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J. H. Longwell, *Director*

A COMPARISON OF FOUR RESIN FINISHED AND MILL FINISHED COTTON FABRICS

BETTY WEISER BLASE, MARY LOUISE LEACH AND ADELLA E. GINTER

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INTRODUCTION

Cotton is a very satisfactory fiber to use for clothing because of its absorption, fairly high dry and wet strength, and low cost. It has the ability to withstand rough handling and high temperatures. Consequently, cotton fabrics can be washed and ironed easily and without deterioration of the fabric. On the other hand, cotton fabrics have the serious disadvantages of soiling and crushing easily. After they are worn once, garments of cotton often appear limp because of the moisture produced from body perspiration. The garments generally are starched to minimize this limp appearance and to give the garment more body. To repeatedly maintain a neat, unmussed appearance in cotton garments becomes a laborious task for the homemaker.

Cotton does not possess natural crease resistance as does wool. This seems to be due to the molecular arrangement within the fiber. Cotton is more crystalline than wool which means that the tensile strength of cotton will be higher, but the resilience and crease resistance of cotton will be lower than that of wool.

Within recent years, the application of synthetic resins to cottons has attracted the attention of consumers. The ability of resin treated fabrics to recover from creasing has been the most stressed advantage. Since cotton garments are laundered frequently, the consumer is interested in the retention of this crease resistance as well as the retention of overall fabric dimensions. To retain these properties, resin loss during laundering must not be excessive.

In the University of Missouri clothing construction laboratories, a large number of students have made garments of crease resistant cottons. Many of these girls as well as other home seamstresses have reported difficulty in obtaining flat, well pressed seams. Even with steaming the seams did not lie flat. This was a serious disadvantage to women who desired a garment with a trim, neat appearance. These garments were constructed from material as it was purchased without previous laundering. The question has been raised as to what the effect of laundering would be on these garments. Would repeated laundering and ironing eventually cause the seams to remain flat? If so, would flatness be obtained at the expense of

resin loss and subsequent loss of crease retention? Or would the women have been better satisfied to have used fabrics that had no resin treatment.

In order to answer these questions, this study was undertaken. Four resin finished fabrics were compared with the same fabrics in an unfinished state as to the desirable qualities sought in a dress fabric.

The objectives of the study were:

1. To compare the amount of finish at the various laundering intervals with possible changes in the other fabric properties.
2. To determine the effectiveness of pressing on the resin finished and unfinished materials before and after laundering.
3. To determine the efficiency in crease resistance and dimensional change of similar fabrics with and without resin finishes.

EXPERIMENTAL PLAN AND PROCEDURE

Plan

Four cotton fabrics including a black percale, a printed percale, a gingham and a nubby fabric were used in this study. Two yards of resin finished and two yards of mill finished fabric of each variety were obtained directly from mills. By laboratory determination the resins found in the black percale were melamine and urea formaldehyde along with pyridine base waterproofing agents.[3]* According to statements from the companies supplying the other fabrics, the printed percale was finished with modified urea-formaldehyde; the nubby fabric was finished with melamine-formaldehyde and a combination of urea and melamine was used on the gingham.

The material was prepared for testing so that the same method of random sampling could be obtained for all tests. Triplicate seam samples of four types: lengthwise, lengthwise bias, crosswise, and crosswise bias were constructed. The seams were made with a five-eights inch seam allowance from eight by ten inch pieces of fabric. Also, three small double collars of the Peter Pan type were made. The seams and collars were made from one end of each fabric strip; the remainder of the two yard piece was marked off for crease-recovery strips, sizing, and shrinkage squares.

After removing the as purchased test samples for crease-recovery and sizing squares, the fabric strips were laundered twenty times. Similar pieces for crease-recovery and sizing determinations were removed after one, five and ten launderings with the remaining material reserved for measurement after twenty launderings.

The laundering was done in an agitator type automatic washer using a wash period of six minutes at a temperature of 120°F. Four pounds of fabric, approximately half a load, were used at one time. The amount of fabric was kept constant for all launderings. One-half cupful of a built detergent was used for the wash cycle. This amount of detergent was used

*See references, page 16

because the hardness of the water measures seventeen grains in Columbia, Missouri.

These test pieces were dried in an automatic dryer for seventeen minutes. After cooling in the air the material was placed in a plastic dampening bag to which a cupful of water was added for every ten inches of fabric. The fabrics were allowed to remain in the plastic bag five hours before ironing.

The as purchased samples were ironed with a steam iron without dampening. A dry iron with the temperature control set on cotton was used for the dampened fabrics.

Tests Used

Thread Count. A Suter pick counter was used for this test. Five tests were taken in both the warp and filling directions. Counts were made only on the as purchased material.

Nonfibrous Material. The nonfibrous material was removed from the five inch square samples by the 0.1 N. HNO_3 method in A. S. T. M.[2] The testing was done in triplicate.

Shrinkage. A. S. T. M. regulations were used for the shrinkage test with the exception of the size of the shrinkage squares.[2] Two sixteen inch squares were marked off within eighteen inch squares of the fabric. The samples were laid out on a flat surface; three lengthwise and three fillingwise measurements were made on each sample. Two were made at each end and one at the center of the square. Shrinkage was calculated in percentage.

Crease Resistance. The strips used for crease resistance were exposed to standard atmospheric conditions for at least four hours before testing. The Monsanto Wrinkle Recovery Tester was used following the manufacturers' directions. The tentative test method is outlined in American Association of Textile Chemists and Colorists Technical Manual and Yearbook.[1] The results were reported as crease recovery angle. This refers to the number of degrees the creased specimen will recover in five minutes. Complete recovery would be 180 degrees.

Flatness of Seams. This measure on the seams and collars was taken thirty minutes after pressing and again after eighteen hours during which time the seams had hung vertically from a clothes hanger and the collars were left lying flat on a table. Since there is no standard method for measuring flatness, a simple method was devised. The seams were placed flat on a table with the wrong side up. A metal hem gauge was placed on the fabric in an upright position so that the cut edge of the seam would meet the markings on the gauge. To assure an accurate measurement, the gauge was read at eye level. (Figure 1.)

Six measurements for each seam were taken, three on each side of the seam with a reading taken about 1½ inches from each end and one taken at the center of the seam.

Figure 1. Measuring for seam flatness.

After the collars were made and turned, the finished edge was measured at six points starting and ending one inch from the raw edge. The gauge was set on the table so the finished edge would meet the markings. The readings were taken in a similar manner as those for the seams. These measurements were recorded in thirty-seconds of an inch.

RESULTS AND DISCUSSION

In reporting the results of this study, the physical characteristics of the as purchased fabrics will be discussed first. Then the effect of laundering on the finished and unfinished fabrics will be compared to determine how the percentage of nonfibrous material, the crease recovery angle, flatness of seams, and the percentage of dimensional change had been altered. Also, visual observations have been recorded.

Physical Characteristics. All the fabrics were a plain weave, and of weight suitable for summer dresses. The highest yarn counts were found in the percales and gingham. (Table 1.) The nubby fabric was much lower

TABLE 1 -- YARN COUNTS FOR FABRICS

Fabrics		Yarn Counts Per Inch	
		Resin Finish	Mill Finish
Plain percale	Warp	90.8	91.4
	Filling	76.4	77.8
Printed percale	Warp	87.6	88.0
	Filling	78.8	76.6
Gingham	Warp	83.2	78.8
	Filling	76.0	81.6
Nubby	Warp	52.6	57.6
	Filling	45.3	46.8

in count. There were more warp yarns than filling yarns to the inch in all the fabrics. The resin finished and mill finished percales were similar in count. There was less similarity in the count of the resin and the mill finished gingham and in the warp direction of the nubby fabric.

Percentage of Nonfibrous Material. From 4.7 to 5.3 percent of resin was found in the new resin finished fabrics (Table 2, Figure 2). Percentage losses in these fabrics were gradual after successive laundering. After twenty launderings from 3.5 to 4.4 percent resin remained.

With the exception of the gingham, much smaller percentages of nonfibrous materials were found in the mill finished fabrics. At the end of twenty launderings from 0.6 to 2.1 percent of nonfibrous material still remained. The presence of nonfibrous materials in these fabrics may be attributed to detergents, lint and other foreign substances.

TABLE 2 -- PERCENTAGE OF NONFIBROUS MATERIAL

Fabrics	Launderings	Resin Finished	Mill Finished
Plain percale	AP[1]	5.26	1.90
	1	4.83	1.28
	5	4.34	1.10
	10	4.39	1.32
	20	4.08	1.13
Printed percale	AP[1]	4.74	1.22
	1	3.80	0.76
	5	3.64	0.82
	10	3.59	0.66
	20	3.54	0.70
Gingham	AP[1]	4.66	4.23
	1	4.43	2.77
	5	4.48	1.89
	10	4.45	1.80
	20	4.32	2.08
Nubby	AP[1]	5.31	0.31
	1	5.38	0.33
	5	4.79	0.39
	10	4.78	0.34
	20	4.39	0.57

[1]As Purchased

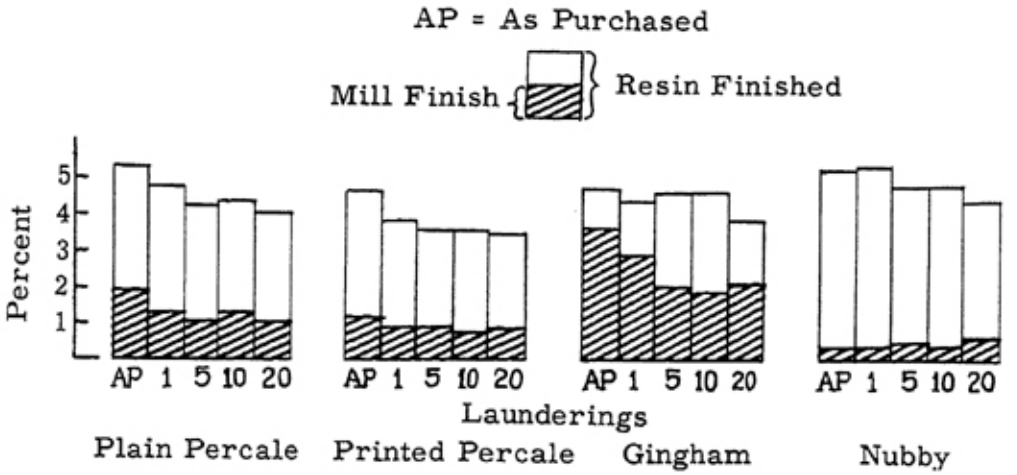

Figure 2. Percentage of nonfibrous material.

Dimensional Change. Better dimensional stability was found in all the resin finished than in the mill finished fabrics (Table 3, Figure 3). The resin finished percales had better stability than the gingham or nubby fabric; and their stability was acceptable after the twenty launderings.

Shrinkages found on the once laundered resin finished gingham and the nubby fabric were not objectionable but tended to arrive at objectionable amounts after twenty launderings.

Greater length than width shrinkages were found in all the fabrics regardless of finish with the exception of the resin finished nubby fabric. Length shrinkages in the mill finished fabrics ranged from 3.3 to 8.7 percent after twenty launderings; changes in width ranged from 3.3 percent stretch to 8.4 percent shrinkage.

TABLE 3 -- DIMENSIONAL CHANGE AFTER LAUNDERING

Fabrics	Launderings	Resin Finished		Mill Finished	
		Length	Width	Length	Width
		%	%	%	%
Plain percale	1	0.78	0.36	2.41	+1.04
	5	0.94	0.39	3.06	+1.50
	10	1.20	0.20	3.06	+2.73
	20	1.66	0.00	3.87	+1.24
Printed percale	1	0.62	0.88	2.02	1.63
	5	0.65	1.36	2.44	1.60
	10	0.91	0.98	2.77	0.48
	20	1.01	0.36	3.26	0.59
Gingham	1	1.37	0.50	5.97	4.50
	5	2.28	1.56	7.75	6.44
	10	2.47	1.97	7.93	6.81
	20	3.06	2.53	8.65	8.40
Nubby	1	1.44	2.56	3.75	+2.62
	5	1.81	3.38	5.25	+3.16
	10	1.81	4.06	5.87	+2.47
	20	2.34	4.31	6.25	+3.25

+Stretch

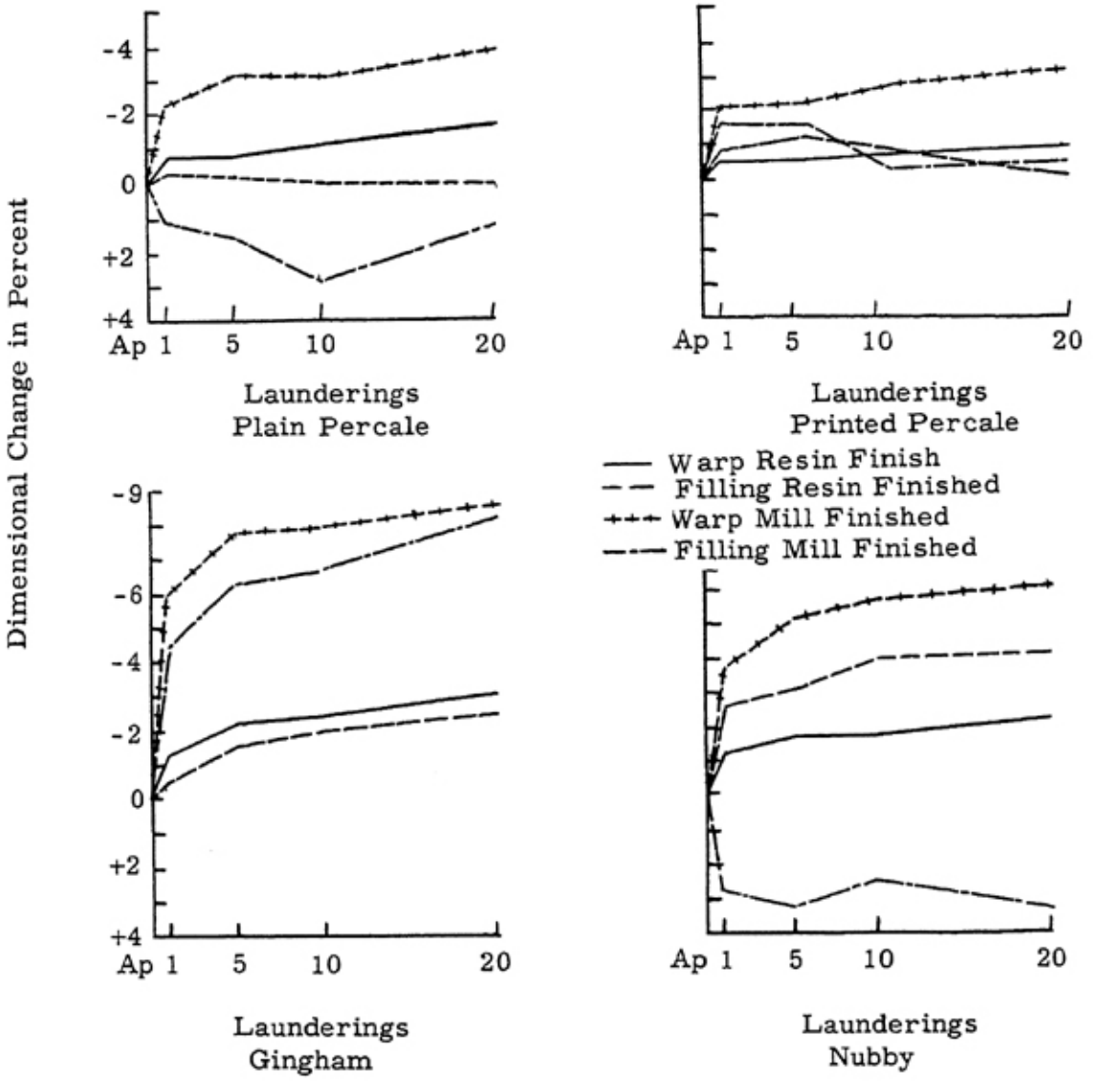

Figure 3. Dimensional change after laundering.

Perhaps the better performance of the resin finished percales was influenced by the superior construction of these fabrics.

Crease Recovery. The highest crease recovery angle and therefore the best crease resistance was obtained for the resin finished fabrics, (Table 4, Figure 4). In these fabrics the crease resistance was better crosswise than lengthwise. In three of the four fabrics the crease resistance was less after twenty launderings than that of the unlaundered fabric; in the plain percale it was approximately the same. In three of the four, the angle of recovery tended to become stationary or slightly increase after ten launderings; in the other fabric crease resistance gradually decreased.

In the mill finished fabrics crease resistance was better crosswise than lengthwise. In these fabrics, there was a tendency for crease resistance to show improvement with successive launderings.

There has been no standard set up to indicate what particular degree of recovery could be labeled "good." One study has set up a recovery of

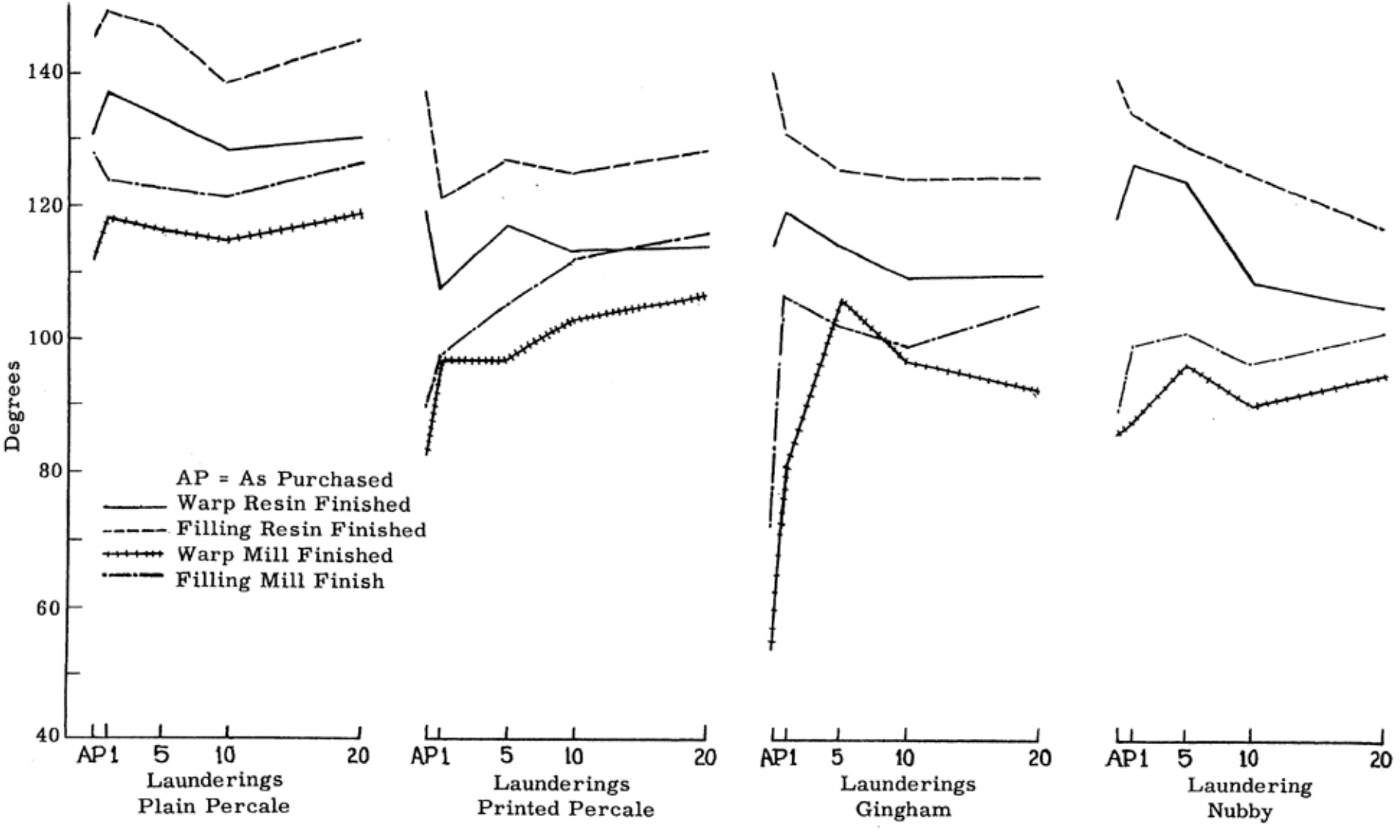

Figure 4. Crease recovery angle in degrees.

TABLE 4 -- CREASE-RECOVERY ANGLE IN DEGREES

Fabrics	Launderings	Resin Finished		Mill Finished	
		Warp	Filling	Warp	Filling
Plain percale	AP[1]	131.2	145.5	112.0	127.9
	1	137.3	149.3	117.9	123.7
	5	133.0	146.5	115.9	123.1
	10	128.2	139.4	114.9	121.5
	20	130.2	144.6	118.5	126.1
Printed percale	AP[1]	118.5	136.5	83.2	90.3
	1	107.6	121.3	96.6	97.2
	5	116.7	126.6	96.6	105.3
	10	113.3	125.1	102.6	111.9
	20	113.9	128.0	106.5	116.2
Gingham	AP[1]	114.4	139.9	54.1	71.9
	1	118.6	131.1	80.8	106.4
	5	114.2	125.0	106.1	102.0
	10	109.6	123.6	97.2	99.3
	20	109.5	123.8	92.1	105.5
Nubby	AP[1]	118.9	138.9	85.9	89.2
	1	126.3	134.2	87.6	99.2
	5	123.8	129.3	96.0	101.1
	10	109.4	124.8	89.8	96.0
	20	105.3	117.0	94.3	100.9

[1]As Purchased

100 degrees as such.[4] If this criteria were accepted the resin finished fabrics as well as the mill finished plain percale in this study could be classed as having good recovery throughout the testing intervals. The other mill finished percale reached this degree; the gingham and nubby fabric reached this degree after the twenty launderings.

Seam Flatness. The greatest difference in seam flatness between the resin finished and the mill finished fabrics was noticed in the as purchased fabrics (Tables 5 and 6, Figure 5). After the laundering intervals there was little difference in flatness between the resin finished and mill finished printed percale, gingham and nubby fabric. The seams in the plain resin finished percale approached the flatness of those on the mill finished plain percale at the twentieth laundering.

Generally, all seams were less flat after hanging for eighteen hours than after thirty minutes.

The crosswise and crosswise bias seams on the as purchased resin finished percales and nubby fabric were not as flat as the lengthwise and lengthwise bias seams on the same as purchased resin finished fabrics.

The collars followed the same general pattern as the seams. However, it must be remembered that since two layers of fabric were measured on the collars, it would be expected that the collar measurements would be somewhat larger than the seams.

Visual Observations. When preparing the materials for cutting, it was found that the threads were more difficult to pull in the resin finished

TABLE 5 -- SEAM FLATNESS MEASURED IN THIRTY-SECONDS OF AN INCH

		Plain Percale				Printed Percale			
		Resin Finished		Mill Finished		Resin Finished		Mill Finished	
Type Seam	Launderings	30 Min.	18 hrs.	30 min.	18 hrs.	30 min.	18 hrs.	30 min.	18 hrs.
Lengthwise seams	AP[1]	5.7	6.1	2.4	4.0	3.0	4.3	1.3	1.3
	1	3.1	3.9	1.4	1.7	1.1	1.5	1.0	1.0
	5	2.2	3.7	1.6	3.4	1.0	1.4	1.0	1.1
	10	1.7	1.2	1.1	1.1	1.1	1.8	1.1	1.3
	20	1.2	1.4	1.2	1.2	1.1	1.2	1.0	1.0
Lengthwise bias seams	AP[1]	4.2	4.5	1.8	2.4	3.7	4.4	2.0	1.6
	1	2.1	3.4	1.6	1.6	1.1	1.5	1.1	1.1
	5	2.6	2.9	1.4	1.7	1.1	1.1	1.0	1.0
	10	1.4	1.1	1.2	1.0	1.1	1.5	1.0	1.1
	20	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.0
Crosswise	AP[1]	7.1	7.5	2.3	3.4	5.7	6.2	1.4	2.1
	1	3.8	5.4	1.5	1.6	1.2	1.7	1.0	1.1
	5	3.9	5.2	1.7	3.3	1.3	1.9	1.0	1.0
	10	2.3	1.3	1.3	1.0	1.1	2.5	1.1	1.5
	20	1.3	1.6	1.3	1.1	1.2	1.7	1.0	1.1
Crosswise bias seams	AP[1]	6.7	8.0	2.3	3.4	5.6	7.0	1.6	2.1
	1	3.3	7.2	1.1	1.3	1.2	1.7	1.0	1.0
	5	2.1	3.5	1.1	1.6	1.3	1.4	1.0	1.0
	10	1.6	1.1	1.1	1.0	1.1	1.4	1.0	1.1
	20	1.2	1.1	1.0	1.0	1.1	1.1	1.0	1.1
Collars	AP[1]	4.3	4.1	2.8	2.6	3.4	3.6	2.2	2.2
	1	2.6	3.3	1.7	1.8	2.4	2.6	2.2	2.1
	5	2.3	2.9	1.4	1.7	2.2	2.5	1.7	1.8
	10	2.4	2.1	1.6	1.7	1.8	2.2	1.8	1.7
	20	2.3	1.9	1.7	1.8	1.8	1.9	1.7	1.7

[1]As Purchased

TABLE 6 -- SEAM FLATNESS MEASURED IN THIRTY-SECONDS OF AN INCH

		Gingham				Nubby			
		Resin Finished		Mill Finished		Resin Finished		Mill Finished	
Type Seam	Launderings	30 min.	18 hrs.	30 min.	18 hrs.	30 min.	18 hrs.	30 min.	18 hrs.
Lengthwise seams	AP[1]	3.6	4.5	2.3	2.7	6.8	9.1	2.7	2.9
	1	1.4	1.9	2.1	2.9	2.2	2.8	1.7	1.7
	5	1.1	1.3	1.6	1.9	1.3	1.8	1.2	1.3
	10	1.1	1.2	1.5	1.5	1.1	1.2	1.0	1.2
	20	1.1	1.1	1.3	1.6	1.0	1.2	1.1	1.1
Lengthwise bias seams	AP[1]	5.2	7.2	3.1	2.9	5.9	8.9	3.0	2.7
	1	1.2	1.3	1.9	2.7	1.7	2.3	1.5	1.4
	5	1.1	1.1	1.2	1.3	1.2	1.3	1.4	1.2
	10	1.0	1.1	1.2	1.2	1.1	1.2	1.1	1.2
	20	1.0	1.0	1.1	1.2	1.1	1.1	1.0	1.1
Crosswise	AP[1]	4.2	5.2	2.5	2.4	12.7	12.5	2.7	3.2
	1	1.7	2.7	3.1	2.7	5.3	7.2	1.8	1.8
	5	1.2	1.4	1.2	1.5	2.2	2.7	1.2	1.3
	10	1.1	1.2	1.1	1.2	1.2	1.4	1.0	1.2
	20	1.3	1.1	1.2	1.3	1.7	1.9	1.2	1.1
Crosswise bias seams	AP[1]	3.4	4.6	2.3	2.4	12.2	12.3	3.1	4.3
	1	1.3	2.0	1.7	2.2	4.0	5.3	1.6	1.7
	5	1.0	1.0	1.1	1.3	1.4	1.7	1.3	1.3
	10	1.0	1.1	1.1	1.1	1.3	1.3	1.1	1.1
	20	1.0	1.1	1.2	1.0	1.1	1.3	1.1	1.1
Collars	AP[1]	2.7	2.9	2.5	2.4	5.6	5.9	3.0	3.0
	1	2.2	2.2	2.4	2.4	3.8	3.8	3.1	2.7
	5	2.1	2.0	2.1	2.2	2.9	3.2	2.2	2.3
	10	2.1	2.1	2.1	2.0	2.6	2.6	2.3	2.5
	20	1.2	2.0	2.0	2.0	2.3	2.4	2.6	2.5

[1]As Purchased

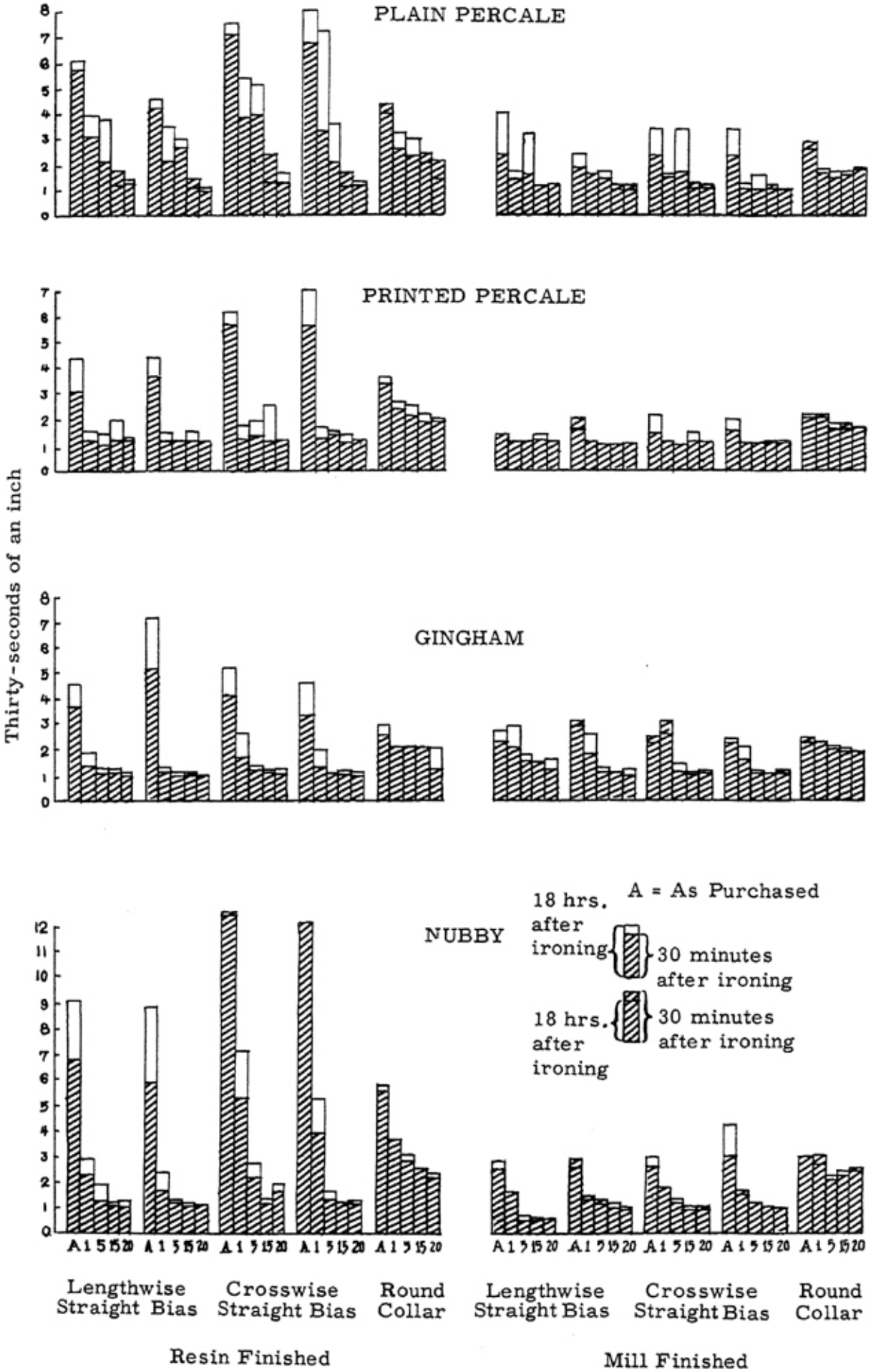

Figure 5. Seam flatness in thirty-seconds of an inch.

percales than in the mill finished. In attempting to cut these fabrics on the grain line it was found that neither the resin nor mill finished percales were true. By pulling on the bias, it was possible to straighten the mill finished fabrics, but the resin finished did not respond. The same conditions prevailed after twenty launderings.

After the first laundering, the mill finished fabrics were extremely wrinkled (Figure 6). The resin finished fabrics remained relatively unmussed throughout the experiment. Fewer ravelings occurred on the seams of these fabrics than on the seams of the mill finished.

With dampening, a greater amount and a more even distribution of moisture seemed to be present in the mill finished than in the resin finished fabrics. In spite of this, the resin finished fabrics generally ironed more easily and smoothly than did the mill finished.

After the twenty launderings, there was a greater degree of fading in the mill finished than in the resin finished percales; the resin finished nubby fabric was definitely brighter than the mill finished.

SUMMARY AND CONCLUSIONS

Two resin finished and two mill finished cotton percales, a gingham and a nubby fabric were compared before and after a series of launderings to determine changes in the percentages of nonfibrous material present, shrinkage, crease resistance and seam flatness. General observations were also made.

The percentages of resin found in the new fabrics ranged between 4.7 and 5.3. There was a gradual loss in resin during laundering, the amounts ranging from 7 to 25 percent.

The resin finished fabrics had better crease resistance than the mill finished fabrics before and after laundering, although usually the mill finished fabrics improved after laundering.

It seems reasonable to presume that the tendency to shrink and to stretch was greatly minimized by the resin treatment on the fabrics, since the study showed a greater dimensional change on the mill finished than on the resin finished fabrics. Even though this was the case, by the end of the study, two of the resin finished fabrics had shrunk enough to be somewhat undesirable.

The seams on the unlaundered resin finished fabrics were not as flat as the seams on the unlaundered mill finished fabrics. This difficulty was reduced after laundering, indicating that if one were not able to press the seams flat in a new garment made of crease resistant cotton, better success might be expected after the garment had been laundered.

The resin finished fabrics were as easy to care for as the mill finished fabrics. Their advantages were: improved crease resistance and improved dimensional stability along with decreased fraying and decreased wrinkling which naturally result from handling and laundering.

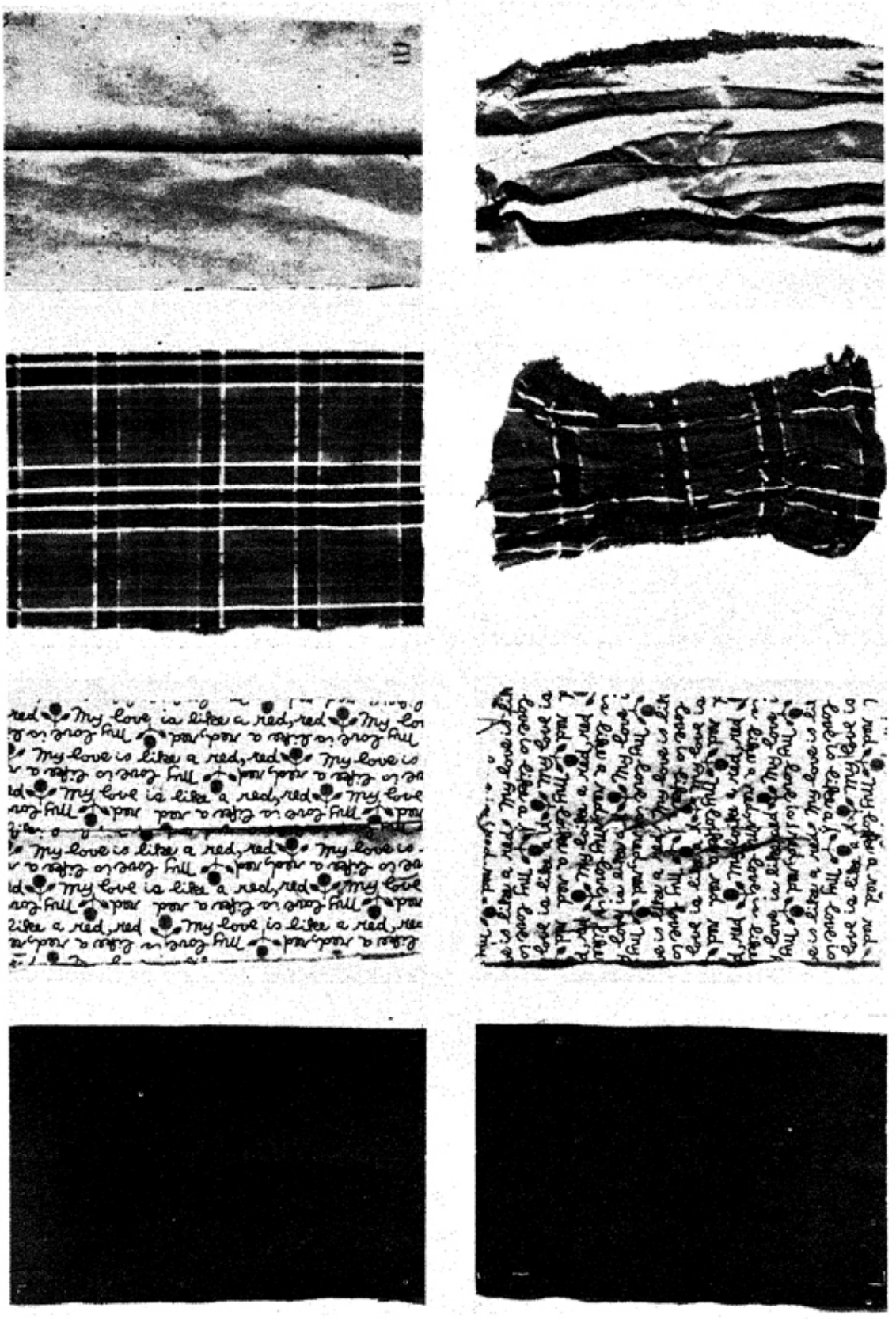

Figure 6. A comparison of resin finished (top) and mill finished (bottom) fabrics after laundering.

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