



MEDICAL RESEARCH COUNCIL.

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HEALTH RESEARCH BOARD.

Sickness amongst Operatives
in Lancashire Cotton
Spinning Mills

(with special reference to the Cardroom).

By A. BRADFORD HILL, D.Sc., Ph.D.

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HEALTH RESEARCH BOARD.

(FORMERLY THE INDUSTRIAL FATIGUE RESEARCH BOARD.)

REPORT No. 59.

Sickness amongst Operatives in Lancashire Cotton Spinning Mills

(with special reference to workers in the Cardroom).

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SICKNESS AMONGST OPERATIVES IN LANCASHIRE COTTON SPINNING MILLS

(with special reference to workers in the Cardroom).

INTRODUCTORY SUMMARY.

In a previous report dealing with sickness statistics* it was pointed out that such investigations inevitably lead to reports that are somewhat elaborate and not easy to follow. They are necessarily made up of large numbers of statistical tables and of a discussion both of the figures contained in them and of the somewhat intricate analysis by which they have been reached. On the other hand, in the opinion of the Industrial Health Research Board, all these data must be presented in full, not only as proof of the conclusions reached and for the critical consideration of any persons who are closely interested, but also because these figures may have an interest to the scientific or social worker quite apart from their bearing on the particular industrial problem under review. At the same time there are undoubtedly some persons who are interested only in the particular problem investigated, but who have neither the time nor the requisite knowledge to study an elaborate and technical report. In the previous instance referred to (Report No. 54) the Board came to the conclusion that it would be of assistance to such readers if the report was prefaced by a simple and short outline of the method of inquiry adopted and the results reached by it. It has been thought wise to repeat the procedure in the present report, and this introductory summary has been prepared for that purpose.

The problem under investigation is not a new one. For many years complaints have been made by the representatives of cotton cardroom operatives in Lancashire that these workers suffer acutely from respiratory diseases, as a result of the environment in which they have to work. These operatives are occupied with processes involved in cleaning the raw cotton, preliminary to spinning. During these cleansing processes it is asserted that a certain amount of dust and fibre is thrown into the air, some of which the operatives unavoidably inhale. In addition, in the years prior to the war a considerable amount of dust was thrown into the atmosphere while the carding machines which extract the dirt from the cotton were themselves cleaned and re-sharpened—a process known as 'stripping and grinding.' In more recent

*An Investigation into the Sickness Experience of Printers by A. Bradford Hill. *Industrial Fatigue Research Board, Report No. 54, 1929.*

years mechanical methods have been installed to remove the dust generated during stripping (by means of locally applied exhaust ventilation). The operatives believe that these improved methods have *not* solved the whole problem, but that dust and floating fibre are evolved to an extent which is injurious to health in the *carding process* (i.e. cleaning the cotton) which is continuous, as distinct from that produced during *stripping and grinding* (i.e. cleaning and re-sharpening the carding machines) which are carried out periodically during the working day. In 1927, the Home Secretary (then Sir William Joynson-Hicks) appointed a Departmental Committee to examine the question, with the following terms of reference : To enquire and report :—

- (1) whether, and if so to what extent, dust in cardrooms in the cotton industry is a cause of ill-health or disease among cardroom operatives,
- (2) if so what is the nature of such ill-health or disease,
- (3) how the sickness rates among cardroom operatives compare in these respects with those of the general population in the same locality,
- (4) what are the constituents (if any) in the dust which are particularly responsible, and
- (5) what remedies can be proposed.

Acting upon Term (3) the Departmental Committee asked the Industrial Health Research Board to carry out a statistical investigation of the sickness rates of cardroom operatives. This the Industrial Health Research Board agreed to do with one amendment. They pointed out that information concerning the general population in the same locality was not available and could not easily be secured. The Departmental Committee, therefore, agreed that the cardroom workers should be compared with other workers in the Lancashire spinning mills instead of with the general population.

Information concerning the sickness experience of various workers in the spinning mills was gathered for the five years 1923 to 1927 from the records of the Amalgamated Association of Card, Blowing and Ring-room Operatives (from the Approved Society Section administering, subject to Government control and audit, the National Health Insurance Acts*).

Of the men three main groups were formed :—

- (1) Strippers and Grinders and other Cardroom Workers—exposed according to belief to more dust than any of the other operatives.

*To which was added a small amount of information relating to females from the Amalgamated Association of Operative Spinners and the Amalgamated Weavers' Association. To the officials of these three Societies the Board are greatly indebted for the help so readily given.

- (2) Blowing-room hands and other preparatory workers—also engaged in cleaning the raw material; exposed to dust but not, according to belief, to the same extent as group (1).
- (3) Cop Packers and Warehousemen and Ring-room Workers—engaged in processes after the cleaning has been completed; exposed to relatively little dust.

These workers were first compared with respect to the amount of sickness they suffered, in the five years under review, from all kinds of illness taken together. The strippers and grinders, etc., it was found (see Table A), had slightly less sickness than the other two groups to begin with—at ages 16–19—showing that they suffer from no initial disadvantage. After age 30, on the other hand, they experienced distinctly more sickness than the workers in the ring room and warehouse, their days of sickness being 23 per cent. higher than the rate for ring-room and warehouse workers at ages 30–39, 30 per cent. higher at ages 40–49, 83 per cent. higher at ages 50–59 and 24 per cent. higher at ages 60–69. In comparison with the blowing-room workers the strippers and grinders, etc., did not show this excess of illness after age 30.

The diseases from which the workers suffer were next divided up into two groups, non-respiratory illnesses and respiratory illnesses*. It was found then that the excess of sickness from all causes of illness experienced by the strippers and grinders and other cardroom workers in comparison with the ring-room and warehouse workers, was due nearly entirely to the high rates experienced by the cardroom operatives from *respiratory* causes (see Table B). From non-respiratory causes the cardroom workers do not differ very much from the ring-room and warehouse operatives; both groups lose about the same amount of working-time from diseases of such types (except in the one age-group 50–59 which may be due to a random fluctuation in the rates which are based upon somewhat small numbers). From respiratory causes the two groups differ remarkably. Up to age 30 no striking difference is seen, *but from age 30 to 59 the cardroom workers suffer over three times as much from these causes of sickness as do the ring-room and warehouse workers and at ages 60–69 at least twice as much.* Compared with the blowing-room workers, who are also exposed to dust, no such large and consistent differences are found.

It is shown in the Report that this excess of lost-time due to respiratory diseases amongst the cardroom workers is not the result of abnormally long periods of illness suffered by these

*Respiratory causes were taken as bronchitis, bronchial catarrh, asthma, emphysema, congestion of the lungs, and pneumonia. All other diseases were taken as non-respiratory (including, for reasons given in the report, pulmonary tuberculosis).

workers, but is due to the fact that they make an excessive number of claims ascribed to these respiratory forms of illness. There are amongst them more men who have to make claims for benefit because of respiratory illness, and also more men who have to make repeated claims because of such illness.

Turning to the women workers, again three occupational groups were examined :—(1) cardroom workers, not in close contact with the carding engines, but exposed to whatever dust may be blown over from these machines to the side of the room in which these women work ; (2) ring-spinners and allied workers and (3) winders, reelers and allied workers ; neither of these groups is exposed to any large amount of dust. The last group is not an entirely satisfactory one for comparative purposes and figures for it are therefore not included in this summary. The amount of time lost from all causes of sickness amongst cardroom workers and ring-spinners is shown in Table C. (for married and single women separately since the sickness experience of these groups is shown in National Health Insurance statistics to differ widely). The cardroom workers, it will be seen, in both groups, married and single, have less sickness than the ring spinners up to age 40. At ages 40–49 the two occupational groups have approximately the same rates, while in the final age group 50–69, the cardroom workers show an excess of time lost. When this sickness is divided up into non-respiratory causes and respiratory causes (Table D) the women in the cardroom, as well as the men, are found to have some excess of the respiratory causes, amongst single women from age 25 onwards and amongst married women from age 40. On the other hand, the excess is nothing like as large as that associated with the male operatives. The men in the cardroom showed rates from respiratory diseases, after age 30, two or three times as high as those of the warehousemen and ring-room workers ; the women in the cardroom have respiratory rates more than one-and-a-half times as high as the rates of the ring-spinners (that is for single women aged 25 to 49, for married women aged 40 to 69).

These higher rates experienced by the cardroom workers of both sexes from this particular group of respiratory diseases cannot easily be explained by any other factors except working environment. On the other hand, as has already been pointed out, since 1912, when localized exhaust ventilation for stripping was being introduced, conditions in the cardroom have been materially altered. The point of obvious importance (which led to this inquiry) is whether present day conditions are such as to cause any excess of respiratory disease, as the operatives' representatives believe, or whether the excess found at the older ages is due only to the very dusty conditions in which these older operatives once worked. There is no evidence of an excess of respiratory illness amongst the younger workers who have only worked under the modern conditions (except perhaps, in the

higher rates of the single women aged 25-29). On the other hand, this is not conclusive that modern conditions do not cause respiratory illness since it may be that some years' exposure is necessary before the effect of the environment will be shown in absence from work due to illness (it must be remembered, too, that the numbers of men exposed to risk at the earlier ages are small so that their rates may be unreliable).

If this is true, that some years' exposure to dust is necessary to produce respiratory illness of the type found to be excessive amongst these older workers, then *sickness statistics* such as are here set out, cannot prove whether modern conditions are detrimental to health or not. For at present there is no body of workers who have worked only under the modern conditions for a considerable number of years. If prolonged exposure is a factor, then ten to fifteen years must elapse before there will exist such a population of operatives who have been exposed to modern conditions for sufficiently long for its effect upon their health to be seen in sickness statistics.

It seems evident that conditions in the cardroom before localized exhaust ventilation for stripping was introduced were distinctly unfavourable to health, both men and women being affected. Such extreme conditions no longer exist and it is to be hoped that the injurious effect upon health has changed with the change of environment. In the absence of positive evidence that this is so, the reduction of the operatives' exposure to dust and fibre, to the maximum extent possible, is obviously desirable.

TABLE A.

Male Operatives,—1923–27.—The Sickness (i.e. first 26 weeks of illness) experienced from ALL CAUSES of illness.

Age Group.	Strippers and Grinders and other Cardroom Workers.	Workers in the Ring-room and Warehouse.	Blowing-room and other preparatory workers and workers in both card- and blowing-room.	Strippers' and Grinders' rates as percentage of	
				Workers in the Ring-room and Warehouse.	Blowing-room workers, etc.
	<i>Number of Days of Sickness per person-year of exposure.*</i>				
16–19	4·41	4·89	4·71	90	94
20–29	4·50	4·42	3·26	102	138
30–39	4·17	3·38	5·15	123	81
40–49	5·84	4·49	6·30	130	93
50–59	10·61	5·81	10·48	183	101
60–69	20·51	16·48	16·32	124	126
Total number of persons exposed	3,165	1,661	1,115		

* The exposed to risk has to be given in this form since it is made up of so many persons exposed for the whole period and so many (entries and exits) exposed for only a part. The addition of these two gives "person-years"; in other words, 100 person-years of exposure are the equivalent of 100 persons exposed for one year, though actually they are composed of more than 100 persons exposed for varying durations, some for a whole year and some for less.

TABLE B.

Male Operatives.—1923-27.—The Sickness (i.e. first 26 weeks of illness) experienced from (1) NON-RESPIRATORY DISEASES and (2) RESPIRATORY DISEASES.

Number of Days of Sickness per person-year of exposure.

Age Group.	Strippers and Grinders and other cardroom workers.		Workers in the Ring-room and warehouse.		Blowing-room Workers and other preparatory workers.		Strippers' and Grinders' Rates as percentage of.			
	Non-Respiratory Causes	Respiratory Causes.	Non-Respiratory Causes.	Respiratory Causes.	Non-Respiratory Causes.	Respiratory Causes.	Non-Respiratory Causes.	Respiratory Causes.	Non-Respiratory Causes.	Respiratory Causes.
16-19	3.90	0.51	4.39	0.49	4.21	0.50	89	104	93	102
20-29	3.88	0.62	3.75	0.67	2.87	0.39	103	93	135	159
30-39	3.23	0.94	3.09	0.28	3.86	1.29	105	336	84	73
40-49	4.07	1.77	3.98	0.51	4.52	1.78	102	347	90	99
50-59	6.01	4.60	4.45	1.37	6.60	3.88	135	336	91	119
60-69	11.27	9.24	12.04	4.44	11.90	4.42	94	208	95	209

TABLE C.

Female Operatives.—1923–27.—The Sickness (i.e. first 26 weeks of illness) experienced from ALL CAUSES of illness.

Age Group.	Single and Widowed Women.			Married Women.		
	Cardroom workers.	Ring Spinners.	Cardroom Workers' rates as percentage of spinners.	Cardroom workers.	Ring Spinners.	Cardroom Workers' rates as percentage of spinners.
	No. of Days of Sickness per person-year of exposure.			No. of Days of Sickness per person-year of exposure.		
16-19 ..	6.47	6.80	95	—	—	—
20-24 ..	7.55	8.73	86	17.92	22.35	80
25-29 ..	6.67	8.22	81	14.60	17.07	86
30-39 ..	8.06	8.87	91	14.19	16.39	87
40-49 ..	10.24	10.39	99	14.45	14.28	101
50-69 ..	17.25	12.46	138	19.75	15.04	131
Total number of persons exposed.	13,251	3,423		9,237	2,386	

x

TABLE D.

Female Operatives.—1923–27.—The Sickness (i.e. first 26 weeks of illness) experienced from (1) NON-RESPIRATORY DISEASES and (2) RESPIRATORY DISEASES.

Number of Days of Sickness per person-year of exposure.

Age Group.	Cardroom Workers.		Ring Spinners.		Cardroom Workers' rates as percentage of ring spinners		
	Non-Respiratory Causes.	Respiratory Causes.	Non-Respiratory Causes.	Respiratory Causes.	Non-Respiratory Causes.	Respiratory Causes.	
		<i>Single and Widowed Women.</i>					
16–19 ..	5·95	0·52	6·22	0·57	96	91	
20–24 ..	6·94	0·61	8·04	0·69	86	88	
25–29 ..	6·00	0·68	7·80	0·42	77	162	
30–39 ..	7·05	1·01	8·24	0·63	86	160	
40–49 ..	8·44	1·80	9·51	0·88	89	205	
50–69 ..	12·59	4·66	8·96	3·51	141	133	
		<i>Married Women.</i>					
20–24 ..	16·72	1·20	20·68	1·67	81	72	
25–29 ..	13·53	1·07	16·02	1·05	84	102	
30–39 ..	12·87	1·32	14·94	1·45	86	91	
40–49 ..	12·08	2·37	12·90	1·38	94	172	
50–69 ..	14·35	5·40	12·15	2·88	118	188	

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(with special reference to workers in the cardroom)

BY

A. BRADFORD HILL, Ph.D., D.Sc.

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Introduction.

For a considerable number of years complaints have been made by the representatives of cotton cardroom operatives in Lancashire that these workers suffer acutely from respiratory diseases, as a result of the environment in which they have to work. In 1927 the Home Secretary (then Sir William Joynson-Hicks) appointed a Departmental Committee to examine the question, with the following terms of reference: To inquire and report:—

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- (2) if so what is the nature of such ill-health or disease,
- (3) how the sickness rates among cardroom operatives compare in these respects with those of the general population in the same locality,
- (4) what are the constituents (if any) in the dust which are particularly responsible, and
- (5) what remedies can be proposed.

Acting upon Term (3) the Departmental Committee asked the Industrial Health Research Board to carry out a statistical investigation of the sickness rates of cardroom operatives. The Industrial Health Research Board agreed to do so (the results are presented in this report) with one modification. It was pointed out that no sickness rates existed for the general population resident in the Lancashire towns involved. To obtain such figures by special inquiry would be virtually impossible. It would involve the taking, by some means, of a local census of all workers insured under the National Health Insurance Acts; the Approved Society to which each belonged would have to be ascertained; and finally the sickness history for each of these workers would have to be secured over a specified period from each of the Approved Societies involved. This would undoubtedly mean approaching at least one hundred to two hundred Societies, very few of which would have any direct interest in the investigation. Quite apart from these difficulties in organizing such a form of inquiry it was suggested that "other operatives in spinning mills" would make a better comparative group than the "general population." In comparing sickness rates it is of very considerable importance to keep in view the amount of unemployment and the wage rates of the work-people, since sickness incidence *may* be affected by either. It is not difficult to allow for these factors if the comparison is confined to different groups of cotton operatives. It is far more intricate if the scores of industries to which the general population belongs all have to be examined. In addition, in comparing the cardroom workers with operatives in

other parts of the mill the environment of each group can be studied. With the general population a very large number of industries would, possibly, have to be examined.

If the comparison could be absolutely controlled, as in a laboratory experiment, obviously the ideal would be a group of cardroom workers on the one hand, working in their normal environment, and on the other a group of workers doing precisely the same task but in an atmosphere completely free from dust and fibre. Such a comparison as this is, of course, out of the question, but it was considered that, failing this, other cotton operatives most nearly supply an adequate "control" group. It is not difficult to obtain sickness statistics for these workers since large numbers of them belong to the one or two Approved Societies attached to the Trade Unions.

The Departmental Committee agreed to this modification of the terms of reference so that the sickness rates of the cardroom operatives, discussed in this report, are examined in comparison with the rates of other operatives in spinning mills (in the same localities) and not with the rates of the general population.

APPENDIX.

THE USE OF RESPIRATORS IN THE CARDROOM.

Towards the end of 1927 the Insurance Section of the Association of Card, Blowing and Ring Room Operatives offered to supply, free of charge, a respirator to any of its members who applied for one. These respirators were made of soft vulcanised rubber shaped to fit over the nose and mouth dust-tightly, and were fitted with dry cotton disc filters to catch the dust and fibre that might otherwise be inhaled. By November, 1928, some 1,100 had been issued. When the respirator was sent to the operative applying he was asked if, after wearing it for about four weeks, he would write and state whether he felt any benefit from it. Only just over one hundred such letters were received all of which, with one exception, were definitely in favour of it and many regretted that they had not had such a device when they first began to work in the cardroom. The single exception was a man of 64 years of age who found breathing through it too difficult for him. There were a certain number of complaints, from those who thought it of value, that it made them too hot to be comfortable. It is impossible to know whether these replies are representative of the general opinion. Less than 10 per cent. of those applying for respirators made any later reply, and it may be that the more enthusiastic would tend to write and those who derived no benefit would not do so but merely cease to use it. A test has been made to see whether any benefit is shown in *recorded* sickness. The date of issue of the respirator was observed for each man and the sickness he experienced in the twelve months before issue compared with that he suffered in the twelve months after issue. Those operatives were taken to whom respirators were issued between October, 1927, and November, 1928, of whom there were 1,094 (excluding two or three who were chronically disabled at the time the respirator was sent to them and never recovered to wear it). Thus, for the whole number, the sickness in the twelve months before issue lies between October, 1926, and November, 1928, and the sickness after issue between October, 1927, and November, 1929. (In the case of exits before 12 months had elapsed *after* issue of respirator the exposure *before* issue was made of equal length with that between date of issue and date of exit). The age distribution remains the same in either case—except, of course, that in the after issue period the population is a year older. The population is too small to allow division into age groups and has therefore been used as a whole. Sickness has been divided into the two groups used throughout the report—respiratory and non-respiratory*.

* Only the sickness experience has been used. The disablement experience is obviously biased since the permanently disabled will not have applied for respirators not being at work, so that the disablement in the year before issue must be less than that in the year after; for a number of persons will become permanently disabled soon after issue and are not counterbalanced by persons permanently disabled in the year before issue.

Out of the 1,094 operatives 730 had no sickness at all over the two year period ; the remaining 364 were ill either in the first year or second year or in both, one or more times. The amount of sickness suffered was as follows :—

	In year previous to issue of respirator.		In year after issue of respirator.		Year after issue as per cent. of year before issue.	
	Non-respiratory causes.	Respiratory causes.	Non-respiratory causes.	Respiratory causes.	Non-respiratory causes.	Respiratory causes.
Days of Sickness experienced	5,384	3,546	4,701	2,977	—	—
No. of Claims made ..	203	110	186	100	—	—
Days of Sickness per person	4·9	3·2	4·3	2·7	88	84
No. of Claims per 100 persons	18·6	10·1	17·0	9·1	91	90

It will be seen that there was a fall in sickness incidence in the year after issue of the respirators but that the fall is just as great for non-respiratory causes as for respiratory causes. The days of sickness per person for non-respiratory causes are in the first year 4·9 and in the second year 4·3 ; the value in the year *after* issue is 88 per cent. of the value in the year *before* issue. For respiratory causes the second year is 84 per cent. of the first, the days per person being 3·2 and 2·7. The claims in the second year are 91 per cent. of those in the first year for non-respiratory causes, the rates being 18·6 and 17·0 per 100 persons, and 90 per cent. for respiratory causes where the rates are 10·1 and 9·1 per 100 persons. The average length of a claim was 27 days for non-respiratory causes and 32 days for respiratory causes in the first year, values which fell to 25 days and 30 days in the second year. Thus the slight fall that has taken place in the incidence of respiratory diseases since the issue of respirators does not differ significantly from the fall that has taken place in all other diseases which cannot have been affected by the introduction of the respirator. In other words this, admittedly slight, test does not show that respirators have affected the incidence of respiratory sickness. On the other hand the trial has been a short one and longer experience might show that respirators were of value—at any rate to workers whose health had not been already affected. The question is not an easy one to test since so many factors affect a sickness rate, *e.g.*, in this case the influenza epidemic of 1929 might have some influence on the results. The operatives' letters show that at least a section of them quite definitely do think their health is improved and their working-day eased by the use of some such device. Better evidence of the respirator's effect would have been supplied if this group to whom respirators were issued could have been compared with a cardroom group who never used such. To get such a population of equal age distribution would entail considerable labour and then be open to the objection that it would not be known whether these workers actually had obtained some form of respirators from other sources (as is known to have been done in some cases). For this reason the change in incidence of non-respiratory diseases was used for comparison rather than the change in incidence of both groups of diseases in another population. This test certainly lacks positive evidence of the respirators conferring benefit, but the evidence presented is too slight to be taken as conclusive.

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- No. 51.—A Study of Absenteeism in a Group of Ten Collieries.

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- No. 15.—Motion Study in Metal Polishing.

C.—TEXTILE INDUSTRIES.

- No. 7.—Individual Differences in Output in the Cotton Industry.
- No. 8.—Some Observations on Bobbing Winding.
- No. 9.—A Study of Output in Silk Weaving during the Winter Months.

† A short account of the principal practical conclusions reached up to 1924 will be found in Report No. 27 (Results of Investigations in Certain Industries) *see* p. 30.

- No. 17.—An Analysis of the Individual Differences in the Output of Silk-Weavers.
 No. 20.—A Study of Efficiency in Fine Linen Weaving.
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 No. 23.—Variations in Efficiency in Cotton Weaving.
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 *No. 49.—On the Relief of Eyestrain amongst Persons Performing very Fine Work.

D.—BOOT AND SHOE INDUSTRY.

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 *No. 35.—A Physiological Study of the Ventilation and Heating in Certain Factories.

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