UNITED STATES DEPARTMENT OF LABOR
BULLETIN OF THE WOMEN'S BUREAU, No. 72

CONDITIONS OF WORK IN SPIN ROOMS

[PUBLIC—No. 259—66TH CONGRESS]

[H. R. 13229]

An Act To establish in the Department of Labor a bureau to be known as the Women's Bureau

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be established in the Department of Labor a bureau to be known as the Women's Bureau.

SEC. 2. That the said bureau shall be in charge of a director, a woman, to be appointed by the President, by and with the advice and consent of the Senate, who shall receive an annual compensation of $5,000. It shall be the duty of said bureau to formulate standards and policies which shall promote the welfare of wage-earning women, improve their working conditions, increase their efficiency, and advance their opportunities for profitable employment. The said bureau shall have authority to investigate and report to the said department upon all matters pertaining to the welfare of women in industry. The director of said bureau may from time to time publish the results of these investigations in such a manner and to such extent as the Secretary of Labor may prescribe.

SEC. 3. That there shall be in said bureau an assistant director, to be appointed by the Secretary of Labor, who shall receive an annual compensation of $3,500 and shall perform such duties as shall be prescribed by the director and approved by the Secretary of Labor.

SEC. 4. That there is hereby authorized to be employed by said bureau a chief clerk and such special agents, assistants, clerks, and other employees at such rates of compensation and in such numbers as Congress may from time to time provide by appropriations.

SEC. 5. That the Secretary of Labor is hereby directed to furnish sufficient quarters, office furniture, and equipment for the work of this bureau.

SEC. 6. That this act shall take effect and be in force from and after its passage.

Approved, June 5, 1920.

UNITED STATES DEPARTMENT OF LABOR
JAMES J. DAVIS, SECRETARY
WOMEN'S BUREAU
MARY ANDERSON, Director

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BY

ETHEL L. BEST

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1929

For sale by the Superintendent of Documents, Washington, D. C. - - - Price 10 cents

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BY

ETHEL L. BEST

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LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF LABOR,
WOMEN'S BUREAU,
Washington, April 22, 1929.

SIR: I have the honor to submit the accompanying two reports on the conditions of work in spin rooms.

The first report is of the effect of a change of method in a spin room on absence and turnover among women operatives and the second is of temperature readings in 15 mills.

Mrs. Ethel L. Best, industrial supervisor, conducted the field work and has written the reports.

Respectfully submitted.

MARY ANDERSON, *Director.*

Hon. JAMES J. DAVIS,
Secretary of Labor.

CONDITIONS OF WORK IN SPIN ROOMS

INTRODUCTION

In a survey of cotton mills made by the Women's Bureau in 1923, absence and turnover rates for women in the year 1922 were found to be higher in the spin rooms than in the other departments of the 18 mills studied.[1] No definite reason for this condition could be discovered, but the report considered as possible causes "conditions of work, workers who were not so efficient as those in the other departments, and too large a proportion of spares to regulars."[2] The reason last named, too large a proportion of spares to regulars, might be a result rather than a cause, since, in order that all the machines may be kept running, it is necessary to have a number of extras when there is considerable absence among the regular workers.

Conditions of work, the first of these possible causes, was selected for the purpose of measuring how far certain definite changes in conditions might result in increased or decreased absence and turnover rates. Two of the working conditions of spin rooms were chosen for study—namely, change in the method of the work and excessively high temperatures. Four mills into which a new method of operating the spinning frames had been introduced were selected for the first part of the study. For the second part of the study, temperature records of spin rooms were obtained from 15 mills. In regard to the second it was found, however, that such temperature readings could not be correlated with absence and turnover figures, since too many other factors contributed to high or low rates. Therefore, the records of the temperature readings in the spin rooms of 15 mills are given merely as a sample of temperatures under which women work in such rooms and not with the idea of showing the effect, if any, of these temperatures on absence or turnover.

[1] U. S. Department of Labor. Women's Bureau. Lost time and labor turnover in cotton mills. Bulletin 52, 1926, pp. 157 and 182.
[2] Ibid., p. 56.

PART I

THE EFFECT OF A CHANGE OF METHOD IN THE SPIN ROOM ON ABSENCE AND TURNOVER AMONG WOMEN OPERATIVES

INTRODUCTION

For more than 60 years, in fact ever since the introduction of ring spinning, tending the spinning frames has been done by spinners or machine tenders who joined the broken threads, cleaned the rolls and frames, and put in the roving.[1] With increased competition and more scientific study of the operations in a mill, the progressive manufacturer began to wonder whether the old way of running a spinning department was the most efficient or the only way. Experience has shown that in most other industries production was improved and costs were lowered when jobs were subdivided and a worker performed only one or two operations. Therefore the question arose as to whether a division of work could with profit be tried out in the cotton mill.

As a result of this, the tending of the spinning frames was divided into two jobs, one called spinning, in which the worker joined the broken threads, and one called cleaning, in which the machine was kept free from lint and the frames were kept supplied with roving. With this change the cost of production was lowered, while the product was equally satisfactory in quantity and quality. But the mill owner, considering the effect of the change on the operative, asked, "How does the worker feel about the change?"

Under the old method a spinner tended from 6 to 10 sides; under the new she tends from 12 to 20, but she has not, of course, the same number of operations to perform. Her helper or cleaner takes care of from 38 to 48 sides. The cleaner's work involves more walking than does that of the spinner, but it requires less care and skill and is not so well paid. Since cleaning is the less skilled job, a worker normally is promoted from that to spinning.

There is likely to be dissatisfaction with the new method when a worker who has been a spinner is put on cleaning. Though her earnings as a cleaner may be as high as those she earned as a spinner under the old method, her feeling of being demoted and of losing caste certainly will affect her attitude toward the new way of working. Some one trained to do cleaning and then or afterwards promoted to spinning probably would not be so dissatisfied with the work of cleaning. The very fact that it is a change would make some operatives oppose the new method, while others probably would be more than compensated by the higher pay received if they were spinners.

[1] Doffing—replacing full bobbins by empty ones as fast as they are filled—under the new as under the old method is attended to by another worker, the doffer.

On the whole, the new method seems to be satisfactory from the viewpoint of the employer, but to tell how the two methods are looked at from the workers' side is difficult. In two ways, however, some estimate may be obtained of the workers' preference in regard to the old and the new way of working. If the workers find the new occupation more fatiguing they probably will take more time away from work, and if they dislike it very much or find it extremely exhausting they will leave and look for other jobs. Thus absence and an increased turnover may indicate to some extent the attitude of the workers.

Accordingly, to obtain some idea of the workers' feelings in regard to the change of method, absence and turnover records were taken in four mills where the new method of work had been introduced in the spin rooms. Such records were taken in three mills affording comparison between a spin room where the new method was in operation and a spin room where the old method was still in use. In the fourth mill, records in the same spin room were taken at four separate periods, two when the room was operating under the old method and two after the new system had been installed. A comparison was made between spring months under the old method and spring months under the new and between winter months under the old method and winter months under the new.

It is, of course, practically impossible in a comparison of absence and turnover records to eliminate every difference between two spin rooms except that of method, but as far as possible all the known variables were considered. Only spin rooms working on the same count and quality of yarn in the same mill were compared.

In three of the four mills surveyed, figures of absence and turnover were taken not only for the spin rooms but for the other departments. The purpose of this was to see whether the same changes as in the spinning department had occurred in the other departments in the same mill and therefore might have been due to causes other than the difference in method of operation. In the fourth mill, that contained units of operation in four different buildings, all in the same locality and under the same general management, complete records were taken for the different buildings though the new method was in operation in only one spinning department.

Only one of the four mills had a regular night force, and for this figures were recorded and tabulated separately.

SUMMARY

Lost time.

A lower per cent of lost time under the new method of spinning than under the old was found in two mills.

In Mill No. III, where four spin rooms were compared, three on the old method and one on the new, lost time under the new method was greater than in two rooms and less than in one room under the old method.

The fourth mill, after eight months' experience with the new method, had more time lost than under the old system.

The night shift showed a slight decrease in absence under the new method, more marked when it had been longest in operation.

Turnover.

In two mills turnover was increased under the new method of spinning.

In the third mill, where four spin rooms were compared, the one under the new method had a higher turnover than two of the others.

In Mill No. IV turnover was much higher immediately after the installation of the new method than under the old, but it was lower under the new method than under the old after it had been in effect for eight months.

The night shift showed an increase in turnover under the new method of spinning both immediately after the change and eight months later.

ABSENCE AND TURNOVER RATES FOR FOUR MILLS

Mill No. I.

In Mill No. I, two of the five spin rooms (designated as No. 4 and No. 5) were engaged on similar work, yarn of a different quality being spun in the other three. One of the spin rooms, No. 4, was operating under the new method and had been so operating for nearly a year, but the old method was still in force in No. 5. Many of the workers remained continuously in the same spin room, but in both No. 4 and No. 5 there were other women who worked part of their time in spin rooms 1 to 3. There was, however, less of such shifting in No. 4 than in No. 5. On account of the shifting, the records of absence and turnover, taken for the first six months in 1927, have been divided into three groups: (1) Those of the women who worked in room No. 4 only; (2) those of the women who worked in No. 4 and in other rooms also; and (3) those of the women who worked in No. 5 and in rooms 1 to 3 also. Only those women who worked the major part of their time in room No. 4 or No. 5 were included in the last two groups, and of course the time worked in the other spin rooms was included in time worked, not in time lost.

TABLE 1.—*Time lost in the spin rooms of Mill No. I during a 6-month period, by spin-room group*

Spin-room group	Number of names on pay roll during period	Number of possible working days [1]	Days lost	
			Number	Per cent of possible working days
Total	64	7,009	186	2.7
Women working in room—				
No. 4 (new method) only	17	2,018	30	1.5
No. 4 and others	13	1,629	40	2.5
No. 5 and others	34	3,362	116	3.5

[1] For the period studied, the number of working days from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books.

Records of this mill were taken for the first six months of 1927 because this was a normal period in which full time was being worked and had been worked for some time.

In all the five spin rooms surprisingly little time was lost—only 186, or 2.7 per cent, of the 7,009 possible working days. During this period the proportion of lost time was lowest for the women who had worked only in spin room No. 4—the room where the new method was in operation—the figure being 1.5 per cent. The amount of time lost in the third group, room No. 5 and also rooms 1 to 3, was more than twice that lost by the workers in room No. 4. Moreover, the women who had worked in other spin rooms as well as No. 4 lost more time than did the women who had worked only in No. 4 and less time than did the women who had worked in No. 5 and other spin rooms also.

The time lost in each month of the period may be seen from Table 2. During May and June very little time was lost by any of the spin-room groups, and no absences were reported in May for the women who worked only in spin room No. 4.

TABLE 2.—*Time lost in the spin rooms of Mill No. I during a 6-month period, by spin-room group and month*

Month	Number of names on pay roll during period	Number of possible working days [1]	Per cent of possible working days los by women in—			
			All spin rooms	No. 4 (new method) only	No. 4 and others	No. 5 and others
Entire period	64	7,009	2.7	1.5	2.5	3.5
January	47	1,095	3.2	4.1	1.5	3.5
February	45	1,074	3.4	1.5	3.0	5.1
March	49	1,113	3.0	1.2	2.6	4.3
April	54	1,472	3.4	.7	3.2	5.1
May	51	1,160	1.6	----------	1.1	2.6
June	51	1,095	1.2	1.5	3.1	.3

[1] For the period studied, the number of working days from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books.

During the 6-month period, as a rule, absences were of short duration. Especially was this true for the group in room No. 4, where no woman was absent for more than six consecutive days. This room also had somewhat the best record as regards the losing of no time during the entire period.

TABLE 3.—*Number of absences of six days or less and of more than six days in the spin rooms of Mill No. I during a 6-month period, by spin-room group*

Spin-room group	Number of names on pay roll during period	Women who lost—					
		No time		6 days or less		More than 6 days	
		Number	Per cent	Number	Per cent	Number	Per cent
Total	64	23	35.9	35	54.7	6	9.4
Women working in room—							
No. 4 (new method) only	17	7	41.2	10	58.8	----------	----------
No. 4 and others	13	3	23.1	9	69.2	1	7.7
No. 5 and others	34	13	38.2	16	47.1	5	14.7

TABLE 4.—*Labor turnover in the spin rooms of Mill No. I during a 6-month period, by spin-room group and month*

Month	All spin rooms				No. 4 (new method) only				No. 4 and others				No. 5 and others			
	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]
Entire period	64	45.8	15	32.8	17	13.3	5	37.6	13	10.7	3	28.0	34	21.8	7	32.1
January	47	44.2	2	4.5	15	13.7	1	7.3	11	10.7	------	------	21	19.8	1	5.1
February	45	43.2	1	2.3	14	13.8	------	------	11	10.7	------	------	20	18.8	1	5.3
March	49	45.0	1	2.2	14	13.6	1	7.4	12	11.0	------	------	23	20.4	------	------
April	54	47.4	6	12.7	14	13.9	1	7.2	12	11.1	1	9.0	28	22.4	4	17.9
May	51	47.6	3	6.3	14	13.1	1	7.6	11	10.8	1	9.3	26	23.7	1	4.2
June	51	47.0	2	4.3	13	11.7	1	8.5	11	9.7	1	10.3	27	25.7	------	------

[1] Total days worked during the period, all employees, divided by number of days mill was in operation.
[2] Employees who left and did not return within the 6 months or who lost more than 2 weeks at end of period.
[3] Number of separations divided by average number of full-time workers, the result—the "separation rate"—being converted into the more familiar "percentage of turnover" by moving the decimal point 2 places.

Of the 17 women who worked only in spin room No. 4, 7 lost no time and 10 lost 6 days or less. In the third group—No. 5 and the other spin rooms—13 of the 34 women lost no time and 16 lost 6 days or less, but 5 lost more than 6 days. (See Table 3.)

The average number of days lost per woman in spin room No. 4 was less than 1 day (0.8). The women who worked in other rooms as well as No. 4 lost an average of 3.1 days, and those who worked in No. 5 and the other three spin rooms lost 3.4 days. Both the per cent of time lost and the average number of days lost per woman thus were greater for the group of women who had worked in room No. 5 and in the other spin rooms than for those in No. 4. Therefore, so far as absence is an index of dissatisfaction, it would appear that in this mill there was less of this feeling in the spin room operating under the new method than in the rooms operating under the old.

However, this indication of contentment with the new method is not confirmed by a study of the other measure, turnover. As may be seen from Table 4, the proportion of separations to the average number employed was higher for those who worked only in spin room No. 4 than for the workers in either of the other two groups

Since absence and turnover are conditions that might be affected by many factors, it is difficult to determine which is the better indicator of labor unrest and dissatisfaction. When, as in this case, absence is lowest and turnover is highest in the same department, the amount of dependence that may be placed on either measure is doubtful, unless confirmed by further study.

Mill No. II.

Records for a 6-month period (December of 1924 and the first five months of 1925) were taken for two sections of Mill No. II, one still operating the spin room under the old method and one that had operated for some time under the new method. The other departments in this mill were included in order that any general condition affecting the entire mill might be noted and allowed for when considering the differences between the two spin rooms in absence and turnover rates.

There were two complete units of operation under one superintendent, and to distinguish these the one with the new method of spinning will be called building 1 and the one with the old method building 2. By a comparison of absence and turnover figures in other departments as well as in the two spin rooms, more accurate information may be obtained in regard to the effect the difference in method may have had on absence and turnover rates in the spin room.

TABLE 5.—*Time lost in Mill No. II during a 6-month period, by department and building*

Department and building	Number of names on pay roll during period	Number of possible working hours [1]	Hours lost	
			Number	Per cent of possible working hours
All departments:				
Building 1	313	242,945	53,473	22.0
Building 2	222	185,100	42,038	22.7
Spinning department:				
Building 1 (new method)	214	161,875	35,743	22.1
Building 2	187	158,385	36,599	23.1
Other departments:				
Building 1	99	81,070	17,730	21.9
Building 2	35	26,715	5,439	20.4

[1] For the period studied, the number of working hours from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books. (Hours used instead of days because time worked was reported in hours.)

On reference to Table 5 it will be seen that the proportion of lost time was slightly higher in the spin room of building 2, operating under the old method, than in the spin room of building 1, operating under the new; it was 23.1 per cent in the former and 22.1 per cent in the latter. For the other departments in the two buildings, the higher rate, 21.9 per cent, was in building 1, the rate in building 2 being 20.4 per cent. The difference in absence rate between the two buildings was not great, either for the spin rooms or for the other departments. Yet the fact that the higher of the rates for the spin rooms was in the building with the old method of spinning and the higher of the rates for the other departments was in the other building would seem to point to the difference in method as having a favorable effect on absence. The large number of women employed in the two spin rooms makes these findings of considerable importance.

TABLE 6.—*Average number of hours lost per woman in Mill No. II during a 6-month period, by department and building*

Department and building	Number of names on pay roll during period	Number of possible working hours [1]	Number of hours lost	
			Total	Average per woman
All departments:				
Building 1	313	242,945	53,473	170.8
Building 2	222	185,100	42,038	189.4
Spinning department:				
Building 1 (new method)	214	161,875	35,743	167.0
Building 2	187	158,385	36,599	195.7
Other departments:				
Building 1	99	81,070	17,730	179.1
Building 2	35	26,715	5,439	155.4

[1] For the period studied, the number of working hours from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books (Hours used instead of days because time worked was reported in hours.)

The difference between the two spin rooms is shown clearly by the average number of hours lost per woman (see Table 6). Where the old method of spinning was in operation, the average of the hours lost per woman exceeded by 28.7 hours the average in the spin room with the new method. For the other departments in the two mills the opposite is true, building 1—where the new method of spinning was in force—having an average time loss per woman 23.7 hours in excess of the average in building 2.

To summarize briefly: The building with the spin room operating under the new method had less time lost in the spin room but more time lost in the other departments than had the building where the old method still was in use in the spin room.

Besides the number of hours or days lost, the proportion of women working one or more full weeks is another method of measuring steady attendance. As is shown in Table 7, the proportion of women who worked one or more full weeks was higher in the spinning department in building 1 than in building 2, the figures being, respectively, 44 and 42.4 per cent for the 26-week period. In the other departments the per cent of women working one or more full weeks was greater in building 2 than in building 1, or again the opposite of the case of the spin rooms in the two buildings, confirming the other findings and indicating that the new method of spinning was conducive to steady attendance.

TABLE 7.—*Extent to which full time was worked in Mill No. II during a 6-month period, by department and building*

Department and building	Number of employee-weeks [1]	Number and per cent of employee-weeks in which no time was lost	
		Number	Per cent
All departments:			
Building 1	4,450	1,832	40.7
Building 2	3,419	1,464	42.7
Spinning department:			
Building 1 (new method)	2,968	1,324	44.0
Building 2	2,912	1,238	42.4
Other departments:			
Building 1	1,482	508	33.9
Building 2	507	226	44.4

[1] The numbers of women on the weekly pay roll, totaled for the 26 weeks reported. The numbers ranged from 153 to 188 in building 1 and from 112 to 141 in building 2.

The percentage of turnover, or the proportion of women who left to the average number employed, was considerably greater for the spin room in building 1, operating under the new method, than for the spin room in building 2, operating under the old, as appears from Table 8.

TABLE 8.—*Labor turnover of Mill No. II during a 6-month period, by department and building*

Department and building	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]
All departments:				
Building 1	313	133.4	151	113.2
Building 2	222	100.7	85	84.4
Spinning department:				
Building 1 (new method)	214	88.8	106	119.4
Building 2	187	85.7	71	82.8
Other departments:				
Building 1	99	44.6	45	100.9
Building 2	35	15.0	14	93.3

[1] Total days worked during the period, all employees, divided by number of days mill was in operation.
[2] Employees who left and did not return within the six months or who lost more than two weeks at end of period.
[3] Number of separations divided by average number of full-time workers, the result—the "separation rate"—being converted into the more familiar "percentage of turnover" by moving the decimal point two places.

That this higher rate of turnover was due not altogether to the method of operation may be seen by the fact that in building 1 the other departments as well as the spin room had a higher rate than had those in building 2. Nevertheless, the difference was much greater between the two spin rooms than between the other departments. Also, it is significant that while three-fifths (60.2 per cent) of the same names appeared on the books in December of 1924 and in December of 1925 in spin room 2, less than two-fifths (38.3 per cent) appeared in the two periods in spin room 1. From these turnover and absence figures it would seem that the workers who adapted themselves to the new method liked it and were steady, while those who did not so adapt themselves left for other jobs. It is impossible to tell without further study whether the turnover was due to lack of adaptability or to the difficulty of the work.

Thus the figures from Mill No. I and Mill No. II give the same indications as to the results of the new method. In each mill the absence rate was lower and the turnover rate was higher in the spin room run under the new method. The cause of this condition still is undetermined. It may be that the unfit and discontented under the new method tended to be eliminated and that those remaining were a picked group and therefore steadier; or unknown causes may have been responsible. Further study is necessary, but it is significant that in two mills in which the new method was being practiced the results were similar.

Mill No. III.

Absence and turnover records were taken for a 3-month period (July, August, and September of 1924) in a mill with four buildings, each having a spinning department. Only in building 1 was the spin room operating under the new system, which had been installed some time before. A general superintendent was in charge of the entire mill, but each unit had its own superintendent and each spin room its own foreman.

The four buildings varied a great deal in their conditions, some being older than others and having lower ceilings, poorer lighting and ventilation, and less up-to-date machinery and methods. The building in which the new method of spinning was in operation not only was the largest but was fairly new and had better conditions than had any of the other units, being well equipped with all modern machines and lighting and ventilating appliances. Therefore, in a comparison of lost time and labor turnover between the spin room in this building and those in the other three, building 1 probably would have an advantage as to general conditions aside from the method of work.

The supervision being by various men, in the buildings and in the spin rooms, some effect of the differences in directing might appear. The absence and turnover records were taken, therefore, for each entire building and a comparison is made among the other departments as well as among the spin rooms. Thus it is possible to note any similarity between the rates of lost time and turnover in the spinning department and in the other departments in the same building.

The proportion of lost time to possible working time during the 3-month period is given in Table 9. In the spinning room of building 1, where the new method of spinning was in force, this was 30.8 per cent—a figure higher than that in the spin rooms of buildings 2 and 3 but lower than that in the spin room of building 4.

TABLE 9.—*Time lost in Mill No. III during a 3-month period, by department and building*

Department and building	Number of names on pay roll during period	Number of possible working hours [1]	Hours lost	
			Number	Per cent of possible working hours
Spinning department:				
Building 1 (new method)	132	63,315	19,487	30.8
Building 2	83	40,685	11,456	28.2
Building 3	32	17,615	5,009	28.4
Building 4	36	17,000	5,835	34.3
Other departments:				
Building 1	220	115,810	30,313	26.2
Building 2	86	48,550	13,307	27.4
Building 3	38	20,780	5,331	25.7
Building 4	11	5,795	1,548	26.7

[1] For the period studied, the number of working hours from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books. (Hours used instead of days because time worked was reported in hours.)

As regards time lost in the other departments, building 1 ranked next to the lowest, instead of next to the highest as it did in the spinning department. However, the differences among the absence rates in the four buildings are not great, and the somewhat wider variation in the rates of the four spin rooms can not be said to have been due to the introduction of the new method in one of these, as the rate in this was neither the highest nor the lowest.

Besides the proportion of lost time, two other sets of figures give indications of the steadiness of the workers in this mill, namely, the average amount of time lost per woman and the per cent of women working one or more full weeks during the 3-months period for which records were taken.

TABLE 10.—*Average number of hours lost per woman in Mill No. III during a 3-month period, by department and building*

Department and building	Number of names on pay roll during period	Number of hours lost	
		Total	Average per woman
Spinning department:			
Building 1 (new method)	132	19,487	147.6
Building 2	83	11,456	138.0
Building 3	32	5,009	156.5
Building 4	36	5,835	162.1
Other departments:			
Building 1	220	30,313	137.8
Building 2	86	13,307	154.7
Building 3	38	5,331	140.3
Building 4	11	1,548	140.7

In Table 10, showing average number of hours lost per woman, as well as in Table 9, showing the per cent of time lost, the spin room with the new method has neither the best nor the poorest record. The average number of hours lost per woman in building 1 is in excess of the average for building 2 but is well below the averages of the other spin rooms operating under older methods. This last statement is minimized, however, by the fact that building 1 had the fewest days lost per woman in the departments other than spinning, not affected by change of method.

TABLE 11.—*Extent to which full time was worked in Mill No. III during a 3-month period, by department and building*

Department and building	Number of employee-weeks [1]	Number and per cent of employee-weeks in which no time was lost	
		Number	Per cent
Spinning department:			
Building 1 (new method)	1,202	132	11.0
Building 2	776	115	14.8
Building 3	334	42	12.6
Building 4	323	17	5.3
Other departments:			
Building 1	2,244	349	15.6
Building 2	924	164	17.7
Building 3	398	96	24.1
Building 4	110	13	11.8

[1] The numbers of women on the weekly pay roll, totaled for the 12 weeks reported. The numbers ranged from a minimum of 31 in one building to a maximum of 303 in another.

The effect of the new method of spinning on the number of women working one or more full weeks in the period studied would seem to be slight. The proportion of full weeks worked in the spin room of building 1 was less than that in two and greater than that in the third of the spin rooms working under the old method, but the same was true of other departments beside spinning. However, since the building with the new method of spinning had not only the best working conditions but showed a lower percentage of time lost in the other departments than did buildings 2, 3, and 4, the new method

in the spin room may have been responsible for a slightly higher absence rate than that under the old method.

The labor turnover in Mill No. III is shown in Table 12. Between the spin room operating under the new method and two of those still operating in the old way, the turnover rate varied only slightly. The fourth spin room, running under the old method, had no final separations during the 3-month period. This is an unusual record for any spin room, and especially so when a comparison is made with the other three spinning departments, whose turnover rates were well over 40 per cent. In buildings 1 and 2 the rates of turnover in the other departments were considerably lower than those in the spinning departments, but the opposite was true in buildings 3 and 4.

TABLE 12.—*Labor turnover of Mill No. III during a 3-month period, by department and building*

Department and building	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]
Spinning department:				
Building 1 (new method)	132	69.6	31	44.5
Building 2	83	46.4	20	43.1
Building 3	32	20.0		
Building 4	36	17.7	8	45.2
Other departments:				
Building 1	220	135.7	48	35.4
Building 2	86	55.9	10	17.9
Building 3	38	24.5	3	12.2
Building 4	11	6.7	5	74.6

[1] Total days worked during the period, all employees, divided by number of days mill was in operation.
[2] Employees who left and did not return within the three months or who lost more than two weeks at end of period.
[3] Number of separations divided by average number of full-time workers, the result—the "separation rate"—being converted into the more familiar "percentage of turnover" by moving the decimal point two places.

As before stated, building 1, in which was located the spin room operating under the new method, was the newest and best equipped of the four buildings. Whether this would tend to decrease turnover is uncertain, but at least it is probable that it would not increase it.

In this mill as a whole, including the four buildings, no very marked showing in turnover appeared to indicate a favorable or an unfavorable effect of the new method of spinning as compared with the old. However, the mill had modifying factors to which Mills No. I and No. II were not subject, since its four separate buildings differed to some extent in conditions of work and in supervision.

Mill No. IV—Day shift.

When records in the same mill were taken for more than one period, months were selected in which general conditions were as nearly as possible alike except for the one variable—the change of method in the spin room. The same season of the year was chosen, and any period having unusual conditions, such as short time in the mill or an influenza epidemic in the village, was avoided.

In Mill No. IV the change in method of operation in the spinning department took place in April, 1926. Accordingly, absence and

turnover records were taken for May, June, and July of 1925 and of 1926—a 3-month period before the new method was installed and the same three months immediately following the change. They were taken also for December, January, and February of 1925–26 and of 1926–27—three months just before the change was made and the same three months a year later. The three months of May, June, and July immediately following the change may have less value for comparison than have the winter months, half a year later, when permanent effects are more likely to have appeared.

In any organization there may be a general condition throughout the establishment that would increase absence or turnover. Therefore, in Mill No. IV, as in two of the other mills, records were taken for the departments other than spinning in order to show whether the increase or decrease found in the spin room occurred also throughout the establishment.

In this mill, for efficiency of operation, the transfer of workers from one department to another and from one shift to another was common. About one-fifth (20.6 per cent) of the women were in a flying squad, that worked some days in one department and some days in another, sometimes on the night shift and sometimes on the day shift. This system of "extras" not only enabled the management to operate the machines continuously but gave the workers steady employment. In this study, however, it created great difficulties in tabulation. Since a change of method must be experienced over a period of time for its effects on the workers to yield results sufficient for study, the workers on the flying squad were separated from those who worked steadily in a single department and shift during the 3-month periods taken, and only the regular workers were included. Under the new method of spinning, furthermore, there was an occasional shift within the department to a different kind of work. In such cases the worker was classified for tabulation under the job held during the greater part of the period for which records were taken.

The proportion of time lost may be studied from Table 13. The loss in the spin room in the early summer of 1925, before the change of method took place, was 19.8 per cent, a little less than one-fifth of the possible working time. This was somewhat higher than the per cent of lost time in the same department a year later, immediately after the change to the new method, when 17.3 per cent of the possible working time was lost. However, if the two winter periods are compared, one in which the women worked under the old method and one after the new method had been in operation for eight months, the opposite of the early-summer findings is revealed. In the winter months, 17.3 per cent of the possible working time was lost in the spin room under the old method and 18.5 per cent under the new method.

Before making a comparison of the spin room and the other departments in regard to lost time it may be of interest to note the number of names on the pay roll in the different 3-month periods. In the two periods in early summer, although the absence rate in the spin room was only 17.3 per cent under the new method compared to 19.8 under the old, the number of names on the pay roll increased by 39.1 per cent. In the winter periods the number of names

TABLE 13.—*Time lost on the day shift of Mill No. IV during various 3-month periods—spinning and other departments*

3-month periods	All departments				Spinning department (new method in April, 1926)				Other departments			
	Number of names on pay roll during period	Number of possible working days [1]	Days lost		Number of names on pay roll during period	Number of possible working days [1]	Days lost		Number of names on pay roll during period	Number of possible working days [1]	Days lost	
			Number	Per cent of possible working days			Number	Per cent of possible working days			Number	Per cent of possible working days
May, June, and July, 1925	95	4,271	740	17.3	46	2,028	401	19.8	49	2,243	339	15.1
May, June, and July, 1926	110	3,629	667	18.4	64	1,906	329	17.3	46	1,723	338	19.6
December, 1925; January and February, 1926	64	2,697	579	21.5	37	1,277	221	17.3	27	1,420	358	25.2
December, 1926; January and February, 1927	87	3,380	598	17.7	40	1,597	296	18.5	47	1,783	302	16.9

[1] For the period studied, the number of working days from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books.

on the pay roll was only slightly greater (three women) under the new than under the old way of working, in spite of the fact that the absence rate was higher, which might necessitate more workers to operate the machines. From these facts it would appear that the result of dissatisfaction with the new method was that a good many women quit their jobs in the period immediately after the change, and that when the new system had been in effect for a number of months fewer left the department, but more time off was taken.

In other departments the proportion of lost time to possible working time was greater in the second early-summer period than in the first, but it was very much smaller in the second winter period than in the first. This was exactly the opposite of the condition in the spinning department. That the variation between the two winter periods was so much greater in the other departments than in the spin room may be explained to some extent by the closing in the earlier period of the cloth department, where the workers normally are steady; their inclusion would have reduced the proportion of absence. Furthermore, between the two winter periods there was a change of method in the weave room that resulted in a reduction in the number of its workers. Therefore, the effects of the inclusion of a steady cloth department and a reduced force in the less steady weave department are apparent in the lower absence rate in the second period.

In any study of absence it is important to know not only the proportion of lost time to possible working time but the amount of full time worked in the period reported. When only the per cent of lost time is considered, the steadiness of a majority of workers in the department may be minimized because of a few women having much absence. The table following shows, for each of the four periods taken, the per cent of full-time weeks in the spin room and in the other departments compared to the total weeks worked.

In the summer the spin room had a larger per cent of full-time weeks in the second period, when the new method of spinning was in operation, than in the first. In the winter the opposite was the case for the spin department. The first period, when the old method was in force, had a considerably higher per cent of full weeks than had the later period, under the new method. For other departments the variations in the same 3-month periods did not correspond to the differences in the spin room. Between the summer months of 1925 and those of 1926, the other departments had an increase in the proportion of full weeks worked, though this was not so great as the increase found in the spin room in this time. Between the two winter periods also the other departments had an increase in the per cent of women working full time, though the spin room experienced a marked decline in such per cent from the first period, under the old method of work, to the second period, under the new method.

TABLE 14.—*Extent to which full time was worked in Mill No. IV during various 3-month periods—spinning and other departments*

3-month periods	All departments			Spinning department (new method in April, 1926)			Other departments		
	Number of employee-weeks [1]	Number and per cent of employee-weeks in which no time was lost		Number of employee-weeks [1]	Number and per cent of employee-weeks in which no time was lost		Number of employee-weeks [1]	Number and per cent of employee-weeks in which no time was lost	
		Number	Per cent		Number	Per cent		Number	Per cent
May, June, and July, 1925	874	390	44.6	436	187	42.9	438	203	46.3
May, June, and July, 1926	764	381	49.9	393	199	50.6	371	182	49.1
December, 1925; January and February, 1926	786	424	53.9	410	231	56.3	376	193	51.3
December, 1926; January and February, 1927	782	398	50.9	369	169	45.8	413	229	55.4

[1] The numbers of women on the weekly pay roll, totaled for the 26 weeks reported. The numbers ranged from 153 to 188 in building 1 and from 112 to 141 in building 2.

In every department of the mill most of the lost time occurred in short absences of a few days or a week. The proportion of long absences in the spinning department, as may be seen from Table 15, generally was less then that in the other departments, and this was little affected by the change in method of work. Six absences of two weeks and over occurred in the first summer period, under the old method, and two in the second summer period, under the new. In the winter, the earlier period, under the old method, showed three long absences, while the later, under the new method, had four absences of two weeks or more.

TABLE 15.—*Number of absences of two weeks or more on the day shift of Mill No. IV during various 3-month periods—spinning and all departments*

3-month periods	Number of names on pay roll during period	Per cent of women in spinning department	Number of continuous absences of 2 weeks or more in—	
			All departments	Spinning department (new method in April, 1926)
May, June, and July, 1925	95	48.4	8	6
May, June, and July, 1926	110	58.2	8	2
December, 1925; January and February, 1926	64	57.8	9	3
December, 1926; January and February, 1927	87	46.0	10	4

When labor turnover is higher in one department than in another or separations are more numerous in one year than in the past years, efficient management regards it as a symptom that conditions in the mill are not as they should be and that the department or plant needs examination. Quitting, like absence, may be due largely to personal reasons. For example, in a recent cotton-mill study the women reported 70.7 per cent of the separations to be due to personal reasons.[2] Normally, personal reasons in the same group would not vary much from year to year nor, unless the composition were very different, from department to department. When there has been a change in the conditions of work in the mill, and no other known change, an increase or decrease in the labor turnover may be an indication of the workers' reaction to the new method.

Most people are so constituted that any change from accustomed ways imposed by others is unwelcome and viewed with suspicion. For this reason, a quitting of workers directly after the installation of any new system may be more or less expected. That this was the case in the spin room may be seen from Table 16, which shows a sharp rise in the separation rate, or turnover, in the early summer of 1926, immediately after the change to the new method of working. In 1925, the first summer period under consideration, the per cent of turnover was 91.7, but it was 130.6 a year later, just after the change to the new method of work.

[2] U. S. Department of Labor. Women's Bureau. Lost time and labor turnover in cotton mills. Bulletin 52, 1926, p. 194.

TABLE 16.—*Labor turnover on the day shift of Mill No. IV during various 3-month periods—spinning and other departments*

3-month periods	All departments				Spinning department (new method in April, 1926)				Other departments			
	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]
May, June, and July, 1925	95	49.7	37	74.4	46	22.9	21	91.7	49	26.8	16	59.7
May, June, and July, 1926	110	41.7	51	122.3	64	22.2	29	130.6	46	19.5	22	112.8
December, 1925; January and February, 1926	64	27.9	21	75.3	37	13.9	14	100.7	27	14.0	7	50.0
December, 1926; January and February, 1927	87	36.6	39	106.6	40	17.1	15	87.7	47	19.5	24	123.1

[1] Total days worked during the period, all employees, divided by number of days mill was in operation.
[2] Employees who left and did not return within the 3 months or who lost more than 2 weeks at end of period.
[3] Number of separations divided by average number of full-time workers, the result—the "separation rate"—being converted into the more familiar "percentage of turnover" by moving the decimal point two places.

It is true that the turnover rate increased during the same period, and to an even greater extent, in other departments, but this was largely due to the spooling department, where a new method was being tried out. For the summer groups the percentage of turnover in the other departments was 59.7 in the first period and 112.8 in the second. Omitting the spooling department, the percentage of turnover was 50.8 in the early period and 64.2 in the later—a difference markedly less than that in either the spinning or the spooling department. As would be expected, the change in method in these two departments was followed by an increase in separations rather than by a rise in the absence rate. After the new method in the spin room had been in operation for eight months the percentage of turnover was 87.7, a rate considerably lower than that for the corresponding period of the year before, under the old method (100.7).

During the periods for which these records were taken an experiment was made in the spooling department and work in the weave room was subdivided, as in the spin room, into the more skilled and the less skilled operations. Therefore, it is difficult to ascertain just how far the variations between the turnover rates in the different periods in the spinning departments were similar to those in the other departments. It would appear significant, however, that there was a marked increase in turnover directly after the installation of the new method of work and that the turnover was considerably lower several months after such change in method had been put in operation. It was in the latest period that the figures showed the lowest rate of turnover for the spinning department.

For the day shift of this mill, unlike Nos. I and II, whose absence and turnover records have been examined, it appears that after eight months' experience the absence rate was unfavorably affected and the turnover rate was favorably affected by the new method of spinning. In short, the effect of the new method of spinning is shown in two mills by the quitting of the dissatisfied and the steadier attendance of those remaining, and in one mill by fewer women leaving and more women taking time off.

Mill No. IV—Night shift.

In Mill No. IV, the only one of the mills that had a regular night shift, the night work was lighter than the day work because the women tended fewer sides at night. The night spinning, like the day, was put under the new method of operation, but each night spinner tended from 12 to 16 sides compared to the day spinner's 16 to 20. The cleaners, also, had charge of fewer sides. Although of course this resulted in less strenuous labor, it might be equally exhausting, since the night shift was 11 hours long instead of 10, the length of the day shift.

A study of Table 17 shows that the proportion of lost time to possible working time for the night workers in the spin room was less in the two periods after the change of method than in the period before the change took place.

TABLE 17.—*Time lost on the night shift of Mill No. IV during various 3-month periods—spinning and other departments*

3-month periods	All departments				Spinning department (new method in April, 1926)				Other departments			
	Number of names on pay roll during period	Number of possible working days [1]	Days lost		Number of names on pay roll during period	Number of possible working days [1]	Days lost		Number of names on pay roll during period	Number of possible working days [1]	Days lost	
			Number	Per cent of possible working days			Number	Per cent of possible working days			Number	Per cent of possible working days
May, June, and July, 1925	101	2,296	470	20.5	36	1,214	255	21.0	65	1,082	215	19.9
May, June, and July, 1926	89	2,220	506	22.8	53	1,280	255	19.9	36	940	251	26.7
December, 1925; January and February, 1926	64	2,276	419	18.4	37	1,372	266	19.4	27	904	153	16.9
December, 1926; January and February, 1927	61	2,127	350	16.5	36	1,274	227	17.8	25	853	123	14.4

[1] For the period studied, the number of working days from date an employee's name first appeared on the books to date of its last appearance, totaled for all names on the books.

On the night shift in the other departments the lost time increased considerably in the second summer period, but it declined somewhat from one winter period to the next, the latter condition coinciding with that of the spin room. Thus the change of method in the spin room on the night shift was followed by a decrease in absence in the spin room in the summer and winter periods, though other occupations on the night shift experienced an increase in the absence rate between the early summer of 1925 and the early summer of 1926.

There were fewer absences of two weeks or more on the night shift under the new than under the old method of spinning. This agrees with the generally better attendance under the new method shown in the per cent of lost time of the night workers in the spinning department.

From Table 18 it appears that there was a considerable increase in separations immediately after the change of method in the spin room, the turnover being half as much again as under the old method 12 months earlier. However, if the turnover figure eight months after the change of method is compared with that a year earlier, when the old method was in operation, it appears that the turnover was only slightly higher under the new method, the winter showing a marked decrease from the rate in the early summer, immediately after the change of method.

For the winter seasons other departments had turnover rates increasing slightly from one year to the next as did the spin-room rate, but for the summer seasons the turnover declined in other departments almost as strikingly as it increased in the spin room.

However, the second winter period, coming after the change of method had been in operation for eight months, would seem a better criterion than would the summer period directly after the new method had been installed. It would appear, therefore, that on the night shift of this mill the new method of spinning had results similar to those in Mills Nos. I and II and slightly increased the turnover but tended to reduce lost time.

TABLE 18.—*Labor turnover on the night shift of Mill No. IV during various 3-month periods—spinning and other departments*

3-month periods	All departments				Spinning department (new method in April, 1926)				Other departments			
	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]	Number of names on pay roll during period	Average number of full-time workers [1]	Number of final separations [2]	Percentage of turnover [3]
May, June, and July, 1925	101	30.4	50	164.5	36	16.0	16	100.0	65	14.4	34	236.1
May, June, and July, 1926	89	29.1	43	147.8	53	17.4	26	149.4	36	11.7	17	145.3
December, 1925; January and February, 1926	64	28.6	28	97.9	37	17.0	16	94.1	27	11.6	12	103.4
December, 1926; January and February, 1927	61	27.8	28	100.7	36	16.4	16	97.6	25	11.4	12	105.3

[1] Total days worked during the period, all employees, divided by number of days mill was in operation.
[2] Employees who left and did not return within the 3 months or who lost more than 2 weeks at end of period.
[3] Number of separations divided by average number of full-time workers, the result—the "separation rate"—being converted into the more familiar "percentage of turnover" by moving the decimal point two places.

PART II

TEMPERATURE READINGS IN 15 MILLS

INTRODUCTION

The air condition prevailing in an industry is dependent to a great extent on the processes of the industry. In places such as steel mills, glass furnaces, and laundries the processes themselves create heat problems, while in others, such as chocolate-dipping rooms, a certain temperature is necessary for the proper condition of the product. Cotton manufacturing is more nearly allied to the latter situation than to the former, for, although the many machines revolving rapidly create heat, the heat thus created must not be allowed to make the air too dry, or the electricity in the cotton will cause the thread to break. In short, a certain amount of moisture is necessary in the manufacture of cotton, and engineers, after careful study, know the best humidities for the running of the lap and thread in the carding, spinning, and weaving of cotton. However, no such exhaustive studies have been made of the effect of the heat and humidity on the worker, but the fact that it is far from beneficial has been realized. Doctor Dearden speaks of dust as a possible hazard in the early processes of cotton manufacture "just as high temperature and humidity constitute the principal menace to the health of the worker in spinning and weaving rooms." [1] Doctor Perry, in a study of preventable death in cotton mills, found that the death rate per 1,000 operatives was higher in the spin room than elsewhere in the mill and that for women operatives the death rate from tuberculosis was above the nonoperative rate to the extent of 207 per cent.[2] It is impossible to know just how far temperature conditions are responsible for the high death rate from tuberculosis, but Doctor Dearden voiced the opinion of many when he said, "I believe I am right in expressing the view that the excessive prevalence of bronchitis among cotton-mill operatives generally is mainly a matter of temperature and humidity, or rather of the influence exercised by these factors on the production of catarrhal colds." [3]

Very warm weather, especially if it is of any duration, often results in a feeling of lassitude and even exhaustion. This being true, it is not strange that "when temperatures are excessive, i. e., over 90° F., one does come across spinning-room operatives showing definite signs of fatigue, mainly, of course, toward the end of the day's work." [4] What is the effect of day after day of this heat if such fatigue may be the result of one day's work in high temperature?

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[1] Dearden, W. F. Health hazards in the cotton industry. Journal of Industrial Hygiene. October, 1927, p. 453.
[2] U. S. Department of Labor. Bureau of Labor Statistics. Preventable death in cotton manufacturing industry. Arthur Reed Perry. Bul. 251, 1919, pp. 87 and 91.
[3] Dearden, W. F. Health hazards in the cotton industry. Journal of Industrial Hygiene. October, 1927, p. 456.
[4] Ibid., p. 464.

Without doubt it is true that to some extent workers get used to the conditions under which they labor, but what such adaptation costs and to what length it can be carried are not as yet known. Ellsworth Huntington thinks such adjustment can be made only within rather narrow limits and that man "adapts himself to climate by artificial means and only slightly by changes in his own body." Furthermore, "In Florida," according to Doctor Huntington, "the cigar makers of Cuban extraction work best at a temperature only about 5° higher than that which is best for workers in New England."[5]

The problem of adjusting temperatures in cotton mills to the human as well as to the material element is one to be solved by engineers, and the imperative need for such a solution is shown by figures contained in the following pages. In this brief report no attempt has been made to suggest remedies or to give results. Here are set forth merely the various dry- and wet-bulb readings as recorded by mills sufficiently interested to keep such records. The figures accentuate the need of further studies in order to learn the effect such temperatures may have on the worker and to determine the range most efficient for both the worker and the work.

From the viewpoint of smooth-running yarn the important element in temperature is the amount of moisture in the air, and this is measured by the relative humidity. In every mill an effort is made to keep the air for ring spinning at a relative humidity of about 60 per cent. An effort is made also to keep the humidity uniform, for if fluctuation occurs the belt tension, machine speed, and thread breakage are affected and the quality of the yarn is uneven.[6] Therefore, it is to the interest of both the management and the operative that the air be moist and not too cool. Wyatt, in an English article, says "production is stimulated physically by a high temperature and a high relative humidity * * *. When, however, high temperatures are reached, the unfavorable physiological effects of the atmospheric conditions are reflected in the efficiency curves; a comparatively heavy reduction occurs toward the end of the afternoon spells, * * * under such conditions the onset of fatigue is more pronounced."[7] The attention of most mills is concentrated on the regulation as well as the range of the humidity, because when this is not done the result is directly reflected in the bad running of the work.

In relation to the worker the effect of the high temperature that frequently accompanies the desirable humidity is not given equal attention, because often the results are not so striking nor so immediately obvious. The important thing for the worker's comfort is the height of the dry-bulb register and, perhaps even more, that of the wet-bulb register. Not the relative humidity of the surrounding air but the absolute amount of water vapor it contains affects the well-being of the operative.[8]

After making an investigation in regard to the effects of atmospheric conditions on different types of work Doctor Winslow summarizes the results of certain studies as follows:

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[5] Huntington, Ellsworth. Temperature and the fate of nations. Harper's Magazine, August, 1928, pp. 364 and 365.

[6] Thompson, Albert W. Air conditioning in textile mills. Parks-Cramer Co., 1924, pp. 65 and 69.

[7] Wyatt, S. Variations in efficiency in cotton weaving. Industrial Fatigue Research Board. Report No. 23. London, 1923, p. v.

[8] Wyatt, S. The effects of atmospheric conditions on health and efficiency (with special reference to the cotton industry). Journal of Industrial Hygiene, July, 1925, p. 318.

"The experiments cited furnish very clear evidence that a temperature of 24° C. (75° F.) and still more one of 30° C. (86° F.) produces a marked disinclination to any form of physical work, even such light work as typewriting."[9]

Another authority says, "For people normally clothed, and slightly active, in still air, the most favorable temperature conditions are 68 degrees Fahrenheit on the dry-bulb and 58 degrees wet-bulb temperature. This corresponds to a relative humidity of approximately 55 per cent." He continues, "A temperature of 75 degrees dry-bulb with the usual relative humidity, or wet-bulb reading, is likely to lower one's efficiency or productivity as much as 15 per cent."[10] Of course it is possible to have both the dry and the wet bulb favorable for the workers and a relative humidity that is good for the work. However, this ideal condition is difficult of realization, especially in summer when the outside heat contributes to that generated by the machines within.

To disclose to some extent what is being achieved in heat regulation in good mills where the management is anxious to have the work run as well as possible is the object of the present study. It was observed from the data obtained that under the same climatic conditions one plant kept its heat down while in another the temperature registered very high. This proves that to some extent the heat conditions within a plant are susceptible of modification.

Since the temperature readings were copied from the mill records, no assurance can be given as to the complete accuracy of the various recording instruments. The dry-bulb readings probably were less liable to error than those of the wet bulb, because it is difficult to keep the wet-bulb covering clean and free from lint. Dust would tend to lower the readings, while they would be too high if the covering of the bulb were not kept sufficiently moist. The bureau itself could not have taken readings covering so long a period as is here reported, and since these records are depended on and used by the mills themselves they give an idea of the atmospheric conditions under which the operatives in the various spin rooms were employed.

A year's records, or as much of a year as was obtainable, and covering various periods from June of 1924 to November of 1927, according to the material, were taken for eight mills in the South and for seven mills in the North. For most of the mills complete temperature readings for a year were available. Five southern mills reported for 6 to 8 months, or even less, because the records had been destroyed or because some special condition (such as part-time operation) made the records of little value. It is probable that the lack of a complete year's records for each mill does not affect the findings to any great extent, since the totals for all mills are used as the bases for the per cents and the seasons were fairly well balanced. The mills reporting much less than a year's records gave the readings for the summer in two cases, the readings for the summer and the winter in two cases, and the readings for the autumn and the winter in one case.

[9] U. S. Department of Labor. Bureau of Labor Statistics. Effect of atmospheric conditions upon fatigue and efficiency, by C.-E. A. Winslow. Monthly Labor Review. February, 1917, p. 290.
[10] Rowe, W. A. Ventilation. The Management Review. January, 1927, pp. 6-7.

SUMMARY OF TEMPERATURE READINGS

Dry-bulb readings.

More than one-half (55 per cent) of all the readings were 75° and under 85°.

Practically five times as many readings were 85° and over as were under 75°.

The northern mills had about a third of their readings 85° and over; the southern mills had two-fifths of their readings 85° and over.

For all mills over a fourth (28.7 per cent) of the morning readings were 85° and over. In the afternoon nearly a half (46.8 per cent) were 85° and over.

In the northern mills three-tenths (30.4 per cent) of the readings in the winter months were 85° and over; in the southern mills this figure was less than a fifth (19.8 per cent).

In the summer months temperatures of 85° and over comprised 43.3 per cent of the readings in the northern mills and 75.9 per cent of those in the southern mills.

Sustained temperatures of 80° and over were reported for 33.8 per cent of the days in the northern mills and 59.6 per cent of those in the southern.

No variation or one of less than 3° is reported for 16 per cent of the days in the northern mills and for 25 per cent of the days in the southern mills.

Wet-bulb readings.

The largest group of readings in the northern mills were 70° and under 75°. The largest group of readings for southern mills were 75° and over.

In the winter months nearly a fifth (19.4 per cent) of the readings in the northern mills were 75° and over; in the southern mills 14.4 per cent were 75° and over.

In the summer months 40 per cent of the readings in the northern mills were 75° and over; in the southern mills over three-quarters (76.8 per cent) of the readings were 75° and over.

For all mills 27.2 per cent of the readings in the morning were 75° and over; 37.4 per cent of the readings in the afternoon were 75° and over.

Sustained temperatures of 76° and over occurred on 6.5 per cent of the days in the northen mills and on 21.1 per cent of the days in the southern mills.

A variation of not more than 2 degrees with a wet-bulb reading of 75° and over was reported for 21.9 per cent of the days in the northern mills and for 35.4 per cent of the days in the southern mills.

Relative humidity.

One-fourth of the relative-humidity records were 60° and under 70°. The northern mills had 18.2 per cent and the southern mills 33.3 per cent within this desirable range.

One-fifth of the temperature readings had a relative humidity of 70° or over.

DRY-BULB READINGS

The majority of the readings of the dry-bulb records in the 15 mills reporting were between 75° and 85°, and the remaining readings showed a far greater proportion at 85° and over than at less than

75°, the figures being respectively 37.3 per cent and 7.7 per cent. The per cent of the readings in each temperature group is shown in the table following.

TABLE 1.—*Dry-bulb readings, by mills North and South*

Dry-bulb reading	All mills		Northern mills		Southern mills	
	Number	Per cent	Number	Per cent	Number	Per cent
All readings	18,687	100.0	9,344	100.0	9,343	100.0
Under 75°	1,436	7.7	766	8.2	670	7.2
75° and under 85°	10,285	55.0	5,364	57.4	4,921	52.7
85° and over	6,966	37.3	3,214	34.4	3,752	40.2

Less than 10 per cent of the dry-bulb readings were under 75° and the variation between the northern and southern mills in this low-temperature group was slight. The proportion of readings in the group of 85° and over, on the other hand, was well over a third of all the readings, but when the northern and southern mills are considered separately the latter are found to have the larger per cent in this group. The difference, however, 40.2 per cent compared to 34.4 per cent, is not so great as might have been expected from the difference in climatic conditions.

The warmer southern climate is reflected in all the southern readings, which are fairly uniform whether taken in the morning or in the afternoon. In both morning and afternoon readings, the southern mills had a slightly lower proportion in the group under 75° than had the northern mills; a somewhat lower per cent than had the northern mills in the middle group, where the range was 75° and under 85°; but a larger per cent in the group 85° or more.

For both mill groups the morning showed more readings under 75° than did the afternoon. This is not surprising, though the morning readings were taken, as a rule, between 10 and 11 o'clock, for the longer the machinery runs the more heat is generated, and a number of the spin rooms were on the top floor and therefore were subject to the accumulated heat of the sun's rays.

TABLE 2.—*Morning and afternoon dry-bulb readings, by mills North and South*

Dry-bulb reading	All mills				Northern mills				Southern mills			
	Morning		Afternoon		Morning		Afternoon		Morning		Afternoon	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
All readings	9,835	100.0	8,852	100.0	4,890	100.0	4,454	100.0	4,945	100.0	4,398	100.0
Under 75°	1,037	10.5	399	4.5	541	11.1	225	5.1	496	10.0	174	4.0
75° and under 85°	5,976	60.8	4,309	48.7	3,096	63.3	2,268	50.9	2,880	58.2	2,041	46.4
85° and over	2,822	28.7	4,144	46.8	1,253	25.6	1,961	44.0	1,569	31.7	2,183	49.6

The temperature readings of mills may vary to a marked degree under much the same climatic conditions. An illustration of this may be made by a comparison of the temperature readings in two of the northern mills. In one mill, where 1,500 records were obtained, nearly one-third of the morning and almost one-fifth of the afternoon readings were under 75°, while another mill, with 1,517 records, had only 9 of the morning and 3 of the afternoon readings under 75°. The variations between mills occurred in the high-temperature as well as in the low-temperature readings. The first mill mentioned above recorded only 96 of its 1,500 readings as 85° and over, while the latter mill had more than two-thirds of its 1,517 readings in that temperature group. Apparently, the large number of high temperatures in the second mill was to some extent avoidable, since the mill was a northern one and the highest proportions were shown for the winter and spring mornings.

Naturally, the temperature within a mill varied considerably with the season of the year, and the variations were considerably greater in the group of southern mills than in the northern mills.

According to Table 3 the variation among the seasons was much the greatest in the high-temperature group, where the readings were 85° and over. The northern mills had a little less than a third of the winter readings and over two-fifths of the summer readings in this group, while the southern mills had here about a fifth of the winter and three-fourths of the summer readings. For all the mills combined, one-fourth of the winter readings and three-fifths of the summer readings were 85° or more.

TABLE 3.—*Dry-bulb readings in relation to season of the year, by mills North and South*

Season	Total number of dry-bulb readings			Per cent of readings that were—								
				Under 75°			75° and under 85°			85° and over		
	All mills	Northern mills	Southern mills	All mills	Northern mills	Southern mills	All mills	Northern mills	Southern mills	All mills	Northern mills	Southern mills
Entire year	18,687	9,344	9,343	7.7	8.2	7.2	55.0	57.4	52.7	37.3	34.4	40.2
Winter	5,633	2,565	3,068	12.5	13.3	11.8	62.9	56.2	68.4	24.6	30.4	19.8
Spring	4,352	2,565	1,787	9.0	9.3	8.4	60.1	57.8	63.3	31.0	32.9	28.2
Summer	4,467	2,118	2,349	1.3	2.4	.3	38.3	54.3	23.8	60.4	43.3	75.9
Autumn	4,235	2,096	2,139	6.7	6.4	6.9	57.1	61.5	52.9	36.1	32.1	40.2

TABLE 4.—*Morning and afternoon dry-bulb readings in relation to season of the year, by mills North and South*

Season	Total number of dry-bulb readings				Per cent of morning and afternoon readings that were—											
					Under 75°				75° and under 85°				85° and over			
	Northern mills		Southern mills		Northern mills		Southern mills		Northern mills		Southern mills		Northern mills		Southern mills	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Entire year	4,890	4,454	4,945	4,398	11.1	5.1	10.0	4.0	63.3	50.9	58.2	46.4	25.6	44.0	31.7	49.6
Winter	1,327	1,238	1,657	1,411	18.2	8.1	15.7	7.3	59.6	52.6	69.6	67.0	22.2	39.3	14.7	25.7
Spring	1,346	1,219	940	847	12.2	6.2	12.0	4.5	63.3	51.8	68.8	57.3	24.5	42.1	19.1	38.3
Summer	1,120	998	1,219	1,130	3.2	1.4	.7		63.8	43.7	32.7	14.2	33.0	54.9	66.6	85.8
Autumn	1,097	999	1,129	1,010	9.0	3.6	10.2	3.3	67.4	55.1	60.2	44.7	23.6	41.3	29.6	52.1

Table 4 shows that, according to the dry-bulb readings, there was a very marked difference between morning and afternoon temperatures in the spin rooms. During each season of the year, in the spin rooms of both northern and southern mills, the proportion of readings that were under 75° was higher in the morning than in the afternoon, when it decreased at times to one-half or a third of the early reading. The opposite is true of the group of readings of 85° and over. The lowest per cent of morning readings in the high-temperature group was for the winter months, 22.2 for the northern mills and 14.7 for the southern, but by afternoon these readings had increased to 39.3 per cent in the northern and 25.7 per cent in the southern mills. The largest per cent of the afternoon readings in the temperature group of 85° and over was 85.8 per cent for the southern spin rooms during the summer months.

It is only reasonable to suppose that these readings reflect to a great extent climatic conditions. For example, the summer months in the northern group of mills had only one-third of the morning readings and somewhat more than one-half of the afternoon readings at 85° and over, while in the southern group two-thirds of the morning readings and almost seven-eighths of the afternoon readings were in the high-temperature group.

Doctor Dearden states that Maloney's observations in India "certainly show a marked diminution in output during hot weather in all cotton processes where machines are stopped for repairing of breakages, and also that the coolest period of the day at this season provided the highest efficiency figures." [11] If, as Doctor Huntington thinks, nature is much the same everywhere, the long stretches of continuous high temperature must have some effect on production as well as on the workers. It is important to know, therefore, whether these high temperatures were merely touched or existed for a considerable period. In some of the mills only two readings were taken during the day, one in the morning and one in the afternoon, while in the other mills four readings were taken, two in the morning and two in the afternoon. Whether two or four daily readings were taken, the proportion of days on which no reading fell below certain specified temperatures is the subject of the table following.

TABLE 5.—*Per cent of days on which no dry-bulb reading fell below temperatures specified, by season and by mills North and South*

Season	Total number of days		Per cent of days on which no reading fell below—					
			76°		80°		86°	
	Northern mills	Southern mills	Northern mills	Southern mills	Northern mills	Southern mills	Northern mills	Southern mills
Entire year	4,147	4,348	64.1	81.5	33.8	59.6	6.5	18.5
Winter	1,089	1,390	51.2	70.6	22.0	37.7	4.1	5.4
Spring	1,106	835	55.4	77.6	28.1	47.1	7.1	9.7
Summer	994	1,123	81.8	97.4	50.4	88.5	10.6	40.6
Autumn	958	1,000	70.3	81.9	36.3	68.0	4.1	19.1

[11] Dearden, W. F. Health hazards in the cotton industry. Journal of Industrial Hygiene. October, 1927, p. 467.

Considering the total number of days in the southern mills for all seasons, on about three-fifths of the days the readings did not fall below 80°. In the northern mills the per cent with readings of 80° and over is not so great, but even there one-third of the days had no temperature record under 80°.

Since long periods of sustained heat are more prevalent in the South than in the North, it is natural that temperatures within the mills should reflect this condition. Nearly one-fifth (18.5 per cent) of the 4,348 days in the southern mills, compared to 6.5 per cent of the 4,147 days in the northern mills, had no temperature reading below 86°. The records for the summer months in the southern mills showed 88.5 per cent of the days with no temperature reading below 80°, and as many as 40.6 per cent of the days with no temperature reading below 86°.

Not only were there many occasions when the thermometer remained high throughout the entire day, but there were many days with little variation in temperature. If the temperatures were not excessively high this would not be an evil, but with readings of 85° and over it must contribute considerably to fatigue. In the southern mills the temperature readings had variations of less than 3 degrees or none at all for one-fourth of the days. This was a considerably higher proportion than that of the northern mills, which had 16 per cent, or one-sixth, of such days. In both northern and southern mills a small per cent of the days, 2.6 and 4.4, respectively, showed constant temperatures with no variation in the dry-bulb readings. For the northern and southern mills combined, a surprisingly large proportion of the sustained temperatures were within the higher range—about 30 per cent of the consecutive readings for a day varying not more than 2 degrees, with the lowest readings at 85° or over.

Any effects of these sustained high temperatures on the well-being of the workers can only be surmised. However, it is significant to note that in a study of lost time and labor turnover in cotton mills it was found that summer was the season with the greatest amount of lost time, for both men and women, and that labor turnover was highest in the three months of July, August, and September.[12]

WET-BULB READINGS

Wet-bulb readings give the temperatures at which evaporation takes place, and therefore they are lower than the dry-bulb readings unless the air is saturated up to the dew point; that is, 100 per cent. Many authorities consider the wet-bulb readings to be of greater importance to the comfort and health of the worker than those of the dry bulb. According to Vernon, Doctor Haldane makes the statement that in still warm air what matters to the persons present is neither the temperature of the air nor its relative saturation—but the temperature of the wet bulb. He also proposes that 75° wet bulb be taken as a permissible maximum (in weave sheds) and that during the major part of the year it should be 70°.[13] In another study the statement is made that medical evidence shows that in weave sheds a rise of mouth temperature makes itself distinctly felt when the temperature of the wet bulb exceeds 75° F.[14]

[12] U. S. Department of Labor. Women's Bureau. Lost time and labor turnover in cotton mills. Bulletin 52, 1926, pp. 57 and 112.

[13] Vernon, H. M. Industrial fatigue and efficiency. London, Routledge, 1921, p. 235.

[14] Wyatt, S. The effects of atmospheric conditions on health and efficiency (with special reference to the cotton industry). Journal of Industrial Hygiene. July, 1925, p. 328.

In the following exposition of the wet-bulb temperatures reported by mills in the present study, some allowance must be made for errors due to the cloth around the bulb becoming too dry or coated with lint and dust. Since one of these conditions would make the readings too high and the other would make them too low, they would, to some extent, offset each other. Furthermore, the large number of readings and the fact that frequently more than one reading was taken in a single room would tend to counteract the errors in some of the readings.

TABLE 6.—*Wet-bulb readings in relation to season of the year, by mills North and South*

Season	Total number of wet-bulb readings		Per cent of readings that were—					
			Under 70°		70° and under 75°		75° and over	
	Northern mills	Southern mills	Northern mills	Southern mills	Northern mills	Southern mills	Northern mills	Southern mills
Entire year	9,344	9,343	32.2	29.7	40.9	33.1	26.9	37.2
Winter	2,565	3,068	42.3	45.6	38.3	40.1	19.4	14.4
Spring	2,565	1,787	39.0	37.8	41.2	41.9	19.8	20.4
Summer	2,118	2,349	17.6	4.1	42.4	19.2	40.0	76.8
Autumn	2,096	2,139	26.5	28.2	42.0	31.1	31.5	40.7

The largest proportion of wet-bulb readings for the northern mills was in the group 70° and under 75°, while for the southern mills the largest proportion was in the division 75° and over. As would be expected, the summer months had much the largest proportion of readings in the high-temperature group (75° and over) in the southern mills—76.8 per cent, or a little over three-fourths. In the northern mills only 40 per cent of the summer readings were as high as this, but more than 42 per cent were 70° and under 75°. In the winter months the northern mills had 42.3 per cent of their readings in the low-temperature group of under 70°, while the figure for the southern mills was 45.6 per cent. It is interesting to note that the per cent of high-temperature readings in winter was lower in the southern than in the northern mills, 14.4 and 19.4, respectively.

In most cases there were considerable differences between the morning and the afternoon readings. The proportion of readings under 70° was less in the afternoons than in the mornings, and the proportion 75° and over was considerably greater in the afternoons. This was true for both northern and southern mills. The fact that the proportions of readings in the middle range, that of 70° and under 75°, were fairly similar in the mornings and afternoons, in both the North and the South, does not prove that most of the readings that started in the middle group in the morning remained so in the afternoon. Some temperatures that started under 70° in the morning shifted to the middle group in the afternoon, and some that started within the group 70° and under 75° moved into the group of 75° and over in the afternoon. Without doubt there were many cases where the few points of change allowed the readings to remain in the same five-point group. In Table 7 the highest per cent of readings in any one group was that of the summer-afternoon readings of the southern mills, when 80.5 per cent of the readings were 75° and over.

TABLE 7.—*Morning and afternoon wet-bulb readings in relation to season of the year, by mills North and South*

Season	Total number of wet-bulb readings				Per cent of morning and afternoon readings that were—											
					Under 70°				70° and under 75°				75° and over			
	Northern mills		Southern mills		Northern mills		Southern mills		Northern mills		Southern mills		Northern mills		Southern mills	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Entire year	4,890	4,454	4,945	4,398	38.9	24.9	33.4	25.5	40.2	41.6	33.1	33.1	20.9	33.4	33.5	41.5
Winter	1,327	1,238	1,657	1,411	53.9	29.9	49.7	40.8	31.7	45.4	37.6	42.9	14.4	24.7	12.7	16.3
Spring	1,346	1,219	940	847	45.6	31.7	41.4	33.8	40.0	42.6	41.1	42.7	14.4	25.8	17.6	23.5
Summer	1,120	998	1,219	1,130	20.1	14.8	5.4	2.7	48.7	35.5	21.3	16.8	31.3	49.7	73.3	80.5
Autumn	1,097	999	1,129	1,010	31.8	20.6	33.0	22.8	42.0	42.0	32.7	29.3	26.2	37.3	34.3	47.9

A condition that is continuous over a considerable period is of greater significance than one that occurs only occasionally and for short periods. This is especially true of high temperatures. Doctor Pembery and Doctor Collis, referring to the high temperatures of weaving rooms, state that "The prolonged exposure to the hot moist atmosphere would appear to be more injurious than exposure to even higher temperatures (wet-bulb) for a shorter time, and, we consider, it would be an advantage to fix the limit of the wet-bulb temperature as low as possible, after every allowance has been made for the difficulties of weaving, and the breaking of threads."[15]

The following is a brief statement of the extent to which the wet-bulb readings in the present study did not fall below certain temperatures.

TABLE 8.—*Per cent of days on which no wet-bulb reading fell below temperatures specified, by season and by mills North and South*

Season	Total number of days		Per cent of days on which no reading fell below—					
			68°		72°		76°	
	Northern mills	Southern mills	Northern mills	Southern mills	Northern mills	Southern mills	Northern mills	Southern mills
Entire year	4,147	4,348	54.3	68.8	23.9	41.6	6.5	21.1
Winter	1,089	1,390	34.4	50.3	12.4	15.6	3.5	2.0
Spring	1,106	835	43.8	59.8	15.4	28.0	3.5	5.6
Summer	994	1,123	78.3	96.2	40.2	80.0	13.0	54.7
Autumn	958	1,000	64.0	71.2	30.1	46.0	6.5	23.0

When the total number of readings for the year is considered, the marked difference between northern and southern mills may be observed. The days on which the wet-bulb readings did not fall below 76° were 1 in 15 in the northern mills and 1 in less than 5 in the southern mills. The southern mills also had the larger per cents in each of the other two groupings, days with no readings below 72° and days with no readings below 68°.

With regard to the seasons, the sustained high temperatures were more prevalent in the South than in the North with one exception, this occurring in the high-temperature group in the winter months. In this case there was a continuous temperature of 76° and over in 3.5 per cent of the days reported by northern mills and in only 2 per cent of the days reported by southern mills. The differences between northern and southern mills in the high-temperature group for the summer and autumn seasons were very great. Over one-half of the summer days in the southern mills, compared to 13 per cent, or about one-eighth, of those in the northern mills, had wet-bulb readings never falling below 75°.

Unless the temperature is a high one, the steadiness of the wet bulb around certain temperatures is not significant, but if it is high there probably is more strain than when the variation is greater. Table 9, giving the number of cases when in the same day two or more successive wet-bulb readings did not vary more than 2°, shows that of

[15] Wyatt, S. The effects of atmospheric conditions on health and efficiency (with special reference to the cotton industry). Journal of Industrial Hygiene, July, 1925, p. 328.

such cases in all mills well over one-fourth, or 28.3 per cent, had the lowest reading at 75° or over. When these cases were tabulated separately by locality, the percentages were 21.9 for the northern and 35.4 for the southern mills.

TABLE 9.—*Number of cases when in the same day two or more successive wet-bulb readings varied not more than two degrees, by season and by mills North and South*

Season	All mills			Northern mills			Southern mills		
	Total number of cases	Lowest reading was 75° or over		Total number of cases	Lowest reading was 75° or over		Total number of cases	Lowest reading was 75° or over	
		Number	Per cent		Number	Per cent		Number	Per cent
Entire year	6,295	1,783	28.3	3,311	726	21.9	2,984	1,057	35.4
Winter	1,680	245	14.6	771	149	19.3	909	96	10.6
Spring	1,455	211	14.5	918	147	16.0	537	64	11.9
Summer	1,740	860	49.4	818	223	27.3	922	637	69.1
Autumn	1,420	467	32.9	804	207	25.7	616	260	42.2

The summer months, as would be expected, had the greatest proportion of cases where the wet-bulb readings varied but little and were high. For this season, in the northern mills more than a quarter and in the southern mills more than two-thirds of the successive readings that varied but slightly were 75° or over.

Table 9 shows that in winter and spring the northern mills, rather than the southern, had the larger per cent of cases when the wet-bulb readings did not vary more than 2° and were 75° or more. Since these were not due to the outdoor temperatures, they certainly could be more easily regulated than can high temperatures that are the result of the heat of the weather combined with the heat generated in the mill.

In both the northern and the southern mills some days had no variation in the wet-bulb reading, but the per cent when this extreme steadiness occurred was small, only 4.1 in the North and 7.2 in the South. However, during the day there was no variation or there was less than 3° in nearly a fourth of the days in the northern and nearly two-fifths of the days in the southern mills.

RELATIVE HUMIDITY

The ideal humidity for cotton-spinning rooms is from 60 to 65 per cent, though the spinning runs satisfactorily with the humidity as high as 70. Most mills try to keep the relative humidity in the spin rooms within these limits and also to keep it fairly uniform, as much variation affects the processing of the work. In a recent pamphlet the evils of fluctuations in humidity were given briefly: Fluctuations in spinning-room temperature, i. e., in relative humidity, affect "belt tension, machine speeds, and power consumption; band tension, spindle speeds, and twist per inch; actual or effective draft, amount of fiber lost as fly or clearer waste, and regain. Variations in the quality and count of the yarn always follow closely any marked variation in the relative humidity."[16]

[16] Thompson, Albert W. Air conditioning in textile mills. Parks-Cramer Co., 1924, p. 69.

The humidity figures in this study, according to Table 10, show that only a quarter of the records were between 60 per cent and 70 per cent, the most desirable limits.

TABLE 10.—*Relative humidity, by mills North and South*

Relative humidity	All mills		Northern mills		Southern mills	
	Number	Per cent	Number	Per cent	Number	Per cent
All readings	18,675	100.0	9,337	100.0	9,338	100.0
Under 50 per cent	4,629	24.8	3,088	33.1	1,541	16.5
50 and under 60 per cent	5,559	29.8	2,680	28.7	2,879	30.8
60 and under 70 per cent	4,807	25.7	1,700	18.2	3,107	33.3
70 and under 80 per cent	2,453	13.1	1,010	10.8	1,443	15.5
80 and under 90 per cent	1,110	5.9	786	8.4	324	3.5
90 per cent and over	117	.7	73	.8	44	.5

This table shows that more of the cases in the southern than in the northern mills fell in the group desired, that is, 60 and under 70 per cent—one-third (33.3 per cent) in the southern mills and only 18.2 per cent in the northern mills. One-fifth of the relative-humidity records of both the northern and the southern mills were 70 per cent or above, but the high figure of 80 and over was much greater in the northern than in the southern group of mills. At the other extreme, where the relative humidity was under 50 per cent, the northern mills also showed much the higher figure. Therefore, the southern mills attained to a greater degree than did the northern the relative humidity that has been considered desirable for the proper running of the cotton in the spin rooms.

In spite of the efforts made to keep the relative humidity steady in the spin room, there were a number of days on which it showed wide variations. The figure varied 15 or more points on nearly one-sixth of the days reported for all mills. The northern mills succeeded somewhat better than did the southern mills in keeping the relative humidity fairly uniform, since in the North 14.3 per cent of the days and in the South 18.5 per cent of the days had fluctuations of 15 or more points.

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No. 2. Labor Laws for Women in Industry in Indiana. 29 pp. 1919.
No. 3. Standards for the Employment of Women in Industry. 8 pp. Third ed., 1921.
No. 4. Wages of Candy Makers in Philadelphia in 1919. 46 pp. 1919.
*No. 5. The Eight-Hour Day in Federal and State Legislation. 19 pp. 1919.
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*No. 8. Women in the Government Service. 37 pp. 1920.
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No. 16. (See Bulletin 63.)
No. 17. Women's Wages in Kansas. 104 pp. 1921.
No. 18. Health Problems of Women in Industry. 11 pp. 1921.
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