36**	30.37	30.15**	30.90	30.81
Lubbock-compressed	31.56	31.33*	31.71	31.16**	30.36	30.34	31.18	31.08
Houston-compressed	31.10	31.14	31.12	31.18	30.45	30.11**	30.89	30.96
CALIFORNIA:								
Houston-compressed	34.03	34.00	34.08	34.11	34.01	34.03	34.05	34.02
Houston-gin standard ...	34.17	34.31*	34.18	34.02**	34.00	34.05*	34.00	34.01
Bakersfield-gin standard	34.02	34.06	33.99	34.06	34.01	34.06	34.14	34.06
Bakersfield-compressed..	34.11	34.04	34.06	34.02	34.03	34.02	34.04	34.02
Bakersfield-flat	34.04	34.00*	34.02	33.99	34.02	34.02	34.09	34.15
ALL LOTS	33.26	33.21	33.22	33.12	32.73	32.66	33.12	33.09
By origin:								
Mississippi	34.00	33.95	33.74	33.66	33.00	32.94	33.94	33.88
Texas	31.40	31.28*	31.48	31.23**	30.39	30.20**	30.99	30.95
California	34.07	34.08	34.07	34.04	34.01	34.04	34.06	34.05
By storage location:								
Greenwood	34.00	33.95	33.74	33.66	33.00	32.94	33.94	33.88
Lubbock	31.55	31.34**	31.66	31.26**	30.36	30.24*	31.04	30.94
Houston	33.10	33.15	33.13	33.10	32.82	32.73	32.98	33.00
Bakersfield	34.06	34.03	34.02	34.02	34.02	34.03	34.09	34.08
By type of bale:								
Flat	33.19	33.09*	33.09	32.96*	32.48	32.37*	32.96	32.94
Compressed	32.96	32.90	32.96	32.85*	32.36	32.29	32.83	32.80
Gin standard	34.10	34.18	34.08	34.04	34.00	34.06	34.07	34.04

* and ** indicate differences between stored and fresh samples were statistically significant at the 5 percent and 1 percent levels, respectively.

Table 10.--Reflectance percentage (R_d) of stored samples and of fresh samples cut from stored bales, by origin, storage location, type of bale, and length of time in storage, 1959 crop

Origin, storage location, and type of bale	3 months		6 months		12 months		24 months	
	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples
MISSISSIPPI:								
Greenwood-flat	75.2	75.2	73.3	73.6	73.7	74.2**	74.3	74.7*
Greenwood-compressed ...	75.8	75.7	73.2	74.0**	74.3	74.9	74.4	75.4**
TEXAS:								
Lubbock-flat	75.5	75.8**	73.4	73.6	73.9	73.9	74.5	74.1**
Lubbock-compressed	75.8	75.6	73.0	73.2	73.6	73.6	74.2	74.4
Houston-compressed	75.7	75.8	73.7	73.8	73.8	73.6	73.7	73.2**
CALIFORNIA:								
Houston-compressed	79.0	79.0	78.2	78.2	77.9	78.0	76.8	76.3**
Houston-gin standard ...	79.5	79.2*	78.7	78.3*	78.2	78.1	77.2	76.9**
Bakersfield-gin standard	79.4	79.1**	78.7	78.5	79.3	79.2	78.2	78.0
Bakersfield-compressed..	79.1	79.0	78.3	78.2	78.7	78.9	77.4	77.9**
Bakersfield-flat	78.2	78.2	77.4	77.5	78.3	78.4	77.3	77.3
ALL LOTS	77.3	77.3	75.8	75.9	76.2	76.3	75.8	75.8
By origin:								
Mississippi	75.5	75.4	73.3	73.8*	74.0	74.6**	74.4	75.0**
Texas	75.7	75.7	73.4	73.5	73.8	73.7	74.1	73.9
California	79.0	78.9	78.3	78.1	78.5	78.5	77.4	77.3
By storage location:								
Greenwood	75.5	75.4	73.3	73.8*	74.0	74.6**	74.4	75.0**
Lubbock	75.6	75.7	73.2	73.4	73.8	73.8	74.4	74.3
Houston	78.1	78.0	76.9	76.8	76.6	76.6	75.9	75.5**
Bakersfield	78.9	78.8	78.1	78.1	78.8	78.8	77.6	77.7
By type of bale:								
Flat	76.3	76.4	74.7	74.9	75.3	75.5	75.4	75.4
Compressed	77.1	77.0	75.3	75.5	75.7	75.8	75.3	75.4
Gin standard	79.4	79.2	78.7	78.4*	78.8	78.6	77.7	77.4*

* and ** indicate differences between stored and fresh samples were statistically significant at the 5 percent and 1 percent levels, respectively.

Table 11.--Yellowness (Hunter's +b factor) of stored samples and fresh samples cut from stored bales, by origin, storage location, type of bale, and length of time in storage, 1959 crop

Origin, storage location, and type of bale	3 months		6 months		12 months		24 months	
	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples
MISSISSIPPI:								
Greenwood-flat	8.9	8.9	9.2	9.2	9.3	9.3	9.5	9.3**
Greenwood-compressed	8.7	8.7	9.0	9.0	9.0	9.0	9.2	9.1*
TEXAS:								
Lubbock-flat	8.9	8.9	9.4	9.3*	9.6	9.7**	10.0	10.1**
Lubbock-compressed	8.6	8.6	8.8	8.8	9.3	9.4*	9.7	9.7
Houston-compressed	8.7	8.7	8.9	9.0**	9.8	10.1**	10.6	10.9**
CALIFORNIA:								
Houston-compressed	8.5	8.5	8.2	8.3	9.2	9.3**	10.2	10.6**
Houston-gin standard	8.8	8.8	8.5	8.6**	9.7	9.8**	10.5	11.0**
Bakersfield-gin standard	8.8	8.8	8.5	8.5	8.8	8.8	9.7	10.0**
Bakersfield-compressed	8.5	8.5	8.1	8.2	8.4	8.4	9.2	9.7**
Bakersfield-flat	8.6	8.7*	8.5	8.5	8.5	8.6**	9.6	10.0**
ALL LOTS	8.7	8.7	8.7	8.7	9.2	9.2	9.8	10.0**
By origin:								
Mississippi	8.8	8.8	9.1	9.1	9.2	9.2	9.4	9.2**
Texas	8.7	8.7	9.0	9.0	9.6	9.7*	10.1	10.2*
California	8.6	8.7	8.4	8.4	8.9	9.0*	9.8	10.3**
By storage location:								
Greenwood	8.8	8.8	9.1	9.1	9.2	9.2	9.4	9.2**
Lubbock	8.8	8.8	9.1	9.0	9.4	9.6**	9.8	9.9*
Houston	8.7	8.7	8.5	8.6*	9.6	9.7*	10.4	10.8**
Bakersfield	8.6	8.7	8.4	8.4	8.6	8.6	9.5	9.9**
By type of bale:								
Flat	8.8	8.8	9.0	9.0	9.1	9.2*	9.7	9.8*
Compressed	8.6	8.6	8.6	8.7	9.1	9.2*	9.8	10.0**
Gin standard	8.8	8.8	8.5	8.6	9.2	9.3	10.1	10.5**

* and ** indicate differences between stored and fresh samples were statistically significant at the 5 percent and 1 percent levels, respectively.

unit greater than the average yellowness of freshly cut samples. In some cases, differences in yellowness of these magnitudes are enough to appreciably affect grade classifications, either adversely or favorably. Thus, in addition to these differences in yellowness being statistically significant, they may be economically significant under some circumstances.

Fiber, Processing, and Dyeing Properties

For all lots combined, differences in fiber and processing properties between stored and fresh samples were negligible and not statistically significant after 2 years of storage (table 12). With few exceptions, this was also true for individual lots (appendix table 29). Nonlint content was slightly greater for fresh samples from four lots, and greater for stored samples from five lots. The differences for four of the latter lots were 0.4 percent or greater. Differences of this magnitude are equivalent to the small difference in trash content which exists between Strict Good Middling and Good Middling cotton, but are less than half the difference in the trash contents associated with Middling and Strict Low Middling cottons.

Fiber strength of samples stored for 2 years was slightly less than that of freshly cut samples for a majority of the lots. However, stored samples did not consistently yield a higher or lower value for the various measurements of fiber length of individual lots.

The average number of neps per 100 square inches of card web based on stored samples was the same or lower than the number obtained from freshly cut samples for all lots. For three lots, the difference between the two sets of samples was eight or more neps per card, which in some cases is sufficiently great to have practical significance. However, differences for six other lots were not statistically significant.

Except for a few lots, yarn strength and yarn appearance were generally lower based on stored samples. However, the differences were not excessively great for a majority of the lots. From the standpoint of determining spinning potential, differences between samples stored for 2 years and freshly cut samples were inconsistent and not statistically significant for any of the 10 lots.

It is probable that some of these small differences in fiber and processing properties between stored samples and fresh samples were due to unavoidable variations in sampling and testing procedures, and to the extra handling of the samples when they were mixed and blended during the compositing process. In view of these limitations of the testing procedure, and considering that differences in test results of these properties based on stored versus fresh samples were either inconsistent or not significant for a majority of the lots, it appeared that stored samples were dependable for evaluating the fiber and processing properties of stored bales.

There was no appreciable difference in yarn color and dyeing properties, between stored and fresh samples for all lots as a whole after 2 years of storage (table 12). However, for individual lots, the gray yarn index based on stored samples was the same or slightly higher than the index based on fresh

Table 12.--Fiber, processing, and dyeing properties of 1,000 bales of cotton based on stored samples and fresh samples cut from bales after storage for 2 years, 1959 crop 1/

Fiber, processing, and dyeing property	Unit	Fresh sample	Stored sample
Nonlint content	Percent	2.4	2.5
Micronaire	Reading	4.3	4.3
Fiber stength:			
"0" gauge	1,000 p.s.i.	87	86
1/8" gauge	Grams/tex	24.2	23.5
Sugar content	Percent	.2	.2
Acid alkaline	pH	6.9	7.0
Fibrograph data:			
Upper half mean	Inches	1.03	1.03
Mean length	Inches	.81	.82
Uniformity ratio	Percent	79	79
Array data:			
Upper quartile	Inches	1.16	1.15
Mean length	Inches	.95	.94
Coefficient of variation	Percent	31	32
Fibers over 1 inch	Percent	52	51
Fibers 1/2 to 1 inch	Percent	37	38
Fibers less than 1/2 inch	Percent	11	11
Picker and card waste	Percent	7.52	7.81
Neps/100 sq. inch card web	Number	28	24
Yarn strength, 22's	Pounds	116	115
Yarn strength, 50's	Pounds	45	44
Break factor, 22's and 50's	Number	2395	2367
Yarn appearance	Index	100	98
Spinning potential	Yarn No.	60	60
Yarn color:			
Gray yarn:			
Reflectance	R_d	71.1	70.6
Yellowness	+b	12.7	12.7
Index	Number	103	102
Bleached yarn:			
Reflectance	R_d	82.4	83.5
Yellowness	+b	2.7	2.8
Index	Number	100	102
Bleached and dyed yarn:			
Reflectance	R_d	27.4	27.1
Blueness	-b	25.9	26.3
Index	Number	103	105

1/ Summarized from appendix tables 29 and 30.

samples for five lots, and from one to three index points less for the other five lots (appendix table 30). These differences, and differences in reflectance and yellowness, were too small to be easily distinguishable, and thus were not significant from a practical standpoint.

Grade-color indexes for bleached and dyed yarns based on stored samples were higher than the indexes based on fresh samples for eight of the lots. The bleached yarn grade indexes for the Texas lots based on stored samples were significantly greater than the indexes based on fresh samples. The higher indexes resulted primarily from the significantly higher reflectance values of the stored samples, which exceeded the values of the fresh samples by 2.3 to 2.8 units.

Differences in the dyed yarn index between stored and fresh samples were equal to at least one full grade for half the lots. Reflectance based on stored samples indicated better dyeing properties than those indicated by fresh samples for seven of the lots. For four of these lots, differences in reflectance between stored and fresh samples exceeded 1.0 unit, which is sufficiently large to be clearly visible, and is thus of practical significance. Differences in blueness between the two types of samples were not significant in an economic sense, although for nine lots the stored samples indicated a slightly higher dye uptake than did the fresh samples.

Difference in Value and Economic Implications

The differences in grade and staple length classifications between stored samples and freshly cut samples were converted into differences in value, to provide an additional basis for judging the usefulness of stored samples. The same two sets of prices were used for these computations as were used for evaluating the changes in value of stored bales.

Using 1960-61 prices, the value of all lots combined based on stored samples, was less than the value based on freshly cut samples at the end of each of the four storage periods (table 13). 7/ However, the differences in bale value between the two types of samples were less than $0.50 up through 1 year of storage, and they were not significant in a statistical sense.

At the end of 2 years of storage, the difference in average value for all lots combined amounted to $0.95 per bale and was statistically significant. The differences in average value between stored and fresh samples for bales stored in Bakersfield for 2 years, and for all flat bales combined, were not significant. For the other three storage locations and the other two types of bales, and for all three origins, differences were significant at the end of the 2-year storage period.

Although the average value based on stored samples was lower than that based on fresh samples for a majority of individual lots, fresh samples did not consistently indicate a higher value at the end of each successive storage

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7/ The differences in value based on 1957-58 prices are summarized in appendix table 31.

Table 13.--Value per pound of cotton based on stored samples and fresh samples cut from stored bales, by origin, storage location, type of bale, and length of time in storage, 1959 crop 1/

Origin, storage location, and type of bale	3 months			6 months			12 months			24 months		
	Fresh samples	Stored samples	Difference 2/	Fresh samples	Stored samples	Difference 2/	Fresh samples	Stored samples	Difference 2/	Fresh samples	Stored samples	Difference 2/
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
MISSISSIPPI:												
Greenwood-flat	31.24	31.17	-.07**	31.23	31.10	-.13	30.20	30.27	.07	30.72	30.90	.18*
Greenwood-compressed	31.24	31.10	-.14**	31.02	30.86	-.16	30.11	30.19	.08	30.95	30.51	-.44**
TEXAS:												
Lubbock-flat	29.91	29.75	-.16	30.07	29.81	-.26**	28.64	28.13	-.51**	28.08	27.66	-.42**
Lubbock-compressed	29.52	29.28	-.24**	29.86	29.34	-.52**	27.54	27.72	.18*	27.90	27.54	-.36**
Houston-compressed	29.27	29.30	.03	29.46	29.42	-.04	27.84	27.47	-.37**	27.34	27.19	-.15
CALIFORNIA:												
Houston-compressed	32.53	32.40	-.13**	32.46	32.49	.03	32.75	32.60	-.15**	32.14	31.88	-.26
Houston-gin standard	32.69	32.63	-.06	32.61	32.60	-.01	32.56	32.46	-.10	31.39	30.82	-.57**
Bakersfield-gin standard	32.57	32.73	.16**	32.36	32.58	.22**	32.65	32.74	.09**	32.84	32.81	-.03
Bakersfield-compressed	32.46	32.43	-.03	32.42	32.43	.01	32.48	32.88	.40**	32.89	32.88	-.01
Bakersfield-flat	32.47	32.46	-.01	32.46	32.46	.00	32.79	32.90	.11**	32.80	32.87	.07*
All lots	31.39	31.32	-.07	31.40	31.31	-.09	30.76	30.74	-.02	30.70	30.51	-.19**
By origin:												
Mississippi	31.24	31.14	-.10**	31.12	30.98	-.14	30.16	30.23	.07	30.84	30.70	-.14*
Texas	29.57	29.44	-.13**	29.80	29.52	-.28**	28.01	27.77	-.24**	27.77	27.46	-.31**
California	32.54	32.53	-.01	32.46	32.51	.05	32.65	32.72	.07	32.41	32.25	-.16*
By storage location:												
Greenwood	31.24	31.14	-.10**	31.12	30.98	-.14	30.16	30.23	.07	30.84	30.70	-.14*
Lubbock	29.71	29.52	-.19**	29.96	29.58	-.38**	28.09	27.92	-.17*	27.99	27.60	-.39**
Houston	31.50	31.41	-.09*	31.51	31.50	-.01	31.05	30.84	-.21**	30.29	29.96	-.33**
Bakersfield	32.50	32.54	.04	32.41	32.49	.08	32.64	32.84	.20**	32.84	32.85	.01
By type of bale:												
Flat	31.21	31.13	-.08*	31.25	31.12	-.13	30.54	30.43	-.11	30.53	30.48	-.05
Compressed	31.00	30.90	-.10*	31.04	30.91	-.13	30.14	30.17	.03	30.24	30.00	-.24**
Gin standard	32.63	32.68	.05	32.48	32.59	.11	32.60	32.60	.00	32.12	31.82	-.30**

1/ Average value was based on the grade and staple length of each bale and the appropriate price as computed from the 14-market average premiums and discounts for the 1960-61 season, for each of the two types of samples. See appendix table 18 for similar data based on the 1957-58 average season premiums and discounts.

* and ** indicate differences in value were significant at the 5 percent and 1 percent levels, respectively.

period except for two lots. Also, the greatest difference in value between the two types of samples occurred after 6 months of storage for two lots, after 1 year for four lots, and after 2 years for the other four lots. These inconsistencies and fluctuations strongly indicate that classing variation was at least partially responsible for some of the difference in value rather than all of it being due to actual differences between stored and fresh samples. For many of the lots, the differences in average value between the two types of samples up to the end of 1 year of storage were either relatively small, or there was an inadequate basis for predicting which type of sample would rate the higher average value.

In addition, the findings that stored samples were generally as reliable as fresh samples for evaluating many fiber and processing properties of stored bales suggest some possibilities for cost-saving changes in warehousing practices. In many warehousing operations, the bales for one resampling order may be located in various bays in several warehouses. Thus, the labor required for locating, flagging, cutting, and assembling samples may be quite costly. Since many bales are resampled one to three times before thay are finally shipped, it would seem plausible that, on arrival of bales at the warehouse, an adequate number of samples could be drawn and stored for future use. The samples could be systematically stored, for easy location when needed, in a specially designed warehouse. This would eliminate the labor needed for locating and identifying bales for resampling and would greatly reduce the labor needed for cutting samples. Further, this would eliminate the frequent handling and moving of bales to make them accessible for sampling, which in many cases contribute to the ragged appearance of American cotton bales. Also, warehousemen could more rapidly fill resampling orders, thus improving their service to merchants and other owners of stored cotton.

Offsetting these advantages are the costs of the sample storage facility and the possible increase in cost of keeping records of the location of stored samples. Comparative costs, which are not presently available, of alternative methods for performing this service should be carefully analyzed. However, it would seem worthwhile for merchants and warehousemen to cooperate in exploring the possibilities of using stored samples to eliminate the need for resampling bales and to increase the efficiency of their operations. It is the continuous acceptance of similar cost-saving practices which enhances the competitive position of American cotton in both domestic and foreign markets.

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APPENDIX

Table 14.--Grade of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, type of bale, and time in storage	Gray	Light Gray		White							Light Spotted					Spotted			Tinged			Stained
	SM	SM	M	SM	M+	Mid.	SLM+	SLM	LM+	LM	GM	SM	M	SLM	LM	SM	M	SLM	SM	M	SLM	M
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
MISSISSIPPI																						
Greenwood-flat:																						
Before storage	--	--	--	--	5	42	5	37	7	4	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	--	--	--	--	50	--	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	--	--	1	2	49	13	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	--	--	28	--	47	--	--	--	7	18	--	--	--	--	--	--	--	--	--
24 months	--	--	--	--	--	46	4	14	--	--	--	--	18	18	--	--	--	--	--	--	--	--
Greenwood-compressed:																						
Before storage	--	--	--	--	3	40	8	37	12	--	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	--	--	--	--	50	1	49	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	--	--	2	3	39	5	48	3	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	--	--	27	--	51	--	--	--	8	12	2	--	--	--	--	--	--	--	--
24 months	--	--	--	--	--	48	3	27	--	--	--	--	12	10	--	--	--	--	--	--	--	--
TEXAS																						
Lubbock-flat:																						
Before storage	--	--	--	--	--	49	--	32	--	--	--	--	12	6	1	--	--	--	--	--	--	--
3 months	--	--	--	--	--	68	--	24	--	--	--	--	5	3	--	--	--	--	--	--	--	--
6 months	--	--	--	22	2	42	--	8	--	--	--	4	21	1	--	--	--	--	--	--	--	--
12 months	--	--	--	9	--	42	--	1	--	--	--	3	33	8	--	1	3	--	--	--	--	--
24 months	--	--	--	--	--	--	--	--	--	--	--	36	42	7	--	1	14	--	--	--	--	--
Lubbock-compressed:																						
Before storage	--	3	--	1	--	43	--	34	--	--	--	--	7	12	--	--	--	--	--	--	--	--
3 months	--	2	--	--	--	51	--	20	--	--	--	1	20	6	--	--	--	--	--	--	--	--
6 months	--	1	2	15	--	42	2	9	--	--	--	1	24	2	--	--	2	--	--	--	--	--
12 months	--	--	--	--	--	--	--	6	--	--	--	33	30	17	--	--	13	--	--	1	--	--
24 months	--	--	--	3	--	--	--	--	--	--	--	35	17	17	--	1	20	--	--	5	--	--
Houston-compressed:																						
Before storage	--	2	--	3	--	45	--	32	--	--	--	--	3	15	--	--	--	--	--	--	--	--
3 months	1	21	2	4	--	47	--	11	--	--	--	--	9	4	--	--	1	--	--	--	--	--
6 months	1	5	1	26	1	30	--	14	--	--	--	--	16	2	--	1	3	--	--	--	--	--
12 months	--	--	--	1	--	6	--	2	--	--	--	39	28	9	--	--	12	--	2	--	--	1
24 months	--	--	--	--	--	--	--	--	--	--	--	32	22	12	--	1	23	2	--	3	2	3

Continued

Table 14.--Grade of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop--Continued

Origin, storage location, type of bale, and time in storage	Gray	Light Gray		White							Light Spotted					Spotted			Tinged			Stained
	SM	SM	M	SM	M+	Mid.	SLM+	SLM	LM+	LM	GM	SM	M	SLM	LM	SM	M	SLM	SM	M	SLM	M
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
CALIFORNIA																						
Houston-compressed:																						
Before storage	--	--	--	--	1	98	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	--	--	15	1	84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	--	--	--	1	99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	44	25	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
24 months	--	--	--	42	12	10	--	--	--	--	--	29	7	--	--	--	--	--	--	--	--	--
Houston-gin standard:																						
Before storage	--	--	--	23	25	29	11	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	--	--	26	25	48	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	--	--	34	15	41	7	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	43	21	27	4	1	--	--	--	2	2	--	--	--	--	--	--	--	--	--
24 months	--	--	--	39	1	2	--	--	--	--	1	19	38	--	--	--	--	--	--	--	--	--
Bakersfield-gin standard:																						
Before storage	--	--	--	27	21	36	10	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	1	--	42	4	47	5	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	--	--	32	41	8	18	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	45	18	32	4	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
24 months	--	--	--	57	13	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bakersfield-compressed:																						
Before storage	--	--	--	--	2	96	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	1	--	1	--	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	2	--	--	3	95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	8	6	85	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
24 months	--	--	--	75	9	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bakersfield-flat:																						
Before storage	--	--	--	9	23	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3 months	--	--	--	4	--	95	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 months	--	--	--	2	1	97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12 months	--	--	--	49	28	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
24 months	--	--	--	55	10	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 15.--Analyses of variance of the grade of paired lots of cotton stored at two locations for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Texas origin, compressed bales Lubbock storage compared with Houston storage	Length of time	4	32.8344	8.2086	99.498**
	Initial grade	4	53.3271	13.3318	161.598**
	Storage location	1	.7033	.7033	8.525*
	Time x grade	16	2.6082	.1630	1.976
	Time x location	4	1.6174	.4044	4.902**
	Grade x location	4	.9570	.2392	2.899
	Time x grade x location	16	1.3194	.0825	--
	Total	49	93.3668	--	--
California origin, gin standard bales, Bakersfield storage compared with Houston storage	Length of time	4	2.6219	.6555	4.474*
	Initial grade	4	16.7094	4.1774	28.515**
	Storage location	1	.3681	.3681	2.513
	Time x grade	16	3.9801	.2488	1.698
	Time x location	4	4.7017	1.1754	8.023**
	Grade x location	4	.1303	.0326	.222
	Time x grade x location	16	2.3437	.1465	--
	Total	49	30.8552	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 16.--Analyses of variance of the grade of paired lots of cotton stored as flat and compressed bales for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Mississippi origin, Greenwood storage, flat bales compared with compressed bales	Length of time	4	2.1875	0.5469	8.821**
	Initial grade	4	50.2580	12.5645	202.653**
	Type of bale	1	.2112	.2112	3.406
	Time x grade	16	3.5563	.2223	3.586**
	Time x bale	4	.4543	.1136	1.832
	Grade x bale	4	.7771	.1943	3.134*
	Time x grade x bale	16	.9928	.0620	--
	Total	49	58.4372	--	--
Texas origin, Lubbock storage, flat bales compared with compressed bales	Length of time	4	15.1006	3.7752	33.677**
	Initial grade	3	40.4883	13.4961	120.393**
	Type of bale	1	1.0857	1.0857	9.685**
	Time x grade	12	1.9730	.1644	1.466
	Time x bale	4	.7901	.1975	1.762
	Grade x bale	3	1.5904	.5301	4.729*
	Time x grade x bale	12	1.3447	.1121	--
	Total	39	62.3728	--	--
California origin, Bakersfield storage, flat bales compared with compressed bales	Length of time	4	.3607	.0902	12.027*
	Initial grade	1	.1786	.1786	23.813**
	Type of bale	1	.0102	.0102	1.360
	Time x grade	4	.0228	.0057	.760
	Time x bale	4	.0205	.0051	.680
	Grade x bale	1	.0252	.0252	3.360
	Time x grade x bale	4	.0300	.0075	--
	Total	19	.6480	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 17.--Staple length of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, type of bale, and time in storage	Staple length								
	1-3/32"	1-1/16"	1-1/32"	1"	31/32"	15/16"	29/32"	7/8"	13/16"
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
MISSISSIPPI									
Greenwood-flat:									
Before storage	4	95	1	--	--	--	--	--	--
3 months	--	100	--	--	--	--	--	--	--
6 months	--	67	32	1	--	--	--	--	--
12 months	--	9	88	3	--	--	--	--	--
24 months	1	88	11	--	--	--	--	--	--
Greenwood-compressed:									
Before storage	16	83	1	--	--	--	--	--	--
3 months	--	100	--	--	--	--	--	--	--
6 months	--	83	17	--	--	--	--	--	--
12 months	--	1	93	6	--	--	--	--	--
24 months	5	87	8	--	--	--	--	--	--
TEXAS									
Lubbock-flat:									
Before storage	--	--	25	27	18	15	10	3	2
3 months	--	--	20	42	16	17	4	1	--
6 months	--	3	24	32	19	17	3	2	--
12 months	--	--	--	5	35	52	8	--	--
24 months	--	1	11	15	24	47	2	--	--
Lubbock-compressed:									
Before storage	--	1	23	32	22	17	5	--	--
3 months	--	2	12	40	33	12	1	--	--
6 months	1	5	17	32	32	12	1	--	--
12 months	--	--	1	3	29	65	2	--	--
24 months	--	13	6	7	35	38	1	--	--
Houston-compressed:									
Before storage	--	--	22	28	19	24	6	1	--
3 months	--	--	11	31	23	27	8	--	--
6 months	--	2	11	23	29	31	4	--	--
12 months	--	--	1	11	30	48	10	--	--
24 months	--	1	12	10	31	44	2	--	--

Origin, storage location, type of bale, and time in storage	Staple length		
	1-3/32"	1-1/16"	1-1/32"
	Pct.	Pct.	Pct.
CALIFORNIA			
Houston-compressed:			
Before storage	--	100	--
3 months	3	97	--
6 months	8	92	--
12 months	1	99	--
24 months	5	95	--
Houston-gin standard:			
Before storage	--	100	--
3 months	17	83	--
6 months	18	82	--
12 months		100	--
24 months	--	100	--
Bakersfield-gin standard:			
Before storage	--	100	--
3 months	2	98	--
6 months	2	95	3
12 months	1	99	--
24 months	14	86	--
Bakersfield-compressed:			
Before storage	--	100	--
3 months	11	89	--
6 months	6	94	--
12 months	3	97	--
24 months	4	96	
Bakersfield-flat:			
Before storage	--	100	--
3 months	4	96	--
6 months	2	98	--
12 months	2	98	--
24 months	10	89	1

Table 18.--Analyses of variance of the reflectance percentage (R_d) of paired lots of cotton stored at two locations for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Texas origin, compressed bales, Lubbock storage compared with Houston storage	Length of time	4	45.6147	11.4037	115.073**
	Initial grade	4	178.6627	44.6657	450.713**
	Storage location	1	.0090	.0090	.091
	Time x grade	16	5.2982	.3311	3.341*
	Time x location	4	3.3363	.8341	8.417**
	Grade x location	4	.4578	.1144	1.154
	Time x grade x location	16	1.5855	.0991	--
	Total	49	234.9642	--	--
California origin gin standard bales, Bakersfield storage compared with Houston storage	Length of time	4	18.7994	4.6998	74.957**
	Initial grade	4	38.1154	9.5288	151.974**
	Storage location	1	1.7113	1.7113	27.293**
	Time x grade	16	.6849	.0428	.683
	Time x location	4	3.9624	.9906	15.799**
	Grade x location	4	.3867	.0967	1.542
	Time x grade x location	16	1.0030	.0627	--
	Total	49	64.6631	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 19.--Analyses of variance of the reflectance percentage (R_d) of paired lots of cotton stored as flat and compressed bales for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean Square	Calculated F value
Mississippi origin, Greenwood storage, flat bales compared with compressed bales	Length of time	4	28.8051	7.2013	45.839**
	Initial grade	4	56.6209	14.1552	90.103**
	Type of bale	1	5.7325	5.7325	36.490**
	Time x grade	16	1.2910	.0807	.514
	Time x bale	4	.5340	.1335	.850
	Grade x bale	4	7.1701	1.7925	11.410*
	Time x grade x bale	16	2.5133	.1571	--
	Total	49	102.6669	--	--
Texas origin, Lubbock storage, flat bales compared with compressed bales	Length of time	4	27.7688	6.9422	103.000**
	Initial grade	3	112.8465	37.6155	558.094**
	Type of bale	1	.1651	.1651	2.450
	Time x grade	12	3.4472	.2873	4.263**
	Time x bale	4	.4862	.1216	1.804
	Grade x bale	3	11.5872	3.8624	57.306**
	Time x grade x bale	12	.8093	.0674	--
	Total	39	157.1103	--	--
California origin, Bakersfield storage, flat bales compared with compressed bales	Length of time	4	3.8024	.9506	10.609**
	Initial grade	1	4.5125	4.5125	50.363**
	Type of bale	1	6.2720	6.2720	70.000**
	Time x grade	4	.7020	.1755	1.959
	Time x bale	4	.8965	.2241	2.501
	Grade x bale	1	.5314	.5314	5.931
	Time x grade x bale	4	.3585	.0896	--
	Total	19	17.0753	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 20.--Analyses of variance of the yellowness (Hunter's +b factor) of paired lots of cotton stored at two locations for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Texas origin, compressed bales, Lubbock storage compared with Houston storage	Length of time	4	23.5115	5.8779	199.929**
	Initial grade	4	3.2561	.8140	27.687**
	Storage location	1	3.3592	3.3592	114.258**
	Time x grade	16	.7692	.0481	1.636
	Time x location	4	1.8809	.4702	15.993**
	Grade x location	4	1.0258	.2565	8.724**
	Time x grade x location	16	.4709	.0294	--
	Total	49	34.2736	--	--
California origin, gin standard bales, Bakersfield storage compared with Houston storage	Length of time	4	23.4825	5.8706	946.871**
	Initial grade	4	1.2142	.3036	48.968**
	Storage location	1	1.5914	1.5914	256.677**
	Time x grade	16	.1155	.0072	1.161
	Time x location	4	2.5295	.6324	102.000**
	Grade x location	4	.1098	.0275	4.436*
	Time x grade x location	16	.0995	.0062	--
	Total	49	29.1424	--	--
California origin, compressed bales, Bakersfield storage compared with Houston storage	Length of time	4	9.0009	2.2502	30.003**
	Initial grade	2	.2628	.1314	1.752
	Storage location	1	.2862	.2862	3.816
	Time x grade	8	.4963	.0620	.827
	Time x location	4	.2387	.0597	.796
	Grade x location	2	.1505	.0752	1.003
	Time x grade x location	8	.5999	.0750	--
	Total	29	11.0353	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 21.--Analyses of variance of the yellowness (Hunter's +b factor) of paired lots of cotton stored as flat and compressed bales for 0, 3, 6, 12, and 24 months, 1959 crop.

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Mississippi origin, Greenwood storage, flat bales compared with compressed bales	Length of time	4	5.3226	1.3306	277.208**
	Initial grade	4	4.3450	1.0862	226.292**
	Type of bale	1	.2874	.2874	59.875**
	Time x grade	16	.1588	.0099	2.063
	Time x bale	4	.1998	.0500	10.417**
	Grade x bale	4	.0283	.0071	1.479
	Time x grade x bale	16	.0762	.0048	--
	Total	49	10.4181	--	--
Texas origin, Lubbock storage, flat bales compared with compressed bales	Length of time	4	9.2826	2.3206	161.153**
	Initial grade	3	1.6281	.5427	37.688**
	Type of bale	1	.8237	.8237	57.201**
	Time x grade	12	.4001	.0333	2.313
	Time x bale	4	.1133	.0283	1.965
	Grade x bale	3	.2073	.0691	4.799*
	Time x grade x bale	12	.1726	.0144	--
	Total	39	12.6277	--	--
California origin, Bakersfield storage, flat bales compared with compressed bales	Length of time	4	4.8443	1.2111	186.323**
	Initial grade	1	.0225	.0225	3.462
	Type of bale	1	.0995	.0995	15.308*
	Time x grade	4	.0282	.0070	1.077
	Time x bale	4	.0928	.0232	3.569
	Grade x bale	1	.0377	.0377	5.800
	Time x grade x bale	4	.0259	.0065	--
	Total	19	5.1509	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 22.--Fiber and processing properties of 60 bales of cotton before storage and after storage for 2 years, by origin, storage location, and type of bale, 1959 crop 1/

Fiber and processing property	Unit	Mississippi cotton stored in Greenwood				Texas cotton stored in--					
						Lubbock				Houston	
		Flat		Compressed		Flat		Compressed		Compressed	
		Before storage	After storage	Before storage	After storage	Before storage	After storage	Before storage	After storage	Before storage	After storage
Nonlint content	Percent	2.4	2.7	2.5	2.6	2.4	2.9	2.3	2.7	2.3	2.3
Micronaire	Reading	4.7	4.7	4.7	4.8	3.6	3.6	3.9	3.9	3.8	3.7
Fiber strength:											
"0" gauge	1,000 p.s.i.	80	78	80	78	79	78	75	74	76	74
1/8" gauge	Grams/tex	21.8	22.6	22.2	22.7	21.7	21.0	21.4	20.0	21.6	21.7
Sugar content	Percent	.0	.0	.0	.0	.2	.3	.3	.4	.3	.3
Acid alkaline	pH	8.4	7.9	8.5	8.4	6.5	6.4	6.4	6.5	6.4	6.2
Fibrograph data:											
Upper half mean	Inches	1.06	1.07	1.06	1.09	.97	.93	1.00	.99	.99	.99
Mean length	Inches	.86	.85	.86	.88	.77	.71	.81	.78	.79	.78
Uniformity ratio	Percent	81	80	81	81	80	77	81	79	80	79
Array data:											
Upper quartile	Inches	1.19	1.19	1.20	1.20	1.06	1.06	1.11	1.10	1.10	1.11
Mean length	Inches	.98	.98	1.00	.99	.85	.85	.90	.90	.88	.90
Coefficient of variation	Percent	30	30	29	29	35	34	31	31	33	33
Fibers over 1 inch	Percent	58	59	60	60	35	33	44	44	40	44
Fibers 1/2 to 1 inch	Percent	32	31	31	31	50	53	45	45	46	44
Fibers less than 1/2 inch	Percent	10	10	9	9	15	14	11	11	14	12
Picker and card waste	Percent	7.59	7.18	7.31	7.22	8.11	8.03	7.68	7.06	7.40	7.34
Neps/100 sq. inch card web	Number	14	12	13	12	24	25	21	21	28	38
Yarn strength, 22's	Pounds	111	111	113	112	105	102	103	104	106	106
Yarn strength, 50's	Pounds	41	43	42	43	38	37	38	39	39	41
Break factor, 22's and 50's	Number	2285	2296	2322	2304	2144	2049	2120	2129	2168	2191
Yarn appearance	Index	111	108	114	105	92	91	100	99	92	87

Continued

Table 23.--Fiber and processing properties of 1,000 bales of cotton before storage and after storage for 2 years, by origin, storage location, and type of bale, 1959 crop 1/

Fiber and processing property	Unit	Mississippi cotton stored in Greenwood				Texas cotton stored in--					
						Lubbock				Houston	
		Flat		Compressed		Flat		Compressed		Compressed	
		Before storage	After storage	Before storage	After storage	Before storage	After storage	Before storage	After storage	Before storage	After storage
Nonlint content	Percent	2.1	2.8	2.4	2.8	2.3	2.0	2.3	2.3	2.7	2.4
Micronaire	Reading	4.7	4.7	4.7	4.7	3.6	3.5	3.8	3.7	3.8	3.6
Fiber strength:											
"0" gauge	1,000 p.s.i.	82	79	80	79	78	78	77	77	76	76
1/8" gauge	Grams/tex	21.6	22.1	21.5	21.7	21.6	22.0	21.0	22.0	21.3	21.4
Sugar content	Percent	.0	.0	.0	.0	.3	.4	.3	.3	.3	.3
Acid alkaline	pH	8.3	7.6	8.4	7.8	6.5	6.6	6.5	6.6	6.5	6.4
Fibrograph data:											
Upper half mean	Inches	1.09	1.04	1.09	1.06	.97	.98	.98	.96	.99	.96
Mean length	Inches	.88	.83	.87	.85	.77	.75	.77	.74	.78	.75
Uniformity ratio	Percent	81	80	80	80	79	77	79	77	79	78
Array data:											
Upper quartile	Inches	1.18	1.17	1.19	1.20	1.10	1.11	1.10	1.07	1.08	1.08
Mean length	Inches	.94	.94	.96	.96	.88	.88	.89	.85	.86	.87
Coefficient of variation	Percent	31	32	33	32	33	34	31	34	33	34
Fibers over 1 inch	Percent	53	55	55	56	39	40	41	36	36	38
Fibers 1/2 to 1 inch	Percent	36	33	33	33	47	47	47	50	50	48
Fibers less than 1/2 inch	Percent	11	12	12	11	14	13	12	14	14	14
Picker and card waste	Percent	7.57	8.03	7.39	8.34	8.00	8.16	8.47	8.28	8.30	7.90
Neps/100 sq. inch card web	Number	17	21	14	23	23	44	22	36	21	37
Yarn strength, 22's	Pounds	109	108	108	106	104	96	104	102	102	102
Yarn strength, 50's	Pounds	40	41	40	40	38	35	38	38	37	38
Break factor, 22's and 50's	Number	2234	2208	2217	2178	2123	1913	2123	2090	2076	2084
Yarn appearance	Index	109	108	109	108	89	85	95	92	92	90
Spinning potential	Yarn no.	53	59	54	59	50	52	49	51	48	49

Continued

Table 23.--Fiber and processing properties of 1,000 bales of cotton before storage and after storage for 2 years, by origin, storage location, and type of bale, 1959 crop 1/--Continued

Fiber and processing property	Unit	California cotton stored in--									
		Houston				Bakersfield					
		Compressed		Gin standard		Gin standard		Compressed		Flat	
		Before storage	After storage	Before storage	After storage	Before storage	After storage	Before storage	After storage	Before storage	After storage
Nonlint content	Percent	1.9	2.1	2.2	2.1	2.2	2.6	1.9	2.5	2.0	2.1
Micronaire	Reading	4.6	4.7	4.4	4.4	4.4	4.5	4.6	4.6	4.7	4.6
Fiber strength:											
"0" gauge	1,000 psi	96	96	100	95	99	98	96	94	96	94
1/8" gauge	Grams/tex	25.4	25.9	26.4	26.6	26.4	27.0	26.3	26.8	25.7	26.5
Sugar content	Percent	.1	.2	.1	.2	.1	.2	.1	.2	.1	.2
Acid alkaline	pH	6.9	6.8	6.9	6.8	6.9	6.6	6.9	7.2	6.7	6.7
Fibrograph data:											
Upper half mean	Inches	1.08	1.06	1.08	1.06	1.07	1.04	1.09	1.06	1.07	1.05
Mean length	Inches	.87	.84	.87	.85	.87	.84	.89	.85	.88	.85
Uniformity ratio	Percent	81	79	81	80	81	81	82	80	82	81
Array data:											
Upper quartile	Inches.	1.20	1.19	1.19	1.19	1.19	1.19	1.18	1.20	1.19	1.21
Mean length	Inches	.99	.98	.97	.98	.98	.98	1.00	1.01	.98	1.01
Coefficient of variation	Percent	28	30	31	30	29	30	27	27	29	28
Fibers over 1 inch	Percent	60	56	58	59	60	59	61	63	58	62
Fibers 1/2 to 1 inch	Percent	32	34	31	32	31	31	31	30	33	30
Fibers less than 1/2 inch	Percent	8	10	11	9	9	10	8	7	9	8
Picker and card waste	Percent	6.40	6.95	7.21	7.16	6.86	6.89	6.76	6.84	6.44	6.57
Neps/100 sq. inch card web	Number	15	18	17	26	14	24	14	18	14	29
Yarn strength, 22's	Pounds	129	128	133	131	135	133	131	128	133	128
Yarn strength, 50's	Pounds	49	49	50	52	50	52	49	50	50	51
Break factor, 22's and 50's	Number	2678	2638	2760	2728	2758	2750	2700	2676	2760	2683
Yarn appearance	Index	102	102	102	100	105	105	112	108	109	105
Spinning potential	Yarn no.	58	65	59	68	58	67	59	66	59	66

1/ Based on composited classification samples.

Table 24.--Color of gray, bleached, and dyed yarns 1/ processed from 60 bales of cotton before storage and after storage for 2 years, by origin, storage location, and type of bale, 1959 crop 2/

Origin, storage location, and type of bale	Reflectance (R_d)			Yellowness or blueness (Hunter's +b factor) 3/			Grade index		
	Before storage	After storage	Difference	Before storage	After storage	Difference	Before storage	After storage	Difference
				GRAY					
Mississippi-Greenwood-flat	71.5	70.8	-.7	11.7	12.1	.4	101	101	0
Mississippi-Greenwood-compressed	71.9	71.3	-.6	11.7	12.0	.3	101	101	0
Texas-Lubbock-flat	67.7	65.9	-1.8	11.5	12.8	1.3	93	93	0
Texas-Lubbock-compressed	68.6	67.5	-1.1	11.2	12.8	1.6	94	96	2
Texas-Houston-compressed	69.4	67.3	-2.1	11.0	13.4	2.4	94	98	4
California-Houston-compressed	72.8	71.2	-1.6	11.2	13.9	2.7	102	108	6
California-Houston-gin standard	73.4	71.2	-2.2	11.6	13.9	2.3	104	108	4
California-Bakersfield-gin standard	73.1	72.1	-1.0	11.7	13.0	1.3	103	106	3
California-Bakersfield-compressed	72.5	71.9	-.6	11.3	12.4	1.1	101	104	3
California-Bakersfield-flat	72.3	71.4	-.9	11.3	12.4	1.1	101	103	2
				BLEACHED					
Mississippi-Greenwood-flat	84.7	82.5	-2.2	2.8	2.4	-.4	105	102	-3
Mississippi-Greenwood-compressed	85.0	82.3	-2.7	2.9	2.4	-.5	106	102	-4
Texas-Lubbock-flat	82.0	81.3	-.7	3.4	3.4	.0	96	95	-1
Texas-Lubbock-compressed	81.9	81.7	-.2	3.1	2.8	-.3	98	98	0
Texas-Houston-compressed	82.7	82.1	-.6	3.0	3.0	.0	100	99	-1
California-Houston-compressed	83.0	82.1	-.9	2.8	2.8	.0	101	99	-2
California-Houston-gin standard	84.2	82.2	-2.0	3.0	2.8	-.2	103	99	-4
California-Bakersfield-gin standard	84.3	81.7	-2.6	3.1	2.5	-.6	103	100	-3
California-Bakersfield-compressed	83.7	82.2	-1.5	3.0	2.6	-.4	102	101	-1
California-Bakersfield-flat	83.5	81.6	-1.9	2.9	2.4	-.5	102	100	-2
			DYED AFTER BLEACHING						
Mississippi-Greenwood-flat	26.7	28.1	1.4	26.8	26.4	-.4	108	103	-5
Mississippi-Greenwood-compressed	26.7	28.1	1.4	26.7	26.4	-.3	107	104	-3
Texas-Lubbock-flat	26.4	27.7	1.3	25.9	25.8	-.1	104	102	-2
Texas-Lubbock-compressed	25.8	26.9	1.1	26.3	26.4	.1	107	106	-1
Texas-Houston-compressed	25.8	27.0	1.2	26.5	25.9	-.6	108	103	-5
California-Houston-compressed	26.7	27.5	.8	26.3	26.2	-.1	106	104	-2
California-Houston-gin standard	26.2	26.9	.7	26.8	26.5	-.3	109	104	-5
California-Bakersfield-gin standard	26.0	26.4	.4	27.0	27.2	.2	109	110	1
California-Bakersfield-compressed	25.7	27.1	1.4	26.9	26.7	-.2	110	107	-3
California-Bakersfield-flat	25.9	26.8	.9	26.9	26.9	.0	110	108	-2

1/ Yarns were dyed after bleaching.
2/ Based on spinning samples from six randomly selected bales in each lot.
3/ Yellowness applies to gray and bleached yarns; blueness to dyed yarns.

Table 25.--Color of gray, bleached, and dyed yarns 1/ processed from cotton before storage and after storage for 2 years, by origin, storage location, and type of bale, 1959 crop 2/

Origin, storage location, and type of bale	Reflectance (Rd)			Yellowness or blueness (Hunter's +b factor) 3/			Grade index		
	Before storage	After storage	Difference	Before storage	After storage	Difference	Before storage	After storage	Difference
GRAY									
Mississippi-Greenwood-flat	71.2	71.9	.7	11.4	12.0	.6	100	102	2
Mississippi-Greenwood-compressed	70.7	71.4	.7	11.4	11.8	.4	98	102	4
Texas-Lubbock-flat	69.0	68.6	-.4	10.9	12.6	1.7	94	98	4
Texas-Lubbock-compressed	68.5	68.1	-.4	11.3	12.6	1.3	94	98	4
Texas-Houston-compressed	68.4	67.4	-1.0	11.0	13.0	2.0	93	96	3
California-Houston-compressed	73.2	72.2	-1.0	11.3	13.4	2.1	102	108	6
California-Houston-gin standard	73.0	72.0	-1.0	11.1	13.6	2.5	102	108	6
California-Bakersfield-gin standard	73.2	73.5	.3	11.2	12.8	1.6	102	108	6
California-Bakersfield-compressed	71.7	72.9	1.2	11.2	12.6	1.4	100	106	6
California-Bakersfield-flat	72.3	73.2	.9	11.1	12.8	1.7	100	106	6
BLEACHED									
Mississippi-Greenwood-flat	85.8	82.3	-3.5	3.0	2.6	-.4	107	100	-7
Mississippi-Greenwood-compressed	84.7	83.0	-1.7	2.7	2.6	-.1	106	102	-4
Texas-Lubbock-flat	82.8	83.0	.2	3.2	2.8	-.4	99	102	3
Texas-Lubbock-compressed	80.9	81.8	.9	3.1	2.8	-.3	95	98	3
Texas-Houston-compressed	82.4	82.2	-.2	3.1	2.8	-.3	99	100	1
California-Houston-compressed	84.1	82.1	-2.0	2.8	2.8	.0	104	100	-4
California-Houston-gin standard	84.4	82.2	-2.2	3.0	2.7	-.3	104	100	-4
California-Bakersfield-gin standard	85.1	82.5	-2.6	3.0	2.4	-.6	106	102	-4
California-Bakersfield-compressed	83.1	82.6	-.5	2.8	2.6	-.2	102	101	-1
California-Bakersfield-flat	84.0	82.0	-2.0	3.0	2.5	-.5	102	100	-2
DYED AFTER BLEACHING									
Mississippi-Greenwood-flat	26.7	27.9	1.2	27.0	25.8	-1.2	108	102	-6
Mississippi-Greenwood-compressed	27.1	28.7	1.6	26.7	25.5	-1.2	106	98	-8
Texas-Lubbock-flat	25.6	26.7	1.1	27.0	26.2	-.8	110	106	-4
Texas-Lubbock-compressed	25.4	28.0	2.6	26.8	25.2	-1.6	110	98	-12
Texas-Houston-compressed	25.6	26.6	1.0	26.3	26.0	-.3	108	105	-3
California-Houston-compressed	27.2	28.0	.8	26.6	25.9	-.7	105	102	-3
California-Houston-gin standard	26.2	28.5	2.3	27.2	25.6	-1.6	110	100	-10
California-Bakersfield-gin standard	25.6	25.4	-.2	27.6	26.7	-.9	112	108	-4
California-Bakersfield-compressed	26.0	26.9	.9	26.9	26.2	-.7	109	105	-4
California-Bakersfield-flat	26.6	26.8	.2	27.0	25.9	-1.1	108	104	-4

1/ Yarns were dyed after bleaching.
2/ Based on composited classification samples for 1,000 bales.
3/ Yellowness applies to gray and bleached yarns; blueness to dyed yarns.

Table 26.--Value per pound of 1,000 bales of cotton before storage and after storage for specified periods, by origin, storage location, and type of bale, 1959 crop

Origin, storage location, and type of bale	Average value of lots 1/					Change in value after storage for --			
	Before storage	After storage for -- 3 months	6 months	12 months	24 months	3 months	6 months	12 months	24 months
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
MISSISSIPPI:									
Greenwood-flat	30.23	30.52	30.71	29.16	29.72	.29*	.48**	-1.07**	-.51**
Greenwood-compressed ...	30.28	30.52	30.22	29.00	30.12	.24*	-.06	-1.28**	-.16
TEXAS:									
Lubbock-flat	28.12	29.27	29.55	27.55	26.30	1.15**	1.43**	-.56**	-1.82**
Lubbock-compressed	28.12	28.63	29.21	25.44	25.68	.51**	1.09**	-2.68**	-2.44**
Houston-compressed	28.00	28.59	28.75	26.04	24.80	.59**	.75**	-1.96**	-3.20**
CALIFORNIA:									
Houston-compressed	32.67	32.88	32.76	33.28	32.31	.21**	.09*	.61**	-.36*
Houston-gin standard ...	32.33	33.22	33.08	32.97	31.10	.89**	.75**	.64**	-1.23**
Bakersfield-gin standard	32.60	32.98	32.65	33.13	33.46	.38**	.05	.53**	.86**
Bakersfield-compressed..	32.66	32.77	32.71	32.79	33.55	.11*	.05	.13*	.89**
Bakersfield-flat	32.90	32.77	32.74	33.36	33.38	-.13**	-.16**	.46**	.48**
ALL LOTS	30.79	31.22	31.24	30.27	30.04	.43**	.45**	-.52**	-.75**
By origin:									
Mississippi	30.26	30.52	30.46	29.08	29.92	.26*	.20*	-1.18**	-.34**
Texas	28.08	28.83	29.17	26.34	25.59	.75**	1.09**	-1.74**	-2.49**
California	32.63	32.92	32.79	33.11	32.76	.29**	.16*	.48**	.13*
By storage location:									
Greenwood	30.26	30.52	30.46	29.08	29.92	.26*	.20*	-1.18**	-.34**
Lubbock	28.12	28.95	29.38	26.50	25.99	.83**	1.26**	-1.62**	-2.13**
Houston	31.00	31.56	31.53	30.76	29.40	.56**	.53**	-.24*	-1.60**
Bakersfield	32.72	32.84	32.70	33.09	33.46	.12	-.02	.37**	.74**
By type of bale:									
Flat	30.42	30.85	31.00	30.02	29.80	.43**	.58**	-.40**	-.62**
Compressed	30.35	30.68	30.73	29.31	29.29	.33**	.38**	-1.04**	-1.06**
Gin standard	32.46	33.10	32.86	33.05	32.28	.64**	.40**	.59**	-.18*

1/ Average value of each lot was based on the grade and staple length of each bale and the appropriate price as computed from the 14-market average premiums and discounts for the 1957-58 season.

* and ** indicate changes in value were significant at the 5 percent and 1 percent levels, respectively.

Table 27.--Analyses of variance of the value of paired lots of cotton stored at two locations for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Texas origin, compressed bales, Lubbock storage compared with Houston storage	Length of time	4	43.6148	10.9037	66.812**
	Initial grade	4	72.7921	18.1980	111.507**
	Storage location	1	.6183	.6183	3.789
	Time x grade	16	4.2669	.2667	1.634
	Time x location	4	2.0815	.5204	3.189*
	Grade x location	4	.3278	.0820	.502
	Time x grade x location	16	2.6106	.1632	--
	Total	49	126.3120	--	--
California origin, gin standard bales, Bakersfield storage compared with Houston storage	Length of time	4	3.3355	.8339	4.530*
	Initial grade	4	20.3906	5.0976	27.689**
	Storage location	1	.4627	.4627	2.513
	Time x grade	16	4.5812	.2863	1.555
	Time x location	4	6.7806	1.6952	9.208**
	Grade x location	4	.1769	.0442	.240
	Time x grade x location	16	2.9453	.1841	--
	Total	49	38.6728	--	--
California origin, compressed bales, Bakersfield storage compared with Houston storage	Length of time	4	1.7595	.4399	12.462**
	Initial grade	2	1.1879	.5940	16.827**
	Storage location	1	.0001	.0001	.003
	Time x grade	8	2.5621	.3203	9.074**
	Time x location	4	.1467	.0367	1.040
	Grade x location	2	.0568	.0284	.805
	Time x grade x location	8	.2823	.0353	--
	Total	29	5.9954	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 28.--Analyses of variance of the value of paired lots of cotton stored as flat and compressed bales for 0, 3, 6, 12, and 24 months, 1959 crop

Description of two-lot comparison	Source of variation	Degrees of freedom	Sum of squares	Mean square	Calculated F value
Mississippi origin, Greenwood storage, flat bales compared with compressed bales	Length of time	4	9.7488	2.4397	24.494**
	Initial grade	4	58.7125	14.6781	147.370**
	Type of bale	1	.1331	.1331	1.336
	Time x grade	16	7.0165	.4385	4.403**
	Time x bale	4	.3139	.0785	.788
	Grade x bale	4	1.2774	.3194	3.207*
	Time x grade x bale	16	1.5940	.0996	--
	Total	49	78.7962	--	--
Texas origin, Lubbock storage, flat bales compared with compressed bales	Length of time	4	22.9089	5.7272	35.551**
	Initial grade	3	60.2377	20.0792	124.638**
	Type of bale	1	.2891	.2891	1.795
	Time x grade	12	3.4975	.2915	1.809
	Time x bale	4	.9200	.2300	1.428
	Grade x bale	3	1.9349	.6450	4.004*
	Time x grade x bale	12	1.9334	.1611	--
	Total	39	91.7215	--	--
California origin, Bakersfield storage, flat bales compared with compressed bales	Length of time	4	.4948	.1237	13.159*
	Initial grade	1	.2247	.2247	23.904**
	Type of bale	1	.0125	.0125	1.330
	Time x grade	4	.0312	.0078	.830
	Time x bale	4	.0267	.0067	.713
	Grade x bale	1	.0258	.0258	2.745
	Time x grade x bale	4	.0375	.0094	--
	Total	19	.8532	--	--

* Significant at 5 percent level; ** significant at 1 percent level.

Table 29.--Fiber and processing properties of stored samples and fresh samples cut from bales after storage for 2 years, by origin, storage location, and type of bale, 1959 cotton crop 1/

Fiber and processing property	Unit	Mississippi cotton stored in Greenwood				Texas cotton stored in --					
						Lubbock				Houston	
		Flat		Compressed		Flat		Compressed		Compressed	
		Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples
Nonlint content	Percent	2.8	2.7	2.8	2.6	2.0	2.5	2.3	2.3	2.4	2.3
Micronaire	Reading	4.7	4.6	4.7	4.8	3.5	3.6	3.7	3.8	3.6	3.7
Fiber strength:											
"0" gauge	1,000 p.s.i.	79	79	79	79	78	76	77	76	76	74
1/8" gauge	Grams/tex	22.1	21.6	21.7	21.0	22.0	21.5	22.0	21.2	21.4	21.0
Sugar content	Percent	.0	.0	.0	.0	.4	.2	.3	.2	.3	.2
Acid alkaline	pH	7.6	7.9	7.8	7.8	6.6	6.7	6.6	6.6	6.4	6.6
Fibrograph data:											
Upper half mean	Inches	1.04	1.06	1.06	1.05	.98	.98	.96	.98	.96	.99
Mean length	Inches	.83	.83	.84	.83	.75	.76	.74	.76	.74	.77
Uniformity ratio	Percent	80	78	80	79	77	77	77	78	78	78
Array data:											
Upper quartile	Inches	1.17	1.18	1.20	1.18	1.11	1.10	1.07	1.08	1.08	1.10
Mean length	Inches	.94	.96	.96	.96	.88	.90	.85	.87	.87	.87
Coefficient of variation	Percent	32	31	32	32	34	32	34	33	34	36
Fibers over 1 inch	Percent	55	55	56	54	40	41	36	37	38	40
Fibers 1/2 to 1 inch	Percent	33	35	33	36	47	48	50	51	48	47
Fibers less than 1/2 in.	Percent	12	10	11	10	13	11	14	12	14	13
Picker and card waste	Percent	8.03	7.93	8.43	8.24	8.16	8.39	8.28	8.37	7.90	8.66
Neps/100 sq. inch card web	Number	21	20	23	22	44	44	36	32	37	29
Yarn strength, 22's	Pounds	108	108	106	107	96	102	102	100	102	98
Yarn strength, 50's	Pounds	41	41	40	40	35	38	38	37	38	36
Break factor, 22's & 50's	Number	2208	2195	2178	2190	1913	2054	2090	2025	2084	1972
Yarn appearance	Index	108	102	108	102	85	85	92	88	90	88
Spinning potential	Yarn no.	59	59	59	59	52	51	51	51	49	51

Continued

Table 29.--Fiber and processing properties of cotton based on stored samples and fresh samples cut from bales after storage for 2 years, by origin, storage location, and type of bale, 1959 crop 1/ --Continued

Fiber and processing property	Unit	California cotton stored in --									
		Houston				Bakersfield					
		Compressed		Gin standard		Gin standard		Compressed		Flat	
		Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples	Fresh samples	Stored samples
Nonlint content	Percent	2.1	2.4	2.1	2.6	2.6	2.6	2.5	2.3	2.1	2.6
Micronaire	Reading	4.7	4.6	4.4	4.5	4.5	4.4	4.6	4.6	4.6	4.6
Fiber strength:											
"0" gauge	1,000 p.s.i.	96	92	95	96	98	97	94	92	94	97
1/8" gauge	Grams/tex	25.9	25.3	26.6	26.2	27.0	26.3	26.8	25.4	26.5	25.8
Sugar content	Percent	.2	.1	.2	.2	.2	.2	.2	.2	.2	.2
Acid alkaline	pH	6.8	6.8	6.8	6.8	6.6	6.9	7.2	6.8	6.7	6.8
Fibrograph data:											
Upper half mean	Inches	1.06	1.05	1.06	1.05	1.04	1.06	1.06	1.06	1.05	1.06
Mean length	Inches	.84	.84	.84	.84	.84	.84	.84	.84	.85	.86
Uniformity ratio	Percent	79	80	80	80	81	80	80	80	81	80
Array data:											
Upper quartile	Inches	1.19	1.17	1.19	1.18	1.19	1.16	1.20	1.18	1.21	1.18
Mean length	Inches	.98	.97	.98	.96	.98	.94	1.01	.97	1.01	.97
Coefficient of variation	Percent	30	29	30	32	30	32	27	30	28	30
Fibers over 1 inch	Percent	56	59	59	57	59	55	63	59	62	56
Fibers 1/2 to 1 inch	Percent	34	32	32	33	31	35	30	33	30	35
Fibers less than 1/2 in.	Percent	10	9	9	10	10	10	7	8	8	9
Picker and card waste	Percent	6.95	7.22	7.16	7.36	6.89	7.34	6.84	6.52	6.57	7.10
Neps/100 sq. inch card web	Number	18	16	26	16	24	22	18	18	29	20
Yarn strength, 22's	Pounds	128	126	131	129	133	128	128	127	128	128
Yarn strength, 50's	Pounds	49	49	52	50	52	50	50	50	51	50
Break factor, 22's & 50's	Number	2638	2616	2728	2669	2750	2676	2676	2634	2683	2640
Yarn appearance	Index	102	105	100	100	105	98	108	105	105	108
Spinning potential	Yarn no.	65	68	68	67	67	66	66	66	66	66

1/ Based on composited classification samples.

Table 30.--Color of gray, bleached, and dyed yarns processed from stored samples and fresh samples cut from bales after storage for 2 years, by origin, storage location, and type of bale, 1959 cotton crop 1/

Origin, storage location and type of bale	Gray			Bleached			Bleached and dyed		
	Reflectance (R_d)	Yellowness (Hunter's +b)	Color index	Reflectance (R_d)	Yellowness (Hunter's +b)	Color index	Reflectance (R_d)	Yellowness (Hunter's +b)	Color index
MISSISSIPPI									
Greenwood-flat:									
Fresh samples	71.9	12.0	102	82.3	2.6	100	27.9	25.8	102
Stored samples	72.4	12.0	104	83.2	2.6	102	27.4	26.6	106
Greenwood-compressed:									
Fresh samples	71.4	11.8	102	83.0	2.6	102	28.7	25.5	98
Stored samples	71.7	12.3	103	82.6	2.6	101	27.4	26.3	104
TEXAS									
Lubbock-flat:									
Fresh samples	68.6	12.6	98	83.0	2.8	102	26.7	26.2	106
Stored samples	67.4	12.3	95	85.3	2.8	106	27.4	25.4	101
Lubbock-compressed:									
Fresh samples	68.1	12.6	98	81.8	2.8	98	28.0	25.2	98
Stored samples	67.8	12.1	96	84.6	3.1	104	26.7	26.1	105
Houston compressed:									
Fresh samples	67.4	13.0	96	82.2	2.8	100	26.6	26.0	105
Stored samples	66.4	13.2	96	84.6	3.2	104	27.4	26.6	106
CALIFORNIA									
Houston-compressed:									
Fresh samples	72.2	13.4	108	82.1	2.8	100	28.0	25.9	102
Stored samples	72.1	13.0	106	82.6	2.6	101	27.2	26.0	104
Houston-gin standard:									
Fresh samples	72.0	13.6	108	82.2	2.7	100	28.5	25.6	100
Stored samples	72.0	13.6	108	83.5	3.1	102	27.5	26.3	104
Bakersfield-gin standard:									
Fresh samples	73.5	12.8	108	82.5	2.4	102	25.4	26.7	108
Stored samples	72.8	12.6	106	83.3	2.6	103	27.0	26.6	106
Bakersfield-compressed:									
Fresh samples	72.9	12.6	106	82.6	2.6	101	26.9	26.2	105
Stored samples	71.9	13.3	106	82.7	2.9	100	26.6	26.5	107
Bakersfield-flat:									
Fresh samples	73.2	12.8	106	82.0	2.5	100	26.8	25.9	104
Stored samples	71.8	12.8	105	82.9	2.6	102	26.2	26.5	107

1/ Based on composited classification samples.

Table 31.--Value per pound of cotton, based on stored samples and fresh samples cut from stored bales, by origin, storage location, type of bale, and length of time in storage, 1959 crop 1/

Origin, storage location, and type of bale	3 months			6 months			12 months			24 months		
	Fresh samples	Stored samples	Difference	Fresh samples	Stored samples	Difference	Fresh samples	Stored samples	Difference	Fresh samples	Stored samples	Difference
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
MISSISSIPPI:												
Greenwood-flat	30.52	30.47	-.05	30.71	30.52	-.19	29.16	29.32	.16	29.72	30.09	.37*
Greenwood-compressed	30.52	30.28	-.24**	30.22	30.03	-.19	29.00	29.09	.09	30.12	29.34	-.78**
TEXAS:												
Lubbock-flat	29.27	29.07	-.20	29.55	29.20	-.35*	27.55	26.71	-.84**	26.30	25.36	-.94**
Lubbock-compressed	28.63	28.30	-.33*	29.21	28.49	-.72**	25.44	25.79	.35*	25.68	25.03	-.65**
Houston-compressed	28.59	28.66	.07	28.75	28.57	-.18	26.04	25.53	-.51**	24.80	24.48	-.32
CALIFORNIA:												
Houston-compressed	32.88	32.67	-.21**	32.76	32.81	.05	33.28	33.04	-.24**	32.31	31.90	-.41
Houston-gin standard	33.22	33.17	-.05	33.08	33.03	-.05	32.97	32.83	-.14	31.10	30.17	-.93**
Bakersfield-gin standard	32.98	33.26	.28**	32.65	33.02	.37**	33.12	33.29	.17**	33.46	33.41	-.05
Bakersfield-compressed	32.77	32.70	-.07	32.71	32.70	-.01	32.79	33.51	.72**	33.54	33.51	-.03
Bakersfield-flat	32.77	32.74	-.03	32.74	32.76	.02	33.36	33.55	.19**	33.38	33.53	.15*
All lots	31.22	31.13	-.09	31.24	31.11	-.13	30.27	30.27	.00	30.04	29.68	-.36**
By origin:												
Mississippi	30.52	30.38	-.14	30.46	30.28	-.18	29.08	29.20	.12	29.92	29.72	-.20
Texas	28.83	28.68	-.15	29.17	28.75	-.42**	26.34	26.01	-.33**	25.59	24.96	-.63**
California	32.92	32.91	-.01	32.79	32.86	.07	33.10	33.24	.14	33.36	32.50	-.86**
By storage location:												
Greenwood	30.52	30.28	-.14	30.46	30.28	-.18	29.08	29.20	.12	29.92	29.72	-.20
Lubbock	28.95	28.68	-.27**	29.38	28.84	-.54**	26.50	26.25	-.25*	25.99	25.20	-.79**
Houston	31.56	31.50	-.06	31.53	31.47	-.06	30.76	30.47	-.29**	29.40	28.85	-.55**
Bakersfield	32.84	32.90	.06	32.70	32.83	.13	33.09	33.45	.36**	33.46	33.48	.02
By type of bale:												
Flat	30.85	30.76	-.09	31.00	30.83	-.17	30.02	29.86	-.16	29.80	29.66	-.14
Compressed	30.68	30.52	-.16	30.73	30.52	-.21	29.31	29.39	.09	29.29	28.93	-.36**
Gin standard	33.10	33.22	.12	32.86	33.02	.16	33.04	33.06	.02	32.28	31.76	-.52**

1/ Average value was based on the grade and staple length of each bale and the appropriate price as computed from the 14-market average premiums and discounts for the 1957-58 season, for each of the two types of samples.

* and ** indicate differences in value were significant at the 5 percent and 1 percent levels, respectively.