



MEDICAL RESEARCH COUNCIL.

INDUSTRIAL
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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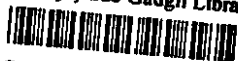
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HEALTH RESEARCH BOARD.

(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).

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

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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:—

- (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. 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.

The Occupations and Environmental Conditions of the Spinning Mill.

Before presenting the various data collected it may assist the reader unacquainted with the trade processes if a brief account is given of the operations carried out in a spinning mill. Such an account will necessarily be very elementary, many technicalities and points of detail are purposely excluded. The object is only to give the reader a broad idea of the processes and of the environment.

When the raw cotton is imported into this country it is in bales, densely compressed by hydraulic power. It is very far from clean. The "ginning" process carried out at the plantations fails to remove all the seeds from the cotton, and in addition it contains a considerable amount of dust from the soil in which the cotton plant was grown. The first procedures are, therefore, concerned with the opening out of the cotton into a loose state and the cleaning of it. The bales are opened in the *bale room* or *cotton room* by male operatives, usually termed *cotton mixers*. These workers take handfuls of cotton from a number of bales and throw them in a mixture on to a travelling lattice. The cotton is drawn by this lattice into a machine called the bale-breaker, the construction of which varies, while in some mills the cotton is thrown direct into this machine without the intervention of a lattice. Within the machine the compressed lumps of cotton are torn apart by a roller fitted with spikes, and the cotton is passed on in a looser and more open condition. From the bale-breaker it is, in some mills passed directly to the "opener," in others it is discharged into the *mixing room* or *cotton chamber*. This sometimes consists of a number of small rooms with boarded walls, but with no front, while in other cases the enclosures are complete,—large store chambers they might be termed. From the cotton chamber it is taken to the "opener." This machine may be situated in the *blowing* or *scutching room*. Loose masses of cotton from the cotton chamber are put into the opener, and are there separated still more thoroughly than was done by the bale-breaker and are further cleaned. The cotton is drawn through the machine by a strong current of air and finally emerges in the form of a "lap"—a flat sheet about three to four feet broad and about half an inch thick which is wound into a roll as it leaves the machine (the final result resembling a very large roll of "cotton wool" or wadding).

Further mixing and cleaning are carried out in this room by the "scutcher." Several laps placed upon the top of one another are drawn into the scutcher together. The cotton is still further separated and cleaned, and again emerges in the form of a lap—a lap of more even proportions and more average quality than each of those which entered the machine. The men employed in supervising these machines are termed *blowing-room operatives*,

while a *blowing-room major* is in charge. The final laps are taken off the machines and weighed by *scutcher tenters* who may be men or women, boys or girls. From the blowing-room the laps are taken by *lap carriers* to the *cardroom*. In the carding machine the cotton is separated and cleaned for the last time and at the same time the cotton fibres are drawn out into parallel lines. This is done by means of wire "cards." The machine consists of a large cylinder covered with "card-clothing"—cloth in which have been set hundreds of fine pointed steel wires (about 300 per sq. in.). Above this cylinder are a number of narrow iron bars called "flats," similarly covered with card-clothing. These flats are fastened together in an endless chain and pass slowly along the surface of the cylinder which is revolving in the same direction, but very much more rapidly. The cotton is torn from the lap by a coarse-toothed roller and passes between the cylinder and the flats. The wires separate the fibres from one another and draw them into a parallel position on the cylinder. Short fibres, dust and dirt are retained mainly by the flats and card cylinder clothing. The cleaned cotton fibres are taken from the main cylinder automatically by means of a smaller cylinder known as a "doffer" and they are removed from this by a rapidly oscillating comb, finally leaving the machine in the form of a "sliver," or narrow tape, which is coiled round and round as it emerges and passes into a can some three feet in depth. As the endless chain of flats turns over, the short fibres and dirt are combed out of the wires by an oscillating comb and fall on the front casing of the machine. During the carding process a certain amount of dust is continually given off at different points of the machine. It is necessary that a process of cleaning the wires of the cylinder and doffer, known as *stripping* and a reshaping and sharpening of the wires, known as *grinding*, be carried out at suitable intervals. Previous to about the year 1910, stripping was carried out by revolving the cylinder slowly and applying to it a rapidly revolving power-driven cylindrical wire brush. Much of the dust and fibre caught in the wires was thrown out into the air so that the men engaged in the work were enveloped in a cloud of dust. The stripping procedure is carried out two or three times a day for each carding machine. In grinding, the machine is first stripped with additional care and then a revolving cylinder covered with emery, and known as a grinding roller, is applied to the card. This cylinder has a traversing motion across the card cylinder and thus grinds down the wires to a true surface. The men employed in this work are known as *strippers and grinders*.

A report upon these methods and the resulting environmental conditions (which will be referred to again later) was made to the Chief Inspector of Factories in 1908, and led to some means being installed for the removal of the dust produced *during stripping* at its point of origin. In the majority of mills one of two methods was adopted. The stripping brush had a cover placed over it

connected with an exhaust system which draws away the dust as it is produced ; or the cylinder and doffer cylinder are cleaned by a vacuum stripper, the nozzles of which pass to and fro across the cylinder and doffer and suck out the dust and fibre. Accordingly, since about 1910, the amount of dust liberated in the cardroom has been very materially reduced.

In addition to the strippers and grinders there are employed in this part of the cardroom the *carder* who is in charge of all the processes carried on in the cardroom, and the *under-carder* who is his deputy ; *lap carriers* who bring the laps from the blowing-room to the cardroom and *card or can tenters*, usually women or girls, who remove the full cans of slivers and replace them by empty ones.

One side of the cardroom is taken up with these carding machines ; on the other (or infrequently in another room altogether) are the draw-frames and speed-frames which carry out the next processes. If the cotton is intended for fine spinning the sliver is first put through a variety of machines known as the sliver lap machine, the ribbon lap machine and the comber, the main object of which is to remove the still remaining short fibres and to secure a more uniform sliver. The object of the draw-frame is to combine a number of slivers into one so as to obtain finally a thread of uniform thickness and strength over its whole length. For instance six or eight slivers are passed through the machine and emerge as one, in which the fibres have been drawn quite parallel to one another. Six of the resulting slivers are treated in the same way on a second draw-frame and the process may be repeated a third time.

In charge of all these machines is the carder who has one or two under-carders below him, and below the latter are the strippers and grinders and "girl tenters" on the draw frames and speed frames. The final slivers from the last draw-frame pass to the adjacent speed-frames of which there may be several—"slubbing," "intermediate," and "roving" frames. On the slubbing frame the sliver is drawn out into a much finer strand (it becomes a "roving") and is wound upon a bobbin, a slight twist being given to it in the process. On the intermediate frame two rovings are drawn out and wound together, to eliminate any remaining inequalities, and a further twist is imparted. On the roving frames the same processes are repeated once more. Looking after these machines—piecing broken ends, replacing full bobbins by empty ones—are girls known by various names, *e.g.*, *slubbing tenters*, *intermediate tenters*, *roving tenters*, or in a general way as *speed-frame tenters* and their juvenile assistants, usually known as *back tenters*. These workers are, it should be noted, exposed to some extent to whatever dust is produced by the carding, stripping and grinding processes. Being normally in the same room some of the dust and fibre permeate the atmosphere which they breathe, being

driven about by the rapidly moving bands and machinery. In the cardroom are also *bobbin carriers* who take the bobbins to the lift, where the *hoistman* receives them and takes them to the *spinning rooms*. Spinning may either take the form of mule-spinning or of ring-spinning. The difference in process between the two is not of any importance here. In either case the operation, broadly speaking, is the drawing out of the roving into thread and imparting to this thread the required amount of twist. The only important difference as far as this inquiry is concerned is that mule-spinning is generally carried out by men and boys—*spinners or mule minders, piecers and creelers*—while ring-spinning is a woman's occupation. There are a certain number of men in the ring-room—the head of the room or the *ring overlooker, oilers and banders*, and *ring-room jobbers*, while there may be boys as doffers (or takers off) or bobbin carriers—but the actual spinners are women. In both kinds of spinning rooms the atmosphere may be slightly humidified artificially (by injection of steam or atomised water), and, relative to other parts of the mill, the temperature must be kept high. The final spun thread, known generally as "yarn" passes to the *warehouse* where it is packed for sale by *cop packers*. Other cops of spun thread go from the spinning room to the *winding and warping department*. Here the thread is first wound on to warper's bobbins and then on to a "beam," ready to form the warp in the weaving shed, or it may be reeled into hanks. Women are largely concerned in these processes as *winders, beamers and reelers*. The beams go finally to the *sizing room* where they are smoothed and strengthened by being passed through a boiling paste.

A spinning mill is thus divided roughly into the following departments :—

- (1) The bale room or cotton room.
- (2) The cotton chamber or mixing room.
- (3) The blowing or scutching room.
- (4) The cardroom :
 - (a) Carding section.
 - (b) Draw-frame and speed-frame section.
- (5) The mule or ring spinning room.
- (6) The winding, warping, reeling and sizing department.
- (7) The warehouse.

The bale room, the cotton chamber, the blowing-room and the carding section of the cardroom are all occupied with the opening, mixing and cleansing of the raw cotton. In all of them the operative works to some extent in an atmosphere that contains floating fibre and dust, which, according to assertion, reach their maximum in the cardroom and to which the strippers and grinders are the workers most exposed. In the draw-frame section of the cardroom the cleansing process has come to an end, but the workers at the frames are exposed, in most mills, to whatever dust may be blown across from the carding machines.

The spinning rooms are relatively free from dust and contain considerably less floating fibre, but they are in some mills artificially humidified and kept at a fairly high temperature.

The warehouse and the winding, warping and reeling departments are also relatively free from the fibre and dust liberated in the cleansing processes. In the warehouse the air is generally kept moist by some means of humidification—injection of steam or atomised water or a water surface on the floor.

The Problem to be Investigated and its History.

As mentioned in the introduction to this report the origin of this investigation is to be found in the concern of the officials of the Trade Union to which Cardroom workers belong over the health of their members. It is asserted, and has been asserted for a considerable number of years, that the dusty atmosphere in which the cardroom operatives work—and most especially the strippers and grinders—affects their health, more particularly by making them liable to or inducing bronchitic complaints.

As evidence the Amalgamated Association of Card and Blowing-room Operatives published in 1908 a pamphlet entitled "Copies of Certificates given by Medical Men shewing that the Inhalation of Dust in Cardrooms impairs the Health of the Operatives employed in them."

This pamphlet is made up of medical reports certifying that certain workers have been suffering (in most cases) from bronchitis and asthma and that in the opinion of the doctor (again in most cases) their physical condition and ill-health are the results of working in the dusty atmosphere of the cardroom. For example :

"I hereby certify that Mr. _____ (34 years of age), suffers from Chronic Bronchitis and Emphysema of some years' duration, after 19 years' work in the Cardroom of a Cotton Mill, and that in my opinion the disease is due largely to the dust amongst which he has worked."

(The names of the patients and of the qualified medical practitioners signing the certificates are given in the original report.)

Such complaints led the Chief Inspector of Factories in 1908 to appoint Dr. (now Professor) E. L. Collis to make some investigation of the condition of workers in the Cardroom. Professor Collis examined 126 men employed as strippers and grinders in Blackburn mills, and concluded that 93 of them, or 74 per cent., had had their health affected by the inhalation of dust. Describing the condition of the sufferer he says "the man loses flesh and any fresh colour he may have had. Consequently he becomes thin in the face and body. As the chest trouble develops into a typical form of asthma, the action of the diaphragm becomes less and less

effective, until the only action of this great respiratory muscle is to fix the lower ribs; at the same time the superior intercostal muscles are being brought more and more into use, and the extraordinary muscles of respiration are more and more called into play to carry on the ordinary act of breathing. The sternum becomes more prominent and the chest becomes barrel-shaped. Meanwhile, the extra tax thrown on the lungs leads to some degree of emphysema. There is little or no sputum produced, and what little there is is expectorated with difficulty. It is not infrequently stained with blood, but I only found doubtful physical signs of phthisis in one case who so complained. The practice of opening the bedroom window at night, even in winter (an unusual habit with these men), indicates the difficulty in breathing which is experienced by them at this stage."* Professor Collis did not suggest that the dust given off in the ordinary processes of carding, *i.e.*, in cleaning the lap of cotton, was injurious, but urged that that produced in stripping, *i.e.*, cleaning the wires of the carding engine after some use, must be removed by exhaust ventilation. His conclusion was that "there is no doubt that if this principle of ventilation is carried out in all the mills, that grinders' and strippers' asthma will cease to exist except among the irreparably damaged old hands." As has already been mentioned stripping with localized exhaust ventilation or by vacuum has become the practice in all mills; such methods had been agreed to by the industry by the end of 1912 and were thereafter gradually adopted.† The operatives believe that these improved methods have *not* solved the whole problem but that dust and floating fibre are evolved in the carding process, as distinct from those of stripping and grinding, to an extent which is injurious to health. Before turning to the results of the present investigation, designed to test, if possible, this belief, it will be of value to examine the evidence offered by the occupational death rates published by the Registrar-General.

Occupational Death Rates in the Cotton Industry.

In the Registrar-General's reports occupational death rates are given for men only. In the latest report—that relating to deaths in 1921–23—six occupational groups are given: cotton blow-room operatives; cotton card and frame (not spinning frame) tenters; cotton strippers and grinders and cardroom jobbers; cotton spinners and piecers; cotton doublers, winders, warpers, beamers, etc.; and cotton weavers. Using the information given for these groups Table I has been compiled.

* Annual Report of the Chief Inspector of Factories for 1908, pp. 203–205.

† Vide the Departmental Committee's report for further evidence on this point.

Occupational Death Rates, 1921-23. Cotton Operatives.

Turning to Table I. it will be seen that from *all causes of death less respiratory diseases* strippers and grinders have somewhat lower rates than any of the other groups up to the age group 45-55, (excluding the age group 16-20 which is based upon very few deaths). From 45 to 65 years of age they die at approximately the same rate, and after age 65 they die somewhat faster. When compared with spinners and piecers the difference in death rates from diseases of the *respiratory system* is very distinct. For 1921-23 the stripper's and grinder's death rates from this group of diseases after age 35 are 1.50, 5.15, 15.97, 28.49 and 103.03, while the corresponding rates for the spinners and piecers are only 1.08, 2.20, 6.10, 15.55 and 42.07—some-where about half the height. The blowing-room operatives both from respiratory diseases and from all other causes die faster than the strippers and grinders up till middle age but at a slower rate after that. Cotton card and frame tenters have, except in early life, higher rates than the spinners both from respiratory diseases and from all other causes. Though their general death rates are as a rule higher than those of the strippers and grinders, their death rates from respiratory diseases are somewhat lower.

Occupational Death Rates, 1921-23. Cotton Operatives and all Workers in England and Wales.

As well as comparing these different groups of workers together it is possible to compare them with all workers (occupied and retired) in England and Wales. This is done in Table II using the Registrar-General's Comparative Mortality Figures for 1921-23. The comparative mortality figure is a standardized death rate, a device for making comparable two or more death rates when the populations concerned have differing age constitutions. Mortality being closely connected with age, allowance has to be made for this factor. Obviously an occupation employing old persons will have a higher death rate than a similar one employing young persons. Unless the age difference is taken into account the difference in mortality conveys nothing. Table II thus states that the comparative mortality figure from all causes of death for all occupied and retired civilian males is 1,000; if the death rates at ages actually found to prevail amongst strippers and grinders are applied to this standard population their comparative mortality figure from all causes of death is found to be 1,396. These two figures are directly comparable, the differences in the age constitution of the population of strippers and grinders and the population of all males having been eliminated.*

* For definition, choice of standard population and method employed *vide* the Decennial Supplement, Registrar-General of England and Wales 1921, Part II.

TABLE I.—The deaths and death-rates of Cotton Operatives in 1921–23. (Figures compiled from the Registrar-General's Decennial Supplement, Part II, 1921).

Age.	16—	20—	25—	35—	45—	55—	65—	70 and up.	
	Population.*								
Strippers and grinders**	756	1,818	5,076	3,999	2,721	1,440	351	165	
Blowing-room operatives	840	1,131	1,995	1,929	1,866	1,245	318	171	
Cotton card and frame tenters	1,992	1,206	2,604	3,087	2,472	1,251	426	306	
Cotton spinners and piecers	27,378	18,801	27,603	23,061	18,174	11,154	2,379	2,163	
Deaths from all causes less bronchitis, pneumonia, chronic interstitial pneumonia, and other diseases of the respiratory system.									
Strippers and grinders	3	3	10	17	33	46	33	33	
Blowing-room operatives	4	5	7	18	24	35	19	29	
Cotton card and frame tenters	2	3	14	23	37	45	20	62	
Cotton spinners and piecers	68	72	96	126	203	361	162	381	
Deaths from bronchitis, pneumonia, chronic interstitial pneumonia and other diseases of the respiratory system.									
Strippers and grinders	—	1	4	6	14	23	10	17	
Blowing-room operatives	—	2	2	3	10	12	4	9	
Cotton card and frame tenters	—	—	2	7	4	16	10	18	
Cotton spinners and piecers	9	9	12	25	40	68	37	91	
Death-rate per 1,000 from all causes of death less bronchitis, pneumonia, chronic interstitial pneumonia and other diseases of the respiratory system.									
Strippers and grinders	3.97	1.65	1.97	4.25	12.13	31.94	94.02	200.00	
Blowing-room operatives	4.76	4.42	3.51	9.33	12.86	28.11	59.75	169.59	
Cotton card and frame tenters	1.00	2.49	5.38	7.45	14.97	35.97	46.95	202.61	
Cotton spinners and piecers	2.48	3.83	3.48	5.46	11.17	32.37	68.10	176.14	
Death-rate per 1,000 from bronchitis, pneumonia, chronic interstitial pneumonia, and other diseases of the respiratory system.									
Strippers and grinders	—	.55	.79	1.50	5.15	15.97	28.49	103.03	
Blowing-room operatives	—	1.77	1.00	1.56	5.36	9.64	12.58	52.63	
Cotton card and frame tenters	—	—	.77	2.27	1.62	12.79	23.47	58.82	
Cotton spinners and piecers .. ..	.33	.48	.43	1.08	2.20	6.10	15.55	42.07

* Census population in 1921 multiplied by 3 to correspond with the 3 years of deaths.

** Groups 55, 51, 53 and 56 in Registrar-General's Supplement. The occupational groups and titles are those adopted by the Registrar-General.

Table II shows that all the groups of cotton operatives have higher comparative mortalities from all causes of death than do all occupied and retired males in England and Wales. The spinners show the least disadvantage, and the blowing-room operatives and the card and frame tenters the greatest. From respiratory tuberculosis both strippers and grinders and blowing-room operatives die at a lower rate than do all males; spinners and card and frame tenters are approximately on a par with all males. For diseases of the respiratory system the rates bear the following relationships to that for all males: strippers and grinders, nearly 3 times as high; blowing-room operatives, nearly two and a half times as high; card and frame tenters, twice as high; spinners and piecers, one and a quarter times as high. For bronchitis the relationships of the death rates are: strippers and grinders, over five and a half times as high as all males; blowing-room operatives, three times as high; card and frame tenters and spinners, approximately one and a half times as high. From pneumonia the strippers and grinders have a rate about one and a half times as high as the rate for all males, while the rates for blowing-room and card and frame tenters are over twice as high, and spinners show only a slight excess. The general conclusion is that from diseases of the respiratory system grouped together and from bronchitis separately strippers and grinders have a very heavy mortality in comparison with the general male population (occupied and retired) of England and Wales, that blowing-room operatives also suffer heavily from these causes of death but less severely than the strippers and grinders, that card and frame tenters and spinners and piecers show some excess but, especially for the spinners, the difference is far less distinct than it is for the first two occupational groups.

TABLE II.—Standardized mortality (comparative mortality figures) of Males aged 20–65 years employed in the Cotton Industry, from all causes and from causes connected with the respiratory system, compared with that of all Occupied and Retired civilian males taken as 1,000. 1921–23.*

	All Causes (including Respiratory diseases).	Respiratory Tuberculosis.	Diseases of the Respiratory System.†	Bronchitis.	Pneumonia.
All occupied and retired civilian males.. ..	1,000	1,000	1,000	1,000	1,000
Strippers and grinders and cardroom jobbers	1,396	796	2,856	5,579	1,593
Blow-room operatives ..	1,516	750	2,432	3,020	2,278
Card and frame (not spinning frame) tenters	1,601	1,057	2,071	1,647	2,181
Spinners and piecers ..	1,248	1,072	1,273	1,431	1,180

* Figures from the Registrar-General's Decennial Supplement. 1921. Part II. Table D. p. cxxii–iii. R.-G.'s occupational groupings.

† Bronchitis, pneumonia, chronic interstitial pneumonia, and other diseases of the respiratory system (excluding tuberculosis).

Occupational Death Rates, 1921-23. Strippers and Grinders and all Workers in Bolton, Oldham and Rochdale.

If the strippers and grinders be compared (as is done in Table III) not with the general population of England and Wales but with the general population of roughly the same localities no very different result is reached. In Table III strippers and grinders (as given in the Registrar-General's supplement) are compared with the population of the three county boroughs of Bolton, Oldham and Rochdale. From all causes of death less those of the respiratory system strippers and grinders have rates up to age 45 lower than those of the general population of these three towns. At ages 45-65 they have the same rate, and at

TABLE III.—*The deaths and death-rates of Strippers and Grinders compared with those of the general population of Bolton, Oldham and Rochdale. 1921-23. (Figures compiled from the Registrar-General's Reports).*

Age.	15—	25—	45—	65 and up.
	Population.*			
Strippers and grinders	2,574	9,075	4,161	516
Bolton, Oldham and Rochdale ..	103,251	175,395	122,364	24,441
Deaths from all causes less bronchitis, pneumonia and other diseases of the respiratory system.				
Strippers and grinders	6	27	79	66
Bolton, Oldham and Rochdale ..	297	915	2,248	2,011
Deaths from bronchitis, pneumonia, and other diseases of the respiratory system.				
Strippers and grinders	1	10	37	27
Bolton, Oldham and Rochdale ..	50	192	526	541
Death-rate per 1,000 from all causes less bronchitis, pneumonia and other diseases of the respiratory system.				
Strippers and grinders	2·33	2·98	18·99	127·91
Bolton, Oldham and Rochdale ..	2·88	5·22	18·37	82·28
Death-rate per 1,000 from bronchitis, pneumonia and other diseases of the respiratory system.				
Strippers and grinders	·39	1·10	8·89	52·33
Bolton, Oldham and Rochdale ..	·48	1·09	4·30	22·13

* Census population of 1921 multiplied by 3 to correspond to the three years of deaths.

ages over 65 they have a considerably higher rate. From respiratory diseases they have lower rates in early life but an excess, rising with age, in later life, so that after age 45 their death rate from these causes is over twice as high as that of the three county boroughs. It must be remembered, too, that the strippers and grinders are included in the county boroughs and contribute to their rates. If they could be deducted their excess of respiratory deaths would be still more distinct. In the final age group, 65 and over, the comparison must necessarily be a very inexact one. The mortality rate recorded depends partly upon the age distribution of persons in that group. If the average age of the persons in the towns over 65 is higher than that of the strippers and grinders (as is probable), then the position of the latter is understated.

Death Rates from Circulatory Diseases. Cotton Operatives.

Before leaving this section on the death rates of cotton operatives as a whole, attention must be paid to certain factors to which the Registrar-General draws notice. In the Decennial Supplement for 1921 it is stated that circulatory mortality "is a very definite feature of one very distinctive group of occupations, the textile trades . . . The textile position is still more remarkable in regard to chronic nephritis . . . With this nephritis excess, no doubt, is associated another distinctive mortality of textile workers—that from cerebral haemorrhage . . . It thus appears that the conditions of work in textile mills promote degenerative changes of the kidneys, heart, and blood vessels."*

The comparative mortality figures for these causes of death (combined) for 1921-23 are set out in Table IV for the four occupational groups under discussion, and are there compared with the similar figures, already given, for respiratory diseases and bronchitis. Amongst all the cotton operatives there is a distinct excess mortality, in comparison with all males in England and Wales, from the group of circulatory and allied diseases. It is least amongst strippers and grinders and spinners, greatest amongst card and frame tenters and blowing-room operatives. On the other hand it should be noted that for strippers and grinders this excess is of far smaller dimensions than that associated with respiratory diseases and bronchitis; for blowing-room hands it is also less but not nearly so substantially so. Card and frame tenters die slightly more from the circulatory than from the respiratory diseases, while for spinners and piecers there is very little difference. It must be remembered too that the respiratory diseases cause considerably more deaths amongst all these cotton operatives than do the circulatory diseases—in each group the

* Registrar-General of England and Wales. Decennial Supplement, 1921, Part II, p. XXXIII.

number of deaths from respiratory diseases (*i.e.*, bronchitis, pneumonia, and other respiratory diseases) is about two and a half times as great as the number of deaths from these circulatory and allied causes. For strippers and grinders, whose health forms the main problem of this inquiry, the death rates of the respiratory groups certainly seem of more importance than the circulatory mortality. In some sense, however, the two forms of mortality seem to be bound up in one another since for the 164 forms of occupations in the Registrar General's report it is shown that there is a definite association between these two groups of deaths. In occupations in which the bronchitis death rate is high the circulatory death rate tends to be high too.*

TABLE IV.—*Standardized mortality (comparative mortality figures) of Males aged 20–65 years, employed in the Cotton Industry, from all causes and from certain selected causes connected with the respiratory and circulatory systems, compared with that of all occupied and retired civilian males taken as 1,000. 1921–23.†*

	All Causes.	Diseases of the Circulatory System and allied Causes.‡	Diseases of the Respiratory System.§	Bronchitis.
All occupied and retired civilian males	1,000	1,000	1,000	1,000
Strippers and grinders and card-room jobbers	1,396	1,566	2,856	5,579
Blow-room operatives	1,516	1,841	2,432	3,020
Card and frame (not spinning frame) tenters	1,601	2,166	2,071	1,647
Spinners and piecers	1,248	1,403	1,273	1,431

One last point must be noted with regard to these occupational death rates. In comparison with all occupied and retired males the position of the cotton operatives may be under-stated since those who are unable to work in the environment of the

* *Vide* Registrar-General's Decennial Supplement, 1921. Part II. p. XXXIX. The correlation coefficients are bronchitis with chronic nephritis + .380 ± .045; bronchitis with cerebral haemorrhage + .411 ± .044; bronchitis with "other" (myocardial) heart disease + .300 ± .053.

† Figures compiled from the Registrar-General's Decennial Supplement, 1921. Part II.

‡ Includes the following headings:—Diseases of the circulatory system; diseases of the heart; valvular disease of the heart; other heart diseases; cerebral haemorrhage; chronic and acute nephritis.

§ Same causes as in Table II.

trade, owing possibly to ill-health acquired in it, leave it and their deaths are debited to their new occupation. Professor Collis in his report in 1908 drew attention to this factor and believed that there was a considerable efflux of workers with injured health from the cardroom into other occupations (*e.g.*, corporation labourers, paper mill labourers, etc.).

Whether the comparison between strippers and grinders and spinners understates the position it is impossible to say since there may be an elimination of the physically unfit from both groups or from only one.

The Investigation of Sickness.

The Method Employed.

In making an investigation of sickness amongst cotton operatives there was a choice of two methods.

(1) Starting with specified mills a "census" of the operatives at work in them on a given date would be taken. Part of the information obtained would be the code number of the Approved Society to which the operative belonged. At the end of a chosen period after the date of the "census" (for instance one year), the sickness history of each operative over this period of time would be obtained from the appropriate Approved Society. This sickness could then be related to the occupation of the operative, which would be ascertained at the census, and to the mill in which the operative worked. Some of the operatives, however, obviously would cease to work during the period of inquiry in the mills in which they were found at the date of the "census." Instead of being "exposed to risk" for the whole period they would only be exposed for some weeks or months. To take count of this it would be necessary for periodical returns to be made by the employers of all operatives definitely ceasing to be employed by them for any other reason than permanent disability. Adjustment could then be made as to the exact time each worker was "exposed" in a particular mill.

There are several disadvantages attaching to this method. Since in each cardroom there are very few strippers and grinders, to get a sufficient "exposed to risk" a very considerable number of mills would have to be selected. A large number of employers would therefore have to co-operate and the organization required for the "census" and the periodical returns of workers leaving would be somewhat substantial. A second consideration is that very many Approved Societies would have to be approached for the sickness histories, and, as with the "general population," many of these would be without any interest in the inquiry. The sickness histories would only be available at the *end* of the chosen period so that some delay would be essential before the inquiry could be completed. The period chosen could not, probably, exceed two years for this reason, and also because, unless "entries" were added, the labour movement out of the

mills selected would be continually diminishing the "exposed to risk." The period of inquiry, naturally, must lie in the future whatever trade conditions may be like.

Finally the sickness history can only relate to "short" sicknesses for the following reason. The persons included in the "census" must have been *at work* at the date of the "census," for otherwise the details relating to their Approved Society could not have been obtained. Obviously then, if the period of inquiry is a year after the "census" the duration of sicknesses suffered must lie within a year. All persons suffering from prolonged sicknesses or permanently incapacitated are excluded since they could not have been employed at the time of the "census." On the other hand the sickness histories can be related to some extent to the variations in environments in the particular mills (unless the labour turnover is too great).

(2) The alternative method is to take the sickness histories over a selected period of all the members of those Approved Societies which are attached to the Trade Unions of cotton operatives, which are very largely confined in their membership to workers in cotton mills. From the point of view of National Health Insurance these societies are on exactly the same basis as any other societies. Their members draw sickness benefit in the ordinary way, only after certification of their incapacity by a panel doctor.

From these Approved Societies would have to be obtained, as well as the sickness history, the exact occupation of each operative. The sickness could then be related to the various occupational categories; it could not be related to the different environments in which particular operatives were at work, for the Approved Society has, normally, no knowledge of the workplaces of its members. This is the disadvantage of the method. On the other hand no extensive organization is required; the employers are relieved of the labour of the "census" and the lists of those leaving their mills, many Approved Societies are relieved of the labour of extracting sickness histories. These histories can be obtained at once since a past period of time can be selected, and this period can be so chosen as to coincide with the best possible trade conditions. In addition a larger number of years of sickness history can be taken than is possible with the first method. Finally, the permanently and semi-permanently incapacitated are included. The advantages of this method are, thus, considerable and it was this method that was finally adopted for the investigation. At the same time further steps were taken to enable the question of differing environments to be considered.

Collection of Data.

The records were taken from three trade Approved Societies—Approved Society No. 1265, the Insurance Section of the Amalgamated Association of Card, Blowing and Ring Room

Operatives ; Approved Society No. 1144, the Insurance Section of the Amalgamated Association of Operative Cotton Spinners ; and Approved Society 1111, the Insurance Section of the Amalgamated Weavers' Association.

The years chosen for investigation were 1923-27 inclusive, *i.e.*, a five years' record. From the Association of Card, Blowing and Ring Room Operatives were taken particulars of every member of the insurance section, male and female, during those years, *i.e.*, every member for the whole period or for a part of the period.* The length of time that each operative was a member during those years, and the dates at which he or she became qualified for benefits, were noted and due allowance made for those who were only "exposed to risk" for some fraction, and not for the whole, of the period. A complete sickness history of each member during this period was taken from the Societies' record cards. (All this work was carried out at the offices of these Societies by clerks specially appointed by the Industrial Health Research Board for the purpose, samples of their work being checked against the original records by the investigator). The number of male members of the Association of Card, Blowing and Ring Room Operatives over this five year period was just over 8,000 and of female members approximately 30,000. Of the males it was estimated that about 3,000 would be cardroom workers, and about 5,000 "other cotton operatives." (Actually it was found that the number finally available for comparative purposes was very much smaller than this, *vide* Table V). This comparative group of other operatives it was hoped to increase by records from the Association of Operative Spinners. The Insurance Section of this Society, however, had a male membership over the five years of over 30,000. It was unnecessary to take records for the whole of this membership since the comparative group would then be unnecessarily large in comparison with the cardroom group, and the labour and cost involved would have been considerable. It was considered that a quarter of this group would be sufficient. Accordingly a random sample of one in four was decided upon. The record cards are kept by the Approved Society divided into the branches to which the members belong. (These branches are synonymous with towns since there is one branch to each town). Within the branch, cards are in order of membership number. Live and "dead" members are kept separately. The procedure agreed upon was that starting with the first card in each section every fourth card should be scrutinized and where the fourth card referred to membership during 1923-27 the particulars required were to be abstracted. Only the fourth card was ever to be taken ; no substitution was to be made for it for any reason whatever, *e.g.*, lack of necessary particulars.

* Excluding only those members who joined the society between 1923 and 1927 but never completed their qualifying period for sickness benefit.

The sample was to cover the complete membership, alive and dead. Owing, however, to an unfortunate oversight this sample miscarried and has been discarded. Before starting on the work it was not brought to the attention of the investigator that the cards of members during sickness were transferred to a "temporary" box, being returned to their normal places in the branch boxes at the end of the period of sickness, and owing to a misapprehension on the part of the clerk in charge of the work this "temporary" box was not properly sampled. The method used by the clerks was as follows: one clerk scrutinized each fourth card and extracted the membership particulars; the second clerk followed behind him and extracted the sickness particulars. If between the extraction of the membership particulars and the sickness particulars the member had fallen sick his card would have been transferred by the Society's clerks to the temporary box. In such cases the card was fetched from the temporary box and the required sickness particulars obtained. This led the clerk in charge to suppose, without referring the matter to the investigator, that he had sampled the temporary box. He overlooked the fact that the permanently disabled and persons ill throughout the time during which the sample was being taken were *always* in the temporary box, and therefore could never have had their membership or sickness particulars procured. Chronic disability was therefore very seriously understated in the sample. Short-period sickness would not be so affected, and comparison of the number of claimants to sickness benefit in the years 1925, 1926 and 1927 showed that for *all ages* the number of claimants was understated in the sample only to the extent of 4 per cent. On the other hand no test is possible to show how much the different age groups are affected—the older ages are certainly more likely to be affected than the younger ages—or to show whether the loss affects respiratory causes more or less than other causes of illness. No means of correction of the sample were possible and it has therefore been thought better to base no conclusions upon it but to rely upon the much smaller control group provided by the Association of Card, Blowing and Ring Room workers. It may be added, however, that the figures reached with the biased sample of 8,000 lives from the Association of Operative Cotton Spinners broadly confirm the conclusions based upon this smaller control group. The bias in short-period sickness was not sufficient to nullify the very distinct differences (shown later) between the sickness experiences of the cardroom workers and the other cotton operatives in the older age groups.

Turning to the female membership, out of the some 30,000 members in the Insurance Section of the Card, Blowing and Ring Room Association it was estimated that about twenty thousand would be workers in the cardroom. This would leave a comparative group of about ten thousand (actually after certain eliminations this comparative group was about 6,500, *vide* Table XVIII). This number was further increased by the records of about 1,400

members of the Weavers' society (Oldham branch), those members being selected who worked in the warping and winding rooms, and of 179 women similarly employed and belonging to the Operative Spinners' Society.

Source of Information as to Occupations.

Reelers and Winders.—For these female members of the Operative Spinners' Society and the Amalgamated Weavers' Association, the occupation *at entry into the society* was taken as the occupation during 1923–27. This occupational grouping is in error in proportion to the movement of such workers out of the cotton industry or into other sections of it. The movement out of the industry results in the occupational groups called "winders" in this investigation actually being composed of winders and members of the general population who were, at one time, winders. When their sickness rates are compared with those of the cardroom workers the change to an outside occupation does not alter their validity as a control group. Movement of winders to other parts of the mill is not of much importance unless such workers go to the cardroom. In other parts of the mill they would still form part of the comparative group. If they move to the cardroom but are here classified as winders the comparison between the two groups is weakened by this inclusion of actual cardroom workers amongst the occupational groups termed winders. Evidence of the extent to which this occurs will be given when the sickness rates of the women are presented.

Cardroom Approved Society Members.—For the members of the Card, Blowing and Ring Room Association, male and female, special means had to be taken to ascertain the precise occupation of the worker, the record on the Society's cards being only "cotton operative." For this purpose a questionnaire was drawn up with the following three questions upon it :

- (1) What was your exact occupation during the years 1st January, 1923 to 31st December, 1927? If you changed your occupation during these years give both occupations and date of change.
- (2) Where were you employed during 1st January, 1923 to 31st December, 1927? Give the name of each town and each mill if you were in more than one during these years and the dates at which you entered and left each mill.
- (3) If you were *not* a cardroom worker during 1st January, 1923 to 31st December, 1927, were you *ever* at work in a cardroom? If so when and for how long?

A questionnaire was filled in with the name and address of each member of the Approved Society during 1923 to 1927 and through the Trade Union contribution collectors in each district one was delivered to every member still alive and still available. In the case of dead members or members with whom contact had come

to an end (*e.g.*, emigrants) information was obtained from relatives or friends or from the personal knowledge of the collector or of the Approved Society's sick visitors.

Analysis of the Data.

MALES.

Occupations.

Out of a male membership of 8,165, information was obtained in these ways for 8,009 or 98 per cent. For 151 of the remaining 156 males information as to occupation *at entry into society* was used instead of occupation during 1923-27, and in only five cases was no information obtained. This use of occupation at entry will introduce some slight error in the occupational groups if there has been any labour movement amongst these 151 workers, but their number is so small compared with the total that the error can only be negligible. The occupation, place of work and other relevant information given on each form was entered upon the corresponding card giving the sickness history. The numbers found in each occupation are set out in Table V.

Certain considerations arise in the grouping of these various occupations. It must be remembered first that for results to have satisfactory reliability they must be based upon relatively large numbers; the larger the numbers the greater the reliance that can be placed upon the results. It is useless to deal with small groups numbering only one or two hundred or less—except, on occasions, merely as confirmatory evidence of conclusions reached with larger numbers or by other methods. For this reason certain small groups must be included with a larger group, although on some grounds their treatment separately would be more satisfactory. For instance it would be of advantage to examine the sickness of the male slubbing tenters, combers and frame overlookers on one side of the cardroom separately from the strippers and grinders directly in contact with the carding machines on the other side. But, it will be seen, in the former group there were only 50 males and it would be valueless to treat these alone. They must either be excluded altogether or included in the cardroom group. For the same reason it is of no value to treat workers returned as carders and undercarders separately from strippers and grinders, and also because the former occupation is constantly recruited from the latter. The cardroom group has therefore been extended to include the first 10 occupations given in Table V and comprises in all 3,165 workers. Certain of these workers may not be employed all their time in the cardroom but only come to and fro to it at intervals; this applies to the lap carriers, bobbin carriers and hoistmen. If any peculiar incidence of sickness is found in this cardroom group that might be ascribed to the effect of dust, it is probable that this peculiarity is diminished by the inclusion of some of these workers and would be more distinct if it had been possible to take strippers and grinders alone.

TABLE V.—*The numbers found in each occupational group amongst male members of the Card, Blowing and Ring Room Insurance Approved Society.*

Carders and undercarders	323
Carder and stripper and grinder during 1923-27	60
Strippers and grinders	2,167
Cardroom jobber, worker, labourer or operative	182
Cardroom tenters, card box tenters, can tenters (in some cases becoming stripper and grinder during 1923-27) ..	117
Lap piecers and carriers (in some cases becoming stripper and grinder during 1923-27)	80
Bobbin carriers (in some cases becoming stripper and grinder during 1923-27)	131
Condenser minders and tenters	23
Slubbing tenters, combers and frame overlookers	50
Hoistmen (some of whom have worked in cardroom) ..	32
	3,165
Cotton room, cotton mixing and cotton chamber workers ..	222
Blowing room operatives or hands, scutchers and finishers	660
Wastemen and waste baggers	35
	917
Cop packers, warehousemen, conditioners and one or two roller coverers	868
Ring room jobbers, oilers and banders, spinners and piecers, bobbin carrier in ring room, doffers, and thread doublers	793
In both card and blowing room during 1923-27 or blowing room in 1923-27 and cardroom previously.. .. .	198
Outside the trade or in other parts of the mill in 1923-27 but previously in the cardroom	646
Outside the trade in 1923-27 but previously in blowing room, ring room or warehouse	102
Workers with more than one occupation in the mill during 1923-27 (excluding those who were ever in the cardroom), e.g., piecer and cop packer	41
Odd jobs in mill, e.g., labourer (undefined), time-keeper, clerk, loom oilers and sweepers	111
In occupations outside the trade and no reference to previous work in a mill	1,183
In Army or Navy during 1923-27	67
On workman's compensation benefits during all or most of 1923-27	18
On war pensions or treatment allowances	51
Untraced	5
	1,578
Total..	8,165

In the description previously given of the occupations and environments in a spinning mill it was noted that the earlier processes of treating the cotton (apart from the cardroom) were

all involved one way or another in cleaning and mixing the raw material. In the later processes the dust has been eliminated and workers in the ring-spinning room and the warehouse are therefore in distinctly different environmental conditions from those of the blowing-room workers. It is obviously of importance not to mix these "control" groups together since their environment differs so considerably, and also because the death rates show quite distinct differences between the blowing-room hands and the spinners. A further reason for differentiation is that there is believed (in the opinion of the trade representatives supervising the inquiry) to be very little interchange between occupations in the cardroom and occupations in the spinning rooms and warehouse. In these returns very few workers in the spinning rooms and warehouse stated that they had previously been in the cardroom. With the blowing room and other preparatory processes the position is quite different. There is certainly quite a considerable interchange, and it is shown in Table V that 198 workers had been at work at some time both in the cardroom and blowing room. This is probably a minimum since there is a tendency amongst the workers to use the term "cardroom" to cover all these earlier processes. For instance on some questionnaires the worker replied that his occupation was a blowing-room hand, while in reply to the question "were you ever at work in a cardroom" he said "yes, all my life." There is therefore a possibility that some workers who returned themselves as blowing-room hands did not reply to the final question at all since they regarded themselves as "cardroom" workers in this wider sense. Whether they had ever worked in the actual cardroom (in the true sense) would then not be known. However this may be, it is certain that the blowing-room and other early processes do not provide an absolutely reliable comparative group, for the differentiation of the cardroom worker and blowing-room worker cannot be distinct. The second group is therefore composed of these workers in the cleaning and mixing processes (exclusive of the cardroom), together with a very small group of wastemen. Operatives who have worked both in the card and blowing rooms have been treated separately to begin with, but finally amalgamated with the blowing-room group, as will be seen later. The third group comprises the warehouse workers and the workers in the ring-spinning room.

The last group that has been analysed is composed of workers who once worked in the cardroom but in 1923-27 had ceased to do so. This is a group of some importance as it should show whether there is any elimination from the cardroom of the physically disabled, and whether ill-health possibly acquired in the cardroom continues after leaving it.

One-fifth of the membership has not been utilized. The first three groups (outside the trade in 1923-27 but previously in blowing, ring room or warehouse; workers with more than one

occupation in the mill during 1923-27—excluding those ever in the cardroom; odd jobs in a spinning mill) are all of some interest but the numbers in them (102, 41, and 111) are not large enough to justify analysis, and they cannot be reasonably added to any of the larger groups. Nearly 1,200 workers were outside the cotton industry altogether in 1923-27 and had not worked previously in the cardroom. They may have worked previously in the ring room or warehouse or in any other department but this is not known. At first sight it might be thought that these workers would supply a "general population in the same localities," but for two reasons they fail to do this. The first reason is that, as has just been pointed out, many of them may be ex-mill workers and so are not clearly differentiated from the cotton industry. The second is that the bulk of this population is composed of youths under 25 years of age and the numbers in the later ages are not sufficient to be of much value. A number of youths who very likely started their working life in spinning mills and left because of unemployment, can hardly be utilized as typical of the "general population." The rejection of all the other groups (army and navy, prolonged compensation cases, war pension cases and untraced members) explains itself.

Sickness.

For examination of the sickness data there remain, after these occupational groupings, three main and two subsidiary groups. These will be entitled as follows and contain the numbers given against them.

Table VI. Occupational Groupings.	
Three main groups (all members of the Card, Blowing and Ring Room Association).	
Strippers and Grinders and other Cardroom Workers	3,165
Blowing-room hands and other preparatory Workers	917
Cop Packers and Warehousemen and Ring Room Workers	1,661
Two Subsidiary Groups (all members of the Card, Blowing and Ring Room Association).	
Operatives who have worked in both Card and Blowing Rooms	198
Workers in the Cardroom who have left it for other employment	646

A preliminary analysis showed that the subsidiary group of workers who had been employed at some period of time both in the card and blowing rooms did not differ in sickness incidence materially from the blowing-room group (some of the members of

which may have worked, as previously pointed out, in the card-room but omitted to state it). The number of days of sickness suffered per person-year of exposure* in each group was as follows :

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

Age.	Blowing-room hands and other preparatory workers.	Workers employed at some time in both card and blowing-room.
16-19	4.8	4.5
20-29	3.5	2.5
30-39	5.2	5.0
40-49	6.3	6.2
50-59	10.5	10.6
60-69	17.5	10.2

In only one age group does the difference appear to be material. At ages 60-69 the blowing-room hands have 17.5 days per person-year and the workers in both card and blowing-rooms only 10.2 days. But this latter rate is derived from only 64.5 person-years of exposure (or about thirteen or fourteen persons) and little importance can be attached to the difference. It was considered that in view of this agreement of the sickness rates and the occupational resemblance already discussed, it was justifiable to amalgamate these two groups and this has been done in the further tables.

Procedure in calculating rates and definitions of technical terms.—Before turning to the rates found some account is needed of the procedure followed in calculating them. The difference between sickness and disablement, in the technical sense of the National Health Insurance Acts, is that sickness is the first 26 weeks of illness, and disablement is illness continuing after the first 26 weeks. The first 26 weeks of illness may be either one prolonged period of incapacity or it may be reached by a series of short "linked-up" periods of sickness which are separated from one another by less than a calendar year. Under the Act any two periods of sickness separated by less than a calendar year are counted as the same sickness and both count towards the

* 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.

first 26 weeks of incapacity. An interval of a calendar year nullifies this linking-up process and after an interval of that length the calculation of the first 26 weeks of incapacity begins afresh. In addition there is a longer qualifying period for disablement benefit than there is for sickness. A person does not become qualified to draw disablement benefit until he has been in insurance 104 weeks and paid 104 contributions; he or she becomes qualified for sickness benefit after 26 weeks and 26 contributions. Hence the person-years of exposure to risk differ, though only materially in the first age group. For these technical reasons it is better to keep the two types of illness apart, and also because a few chronically disabled persons may contribute so much to the total incapacity of a relatively small population that they may obscure actual differences in sickness incidence.

In dealing with claims it may be pointed out now that in this investigation every period of illness has been counted as a claim irrespective of whether it was "linked-up" with another period or not. Also, the whole of the sickness has been included in the calculation of the duration, *i.e.*, the first 3 days of illness which are not paid for (unless linked-up) are included here in *all* periods of sicknesses. Finally, the sickness and disablement have been calculated for each calendar year separately and then totalled for the five years. This means that one continuous claim running into two or three calendar years appears as two or three claims in the total. Unless this is done the great disadvantage of over-lapping age groups must result (*e.g.*, a person claiming at age 29 in 1923 is age 30, and, therefore, in the next age group, in 1924). Such claims naturally do not form a very large proportion of the total (except possibly in disablement).

Periods of incapacity definitely stated to come under the Workmen's Compensation Act have not been included, and no allowance has been made for them. This overestimates the exposure to risk since persons away incapacitated are continued as exposed to risk, but the error is not of any magnitude. As has already been pointed out persons drawing Workmen's Compensation for a very prolonged period have been excluded from the experience altogether, as have also cases of incapacity due to the war. The latter have no bearing on occupational risks.

Sickness and Disablement Rates of the Occupational Groups from All Causes of Illness.—In Tables VII and VIII are set out the figures for the sickness and disablement experienced from all causes of illness in the three occupational groups—the strippers and grinders and cardroom workers, the ring-room and warehouse workers and the blowing-room workers. The sickness rates (Table VII), *i.e.*, days of sickness experienced per person-year of exposure, show that the cardroom group have rates closely approximating to those of the ring-room and warehouse workers in early working life, that is from ages 16 to 30. After age 30, on the contrary, they have a distinct excess of sickness, their

days of sickness per person-year being 123 per cent. of the rate for ring-room and warehouse workers at ages 30-39, 130 per cent. at ages 40-49, 183 per cent. at ages 50-59 and 124 per cent. at ages 60-69. In comparison with the blowing-room workers, on the other hand, the strippers and grinders, etc., do not show this consistent excess of illness after age 30.

Figures for disablement (long-period incapacity after the first 26 weeks of sickness) are not very satisfactory for populations as small as these. For such forms of illness a much larger exposed to risk is needed to secure stable rates. Therefore only their general indication will be referred to, and the rates for the cardroom workers will not be given as percentages of the rates for the other workers, both being liable to large random fluctuations.

Table VIII shows that for this long-period morbidity the comparison between the cardroom workers and the ring-room and warehouse workers gives broadly the same result as was found in the comparison of short-period illness. The cardroom workers have less disablement at the start of working life but suffer an appreciable excess after age 30. In this case they have, too, an excess over the blowing-room workers, an excess which was absent from the short-period sickness figures.

The origin of this excess of illness can be shown to lie, mainly, in the abnormal rates experienced by the cardroom workers, aged 30 years and over, from respiratory diseases.

Sickness and Disablement Rates from Respiratory Diseases and from all other causes less respiratory diseases.—In Tables IX and X the sickness and disablement experiences are subdivided into all causes of illness less respiratory causes and respiratory causes alone. The causes defined as respiratory are bronchitis, bronchial catarrh, asthma, emphysema, congestion of the lungs and pneumonia. In Tables IX and X are given the actual numbers exposed to risk, the days of illness suffered and the numbers of claims made. In Tables XI and XIII are given the rates based upon these figures, while in Table XII the sickness rates of the cardroom workers are expressed as percentages of the rates of the two comparative groups.

Reference to Tables XI and XII shows that from all causes of sickness less respiratory causes the cardroom workers do not differ appreciably from the ring-room and warehouse operatives either in days of sickness or in number of claims made, except in the one age group 50-59 (which may be due to a random fluctuation in the rates which are admittedly based upon somewhat small numbers). From respiratory causes they 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.* Their position is shown in comparison with these other cotton operatives in the ring-room and warehouse in figure (1).

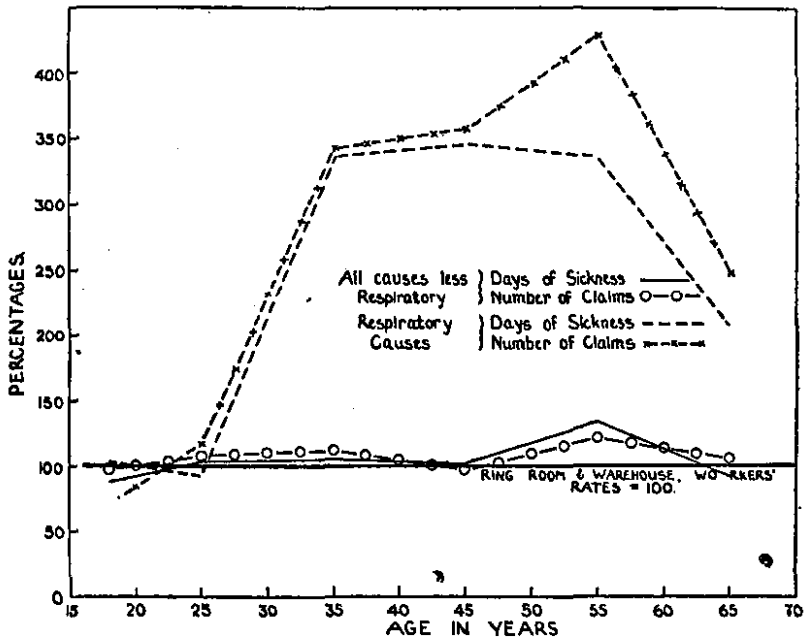


FIG. (i).

1923-27. Sickness rates found for Strippers and Grinders, MALES (days of sickness per person-year and number of claims per 100 person-years), expressed as percentages of the rates found for Male workers in the Ring Room and Warehouse.

Comparing the cardroom group with the blowing-room group (Tables XI and XII) no such abnormal discrepancy in rates is found—as would be expected, as previously pointed out, in view of the greater similarity of environment compared with the other occupational groups, and also because of the interchange of workers. From all causes of sickness less respiratory causes the cardroom workers have, taken as a whole, slightly fewer days of sickness than the blowing-room group, and in later life slightly fewer claims. The difference in neither case is very pronounced and, since the blowing-room group is relatively a small one, it is probably not significant. It is probably fair to say that from all causes of sickness less respiratory causes the two groups suffer equally.

From respiratory causes taken alone there is, similarly, no consistent difference in incidence. The cardroom operatives suffer more from these causes up to age 30, less from ages 30-39, about as much at ages 40-49, and more after age 50. Since the cardroom rates for these respiratory causes are higher than the blowing-room rates in four out of the six age groups, and roughly equivalent in the other two age groups, it is justifiable to say that the cardroom workers have a slightly higher morbidity from such causes than the blowing-room workers. The difference, obviously, is far less than the difference between cardroom workers and the ring-room and warehouse workers.

The disablement experience divided into these two morbidity cause groups is too liable to random fluctuations in the rates to allow any detailed consideration of it. In general it suggests confirmation of the conclusions reached from the more stable short-period sickness rates, the cardroom workers showing, as a whole, no such pronounced excess of illness from non-respiratory causes as they reveal from respiratory illness after age 30.

Incidence of Tuberculosis amongst the Cotton Operative groups.—In selecting the two cause groups for comparison (respiratory causes and all causes less respiratory causes) *respiratory tuberculosis* was not included with the respiratory diseases but kept in the general group. The medical members of the sub-committee supervising the inquiry were of opinion that exposure to certain dusts may cause respiratory complaints of a bronchial type but not tuberculosis. Judging by the standardized death rates (*vide* Table II) and Professor Collis's evidence (quoted on p. 12) the cardroom workers show no abnormal incidence of this complaint. As a cause of death they suffer from it somewhat less than all civilian males and less than spinners and piecers (the number of deaths upon which the standardized death rates are based is, however, not very large). Actually when the sickness and disablement rates for tuberculosis (of all forms) found in this inquiry were examined it was seen that strippers and grinders showed from ages 20 to 60 a *higher* incidence than the ring-room and warehouse workers. If these tuberculosis rates were added to the respiratory group instead of to the non-respiratory group it would have the effect of making the strippers' and grinders' excess of respiratory illness at these ages still more abnormal.

The Duration of Sickness Claims amongst the Cotton Operative groups.—It was seen that the excess of respiratory illness amongst cardroom workers, when compared with ring-room and warehouse workers, was in evidence both in the number of claims made and in the total duration of sickness suffered. It is of some interest to see whether this excess in number of days of sickness per person-year is the result only of this greater number of claims or whether it is also derived from a longer duration of each claim. The figures in answer to this question are given in Table XIV.

Comparing first strippers and grinders with ring-room and warehouse operatives, it is seen that the difference in length of claim from non-respiratory causes is very slight, and not consistent over the age groups. From respiratory causes, after the first age group (which is based upon too few claims to be reliable), they make somewhat shorter claims. Compared with the blowing-room workers the strippers and grinders show no consistent differences in claims from non-respiratory causes. From respiratory causes there is, again, a suggestion of shorter claims up to age 50.

The conclusion is that the excess of sickness of a respiratory nature amongst cardroom operatives is due to a larger *number* of claims being made, possibly of a slightly shorter average duration than those made by the control group, and *not to an abnormal average length of incapacity* suffered by strippers and grinders from these diseases.

TABLE VII.—Males, 1923-27.—The SICKNESS experience from all causes.

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.			
Age Group (age last birthday at beginning of year of exposure).	Person-years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person-year of exposure.	Person-years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person-year of exposure.	Strippers' and Grinders' rate as percentage of rate of these ring-room and warehouse workers.	Person-years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person-year of exposure.	Strippers' and Grinders' rate as percentage of rate of these blowing-room workers.
16-19	695.5	3,069	4.41	1337.0	6,534	4.89	90	323.0	1,520	4.71	94
20-29	1944.0	8,742	4.50	1897.5	8,395	4.42	102	852.0	2,775	3.26	138
30-39	3663.5	15,284	4.17	1570.5	5,304	3.38	123	859.5	4,425	5.15	81
40-49	3865.0	22,575	5.84	1363.0	6,123	4.49	130	1223.0	7,699	6.30	93
50-59	2351.0	24,939	10.61	610.0	3,545	5.81	183	1039.5	10,896	10.48	101
60-69	961.5	19,716	20.51	183.5	3,024	16.48	124	389.0	6,350	16.32	126
Total number of persons exposed	3,165			1,661				1,115			

TABLE VIII.—*Males, 1923-27.—The DISABLEMENT experience from all causes.*

Age Group (age last birthday at beginning of year of exposure).	Strippers and Grinders and other Cardroom Workers.			Workers in Ring-room and Warehouse.			Blowing-room and other preparatory workers and workers in both Card and Blowing-room.		
	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.
16-19	440·0	8	·02	813·0	1,244	1·53	213·5	33	·15
20-29	1,917·5	3,204	1·67	1,883·5	6,152	3·27	848·5	1,988	2·34
30-39	3,634·0	8,373	2·30	1,562·5	1,056	·68	844·0	64	·08
40-49	3,836·5	23,494	6·12	1,351·5	3,649	2·70	1,214·5	4,235	3·49
50-59	2,333·0	35,885	15·38	606·0	4,729	7·80	1,028·5	10,202	9·92
60-69	954·5	45,536	47·71	181·5	7,427	40·92	386·5	9,652	24·97

TABLE IX.—*Males, 1923-27.—The number of person-years of exposure to risk, the duration of SICKNESS suffered and the number of claims made from (1) all causes of sickness less particular respiratory causes and (2) particular respiratory causes,* amongst the occupational groups in spinning mills.*

Age Group (age last birthday at beginning of year of exposure).	Strippers and Grinders and other Cardroom Workers.			Ring Room and Warehouse Workers.			Blowing-room and other Preparatory Workers and Workers in both Card and Blowing-room.		
	Person-years of exposure to risk.	Total duration of sickness in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of sickness in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of sickness in days. Total number of claims made.	
		All causes less respiratory.	Respiratory causes.		All causes less respiratory.	Respiratory causes.		All causes less respiratory.	Respiratory causes.
16-19	695.5	2,715 125	354 8	1,337.0	5,875 246	659 21	323.0	1,358 54	162 3
20-29	1,944.0	7,539 313	1,203 45	1,897.5	7,120 285	1,275 38	852.0	2,443 127	332 10
30-39	3,663.5	11,831 493	3,453 121	1,570.5	4,858 190	446 15	859.5	3,315 114	1,110 31
40-49	3,865.0	15,750 484	6,825 252	1,363.0	5,428 175	695 25	1,223.0	5,522 200	2,177 72
50-59	2,351.0	14,118 406	10,821 298	610.0	2,712 86	833 18	1,039.5	6,861 203	4,035 114
60-69	961.5	10,836 220	8,880 196	183.5	2,210 40	814 15	389.0	4,631 102	1,719 51
Total number of persons exposed..	3,165			1,661			1,115		

* These respiratory causes comprise here and throughout bronchitis, bronchial catarrh, asthma, emphysema, congestion of the lungs and pneumonia.

TABLE X.—Males, 1923-27.—The number of person-years of exposure to risk, the duration of DISABLEMENT suffered and the number of claims made from (1) all causes of disablement less respiratory causes and (2) particular respiratory causes, amongst the occupational groups in spinning mills.

Age Group (age last birthday at beginning of year of exposure).	Strippers and Grinders and other Cardroom Workers.			Ring Room and Warehouse Workers.			Blowing-room and other Preparatory Workers and Workers in both Card and Blowing-room.		
	Person-years of exposure to risk.	Total duration of disablement in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of disablement in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of disablement in days. Total number of claims made.	
		All causes less respiratory.	Respiratory causes.		All causes less respiratory.	Respiratory causes.		All causes less respiratory.	Respiratory causes.
16-19	440.0	8	—	813.0	1,244	—	213.5	33	—
		1	—		6	—		1	—
20-29	1,917.5	2,979	225	1,883.5	5,789	363	848.5	82	1,906
		20	4		26	7		2	6
30-39	3,634.0	7,087	1,286	1,562.5	1,056	—	844.0	24	40
		37	11		5	—		2	1
40-49	3,836.5	16,546	6,948	1,351.5	3,037	612	1,214.5	3,095	1,140
		65	58		17	4		18	8
50-59	2,333.0	18,715	17,170	606.0	3,911	818	1,028.5	7,503	2,699
		87	86		16	4		32	18
60-69	954.5	28,741	16,795	181.5	6,651	776	386.5	6,748	2,904
		117	83		29	4		29	12

TABLE XI.—Males, 1923-27.—Sickness Rates.—The number of days of sickness per person-year of exposure and the number of claims per 100 person-years of exposure from (1) all causes of sickness less particular respiratory causes and (2) particular respiratory causes, amongst the occupational groups in spinning mills.

Age Group (age last birthday at beginning of year of exposure).	Strippers and Grinders and other Cardroom Workers.		Ring Room and Warehouse Workers.		Blowing-room and other Preparatory Workers and Workers in both Card and Blowing-room.	
	Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.	
	All causes less respiratory. (2)	Respiratory causes. (3)	All causes less respiratory. (4)	Respiratory causes. (5)	All causes less respiratory. (6)	Respiratory causes. (7)
(1)						
16-19	3.90	.51	4.39	.49	4.21	.50
	17.97	1.15	18.40	1.57	16.72	.93
20-29	3.88	.62	3.75	.67	2.87	.39
	16.11	2.31	15.02	2.00	14.91	1.17
30-39	3.23	.94	3.09	.28	3.86	1.29
	13.46	3.30	12.10	.96	13.26	3.61
40-49	4.07	1.77	3.98	.51	4.52	1.78
	12.52	6.52	12.84	1.83	16.35	5.89
50-59	6.01	4.60	4.45	1.37	6.60	3.88
	17.26	12.68	14.10	2.95	19.53	10.97
60-69	11.27	9.24	12.04	4.44	11.90	4.42
	22.89	20.38	21.80	8.17	26.22	13.11

TABLE XII.—1923-27. Males.—The sickness rates of strippers and grinders and other cardroom workers expressed as a percentage of the similar rates of other groups of cotton operatives (1) for all causes of sickness less particular respiratory causes, (2) for particular respiratory causes.

Age Group (age last birthday at beginning of year of exposure).	Strippers' and Grinders' and Cardroom Workers' rates as percentage of Ring Room and Warehouse Workers' rates.				Strippers' and Grinders' and Cardroom Workers' rates as percentage of Blowing-room and other Preparatory Workers' rates.*			
	All causes less respiratory.		Respiratory causes.		All causes less respiratory.		Respiratory causes.	
	Days of sickness.	Number of claims.	Days of sickness.	Number of claims.	Days of sickness.	Number of claims.	Days of sickness.	Number of claims.
16-19	89	98	104	73	93	107	102	124
20-29	103	107	93	116	135	108	159	197
30-39	105	111	336	344	84	102	73	91
40-49	102	98	347	356	90	77	99	111
50-59	135	122	336	430	91	88	119	116
60-69	94	105	208	249	95	87	209	155

* Including workers in both card and blowing-room.

TABLE XIII.—1923-27. Males.—Disablement Rates.—The number of days of disablement per person-year of exposure and the number of claims per 100 person-years of exposure from (1) all causes of disablement less particular respiratory causes and (2) particular respiratory causes, amongst the occupational groups in spinning mills.

Age Group (age last birthday at beginning of year of exposure). (1)	Strippers and Grinders and other Cardroom Workers.		Ring Room and Warehouse Workers.		Blowing-room and other Preparatory Workers and Workers in both Card and Blowing-room.	
	Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.	
	All causes less respiratory. (2)	Respiratory causes. (3)	All causes less respiratory. (4)	Respiratory causes. (5)	All causes less respiratory. (6)	Respiratory causes. (7)
16-19 .. ..	.02 -23	— —	1.53 .74	— —	.15 .47	— —
20-29	1.55 1.04	.12 .21	3.07 1.38	.19 .37	.09 .23	2.25 .71
30-39	1.95 1.02	.35 .30	.68 .32	— —	.03 .24	.05 .12
40-49	4.31 1.70	1.81 1.51	2.25 1.26	.45 .30	2.55 1.48	.94 .66
50-59	8.02 3.73	7.36 3.69	6.45 2.64	1.35 .66	7.30 3.11	2.62 1.75
60-69	30.11 12.25	17.60 8.70	36.64 15.98	4.28 2.20	17.46 7.51	7.51 3.10

TABLE XIV.—1923-27. Males.—The average duration of each sickness claim,* (first 26 weeks of incapacity) from (1) all causes of sickness less particular respiratory diseases and (2) particular respiratory diseases, amongst the occupational groups in spinning mills. In days.

Age Group (age last birthday at beginning of year of exposure).	16-19.		20-29.		30-39.		40-49.		50-59.		60-69.	
	All causes less respiratory.	Respiratory causes.	All causes less respiratory.	Respiratory causes.	All causes less respiratory.	Respiratory causes.	All causes less respiratory.	Respiratory causes.	All causes less respiratory.	Respiratory causes.	All causes less respiratory.	Respiratory causes.
Strippers and grinders and other cardroom workers	22	44	24	27	24	29	33	27	35	36	49	45
Ring-room and warehouse workers ..	24	31	25	34	26	30	31	28	32	46	55	54
Blowing-room and other preparatory workers and workers in both card and blowing-room	25	54	19	33	29	36	28	30	34	35	45	34
Strippers and grinders, etc., as percentage of ring-room and warehouse workers	92	142	96	79	92	97	106	96	109	78	89	83
Strippers and grinders, etc., as percentage of blowing-room workers, etc.	88	81	126	82	83	81	118	90	103	103	109	132

* Each period of sickness was counted as a claim irrespective of whether it was "linked-up" with another period or not. Since, to avoid overlapping age-groups, the sickness was analysed for each calendar year separately and then totalled for the 5 years, a claim running into two calendar years appeared as two in the total. The duration is therefore the duration within the calendar year.

Number of claimants from respiratory diseases in the cotton operative groups.—A further point that arises is whether this larger number of claims made by the strippers and grinders is derived from an actually larger number of *persons* claiming or rather from an excess of persons making a large number of claims each. The answer is that both factors seem to be responsible, and the figures are given in Tables XV and XVI. The former table shows for the three occupational groups the number of persons who were ill (either one or more times during the 5 years) with respiratory complaints, this number being given in absolute and percentage form (as per cent. of total number of persons exposed). At ages 16–24 the percentage ill from these causes is lowest amongst the cardroom workers, showing that initially they are not peculiarly liable to these diseases. At ages 20–34 the cardroom group has an appreciably higher percentage of persons ill from these causes than those found in the other groups. In all the later age groups the cardroom workers have approximately twice as high a proportion of persons ill from respiratory causes as the ring-room and warehouse workers. The blowing-room workers show higher percentages at ages 30–54 and lower percentages from 50–69. The difference between them and the cardroom workers is, as before, not distinct.

The incidence of multiple claims.—Table XVI shows that, amongst the cardroom group, as compared with the ring-room and warehouse group, as well as a relatively larger number of persons making claims for respiratory causes, there were a large number of persons in the older age groups who were compelled to have recourse to benefit on repeated occasions. The numbers involved are small but both the older age groups give the same result. At ages 30–54 out of those claiming benefit from respiratory causes, amongst the strippers and grinders 51·3 per cent. made only one claim, 33·5 had to claim twice and 15·2 per cent. had to claim four or more times. Amongst ring-room and warehouse workers, on the other hand, 70·4 per cent. of the claimants claimed once only, 22·2 per cent. claimed twice and only 7·4 per cent.—or half as many as in the cardroom group—had to make four or more claims. At ages 50–69 the differences are still more distinct. When the cardroom group is compared with the blowing-room group, the differences as usual are found to be slighter.

In other words this population of strippers and grinders, etc., in comparison with ring-room and warehouse workers contains not only more persons in the older age groups who were ill during 1923–27 from respiratory illnesses (Table XV) but also more persons who had repeated attacks of respiratory illnesses (Table XVI).

TABLE XV.—1923-27. Males.—The number of persons in each occupational group who claimed benefit (once or more times) during the five years because of sickness of a respiratory nature, shown absolutely and as a percentage of the number of persons exposed to risk.

Age Group* (age last birthday at beginning of year of exposure).	Strippers and Grinders and other Cardroom Workers.			Ring-room and Warehouse Workers.			Blowing-room and other Preparatory Workers and Workers in both Card and Blowing-room.		
	Number of persons exposed to risk.	Number of persons making claims from respiratory causes.	Column (3) as percentage of column (2).	Number of persons exposed to risk.	Number of persons making claims from respiratory causes.	Column (6) as percentage of column (5).	Number of persons exposed to risk.	Number of persons making claims from respiratory causes.	Column (9) as percentage of column (8).
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
16-24	340	12	3.5	572	27	4.7	147	6	4.1
20-24	466	40	8.6	334	19	5.7	192	8	4.2
30-44	885	78	8.8	355	11	3.1	218	23	10.6
40-54	813	119	14.6	259	16	6.2	269	42	15.6
50-64	474	121	25.5	104	14	13.5	220	41	18.6
60-69	187	68	36.4	37	8	21.6	69	17	24.6

* Since, for this purpose, a claim was counted as only one when it ran into two or more calendar years, overlapping age groups are produced. The number of persons exposed to risk, e.g., 340 cardroom workers aged 16 to 24, is the number aged between 16 and 19 (age last birthday) at 1.1.23 or at any later entry date. Obviously by 1927 some of these persons will have moved into the next age group, 20-24, so that during the years 1923-27 they are of ages 16 to 24. Similarly the ages in the next age group cover the years 20 to 34.

TABLE XVI.—1923-27. Males.—The number of persons making one or more claims from respiratory causes, grouped according to the number of claims made.

Age Group (age last birthday at beginning of year of exposure).		Number of Persons making a claim or claims from respiratory diseases.	Percentage of total number claiming from respiratory causes who claimed from such causes during the 5 years :—			
			Once.	2-3 times.	4-5 times.	6 and more times.
16-34	Strippers and grinders and other card- room workers	52	76.9	19.2	1.9	1.9
	Ring-room and Warehouse workers ..	46	84.8	10.9	2.2	2.2
	Blowing-room workers, etc.	14	71.4	28.6	—	—
30-54	Strippers and grinders and other card- room workers	197	51.3	33.5	9.1	6.1
	Ring-room and Warehouse workers ..	27	70.4	22.2	7.4	—
	Blowing-room workers, etc.	65	66.2	23.1	9.2	1.5
50-69	Strippers and grinders and other card- room workers	189	51.3	32.3	11.1	5.3
	Ring-room and Warehouse workers ..	22	81.8	13.6	4.5	—
	Blowing-room workers, etc.	58	50.0	31.0	15.5	3.5

Consideration of the elimination of the incapacitated from the cardroom.—It must be remembered too that these differences shown between cardroom workers and the other groups of operatives may not show the true position of the cardroom group. If there is any appreciable proportion of persons who work in the cardroom but who are forced to leave it, either because they cannot endure its environment or because their health is affected, then the disparity in rates between this group and the other groups is reduced and is smaller than the true disparity. It is for this reason that the second subsidiary group has been examined—those persons who once worked in the cardroom but had ceased to do so in 1923–27.

At first sight the distribution of the exposed to risk in Table VII would suggest that there was an influx of workers to the cardroom rather than an efflux, since the numbers increase to beyond age 40. This is not necessarily contradictory evidence. The cotton spinning industry has made practically no expansion since 1909. This is shown in the following figures* :—

Estimated Number of Spindles in Great Britain.

1913 = 100.

1900	..	..	..	73
1905	..	..	..	81
1909	..	..	..	97
1910	..	..	..	98
1911	..	..	..	98
1912	..	..	..	99
1913	..	..	..	100
1920	..	..	..	101
1921	..	..	..	101
1922	..	..	..	101
1923	..	..	..	100
1924	..	..	..	101
1925	..	..	..	102
1926	..	..	..	102

Between 1909 and 1926 there has only been a five per cent. increase in the number of spindles. This means that the number of entries to the trade has, since 1909, been practically dependent upon the number of exits—from death or other causes. There were large numbers of entries at the end of the nineteenth and beginning of the twentieth centuries when the industry was quite rapidly expanding but this entry rate must have come to an end by 1909. The result is that the larger numbers who entered before 1909 are found in the older age groups at 1923 and there are smaller numbers in the younger age groups owing to the slackening of this rate of increase.† (The effect of the war

* Daniels and Jewkes. *The Post-War Depression in the Lancashire Cotton Industry.* Journ. Roy. Stat. Soc., XCI. Part II, p. 165, 1928.

† For instance in 1923 the strippers and grinders here dealt with gave a total of 2,774.5 years of exposure, 21 per cent. being at ages 16–29, 57 per cent. at ages 30–49 and 22 per cent. at ages 50–69. In 1927 the years of exposure were 2,622.0, those at ages 30–49 having fallen to 54 per cent., and those at ages 50–69 having risen to 27 per cent.

casualties would also be to produce a higher age distribution.) Naturally there may be some influx too—of workers from the blowing or cotton rooms or of piecers who see no prospect of becoming spinners.

The ring-room and warehouse workers do not show this older age distribution, probably because of the large efflux of young ring-room workers who have no prospect of reaching more highly paid work.

Thus there may be an efflux of workers from the cardroom in spite of the distribution of persons increasing with age.

Eighteen persons definitely stated on their questionnaires that they left the cardroom because their health was affected by the dust, which agrees with Collis's suggestion that there is some elimination of persons whose health is damaged. The absolute figures and rates for the whole group are given in Table XVII and compared with those already given for the strippers and grinders and other cardroom workers (in Table XI).^{*} Comparison of the rates from all causes less respiratory shows that the "ex-cardroom" workers have considerably higher rates than the "present" cardroom workers, especially at the younger ages. It is possible that this is due to a process of selection. Workers who leave their original occupation may be of weaker physique and leave their employment through ill-health (apart from that acquired by environment), so that the population remaining in the particular occupation is to some extent the more physically fit. Unless the control groups are equally stringently selected (and on that point no information is available) the relative position of the cardroom group is understated. Comparing the rates from respiratory diseases (columns 6 and 8) it will be seen that the ex-cardroom workers are, at least, as badly off as the present cardroom workers. (The rates are based on small numbers and fluctuate erratically, in some age groups being below and in some age groups above the strippers' and grinders' rates). In other words the rates *suggest* (though in the absence of similar information for the control group they cannot prove) an elimination from the cardroom of persons who suffer from respiratory complaints, and continue so to suffer even after they have ceased to work in the environment. No doubt persons with asthmatic tendencies, quite apart from any environmental cause, would tend to forsake an occupation in which they were exposed to dust and thus contribute to the respiratory rates of the "ex-cardroom" group. To some extent, therefore, the position of the cardroom workers in comparison with the workers in the ring-room and warehouse is probably an understatement, and the excess of respiratory complaints, it is suggested, is modified by the fact that there is some elimination from the cardroom of workers who lose their health in it. Some of these workers continue to suffer from bronchitic complaints although they have left the cardroom environment, indicating that their health is impaired. This leads to one important point of this inquiry.

^{*} The population of "ex-cardroom" workers was too small to allow disablement rates to be of any value.

TABLE XVII.—Males 1923-27.—Sickness amongst workers not in the cardroom during 1923-27 but who had previously worked in that room (ex-cardroom workers) compared with the sickness of strippers and grinders and other cardroom workers in 1923-27.

Age Group (age last birthday at beginning of year of exposure). (1)	Ex-Cardroom Workers.					Strippers and Grinders and other Cardroom Workers.	
	Person-years of exposure to risk. (2)	Total duration of Sickness in days. Total Number of Claims made.		Number of Days of Sickness per person-year. Number of Claims per 100 person-years.		Number of Days of Sickness per person-year. Number of Claims per 100 person-years.	
		All Causes less Respiratory. (3)	Respiratory Causes. (4)	All causes less Respiratory. (5)	Respiratory Causes. (6)	All Causes less Respiratory. (7)	Respiratory Causes. (8)
16-19	149.5	916 34	39 4	6.13 22.74	.26 2.68	3.90 17.97	.51 1.15
20-29	617.5	3,451 149	242 8	5.59 24.13	.39 1.30	3.88 16.11	.62 2.31
30-39	560.0	2,945 113	509 23	5.26 20.18	.91 4.11	9.23 13.46	.94 3.30
40-49	632.5	3,852 110	2,469 65	6.09 17.39	3.90 10.28	4.07 12.52	1.77 6.52
50-59	590.5	3,842 107	3,811 95	6.51 18.12	6.45 16.09	6.01 17.26	4.60 12.68
60-69	240.0	2,711 46	1,752 32	11.30 19.17	7.30 13.33	11.27 22.89	9.24 20.38
Total Number of Persons exposed.	646						

The origin of the high respiratory rates amongst strippers and grinders.—Are the high respiratory rates found amongst strippers and grinders a product of the past, the sickness being confined to persons whose health was impaired by the conditions previous to the introduction of exhaust ventilation and vacuum for stripping, or are present conditions still producing this excess of respiratory incapacity? Professor Collis in his report of 1908 already quoted (p. 12) expressed the opinion that these improvements would solve the problem and that only the irreparably damaged workers would still suffer. The Trade Union representatives dispute this. The rates of the "ex-cardroom" workers suggest that the excess *does* continue even though the environment is changed, so that it seems probable that the very high rates at the older ages are, at least in part, due to the bad environment to which the older workers were exposed for many years. No excess of respiratory illness is found amongst the younger workers, under age 30, and any operatives over this age in 1923-27 must have been, at least for some time, exposed to the old conditions. This absence of abnormal rates under age 30 and the sudden jump in incidence after that age certainly suggests the presence of previously damaged lives in the older age groups. On the other hand, even if this is so it cannot prove that modern conditions are not injurious to health. It may well be that some years' exposure is needed before health is damaged sufficiently to be apparent in sickness incidence, and workers who have had prolonged exposure can appear only in the older age groups. Evidence that it does not need the extreme of dust and fibre blown out during the old methods of stripping and grinding to produce such an excess of respiratory illness might be adduced from the fact that an excess of these forms of illness is found amongst workers engaged in the earlier cleansing processes—mixing, blowing and scutching. This evidence is very much weakened, however, by the fact that there is (as previously pointed out) a considerable interchange of labour between the cardroom and these other rooms. The excess amongst the latter may only be due to their recruitment from the former of operatives whose health is damaged. In addition no data are available showing the actual prevalence of dust and fibre in these various rooms.

It might be thought that examination of the annual movement of the sickness rates during 1923 to 1927 would show whether the incidence of respiratory diseases is becoming less acute, through the gradual elimination of such operatives with damaged health, or whether the incidence is still maintained by the addition of persons incapacitated by the present environmental conditions. Actually such evidence may not be valid. The sickness incidence of the general insured population of the whole country has been rising fairly steadily over the last few years. This phenomenon is probably explicable in terms of quite a number of causes, e.g., epidemics, wage levels, unemployment, and in discussing the

movement from year to year it is impossible to isolate the effect of any one particular factor. In the population here dealt with it probably would not be possible to distinguish between these general factors affecting its sickness experience and the one particular factor—the environment—with which the inquiry is specially concerned. In addition the number of persons involved in the inquiry is too small to allow any such analysis to give reliable results. The final conclusion must be that, at present, sickness statistics do not afford any evidence that modern conditions *are* producing an abnormal amount of respiratory sickness amongst the male workers in the cardroom, but that this lack of evidence is not conclusive since valid evidence *of this type* cannot be obtained until another ten or fifteen years have elapsed. After that time there will exist a population of cardroom workers who have been exposed for a considerable number of years to the improved conditions only, and it will be possible to see then whether they, like the workers who were exposed to the pre-vacuum stripping conditions, suffer abnormally from respiratory illness.

Comparison of sickness between mills spinning coarse and fine counts.—One of the questions asked on the occupational questionnaire circulated to the members of the Insurance Section of the Cardroom Association related to the mill or mills in which the operatives worked during 1923–27. It was hoped, on the basis of the answers, that it would be possible to divide up the workers according to whether they worked in a mill spinning “coarse, medium or fine counts.” The importance of the difference lies in two points :

- (1) where coarse counts are to be spun rather more stripping (*i.e.*, cleaning of the carding wires) must be carried out. Also during the carding process itself it is stated that more fibres are thrown off into the air ;
- (2) the finer counts are spun mainly from Egyptian cotton and the coarser from American cotton. It has been suggested that the dust eliminated from the Egyptian cotton may be finer and sandier than that contained in the American cotton, and may be more or less injurious to health if inhaled.

Unfortunately it was found impracticable to divide the workers up on this basis of counts spun, the first reason being that there was, in the five years, a considerable interchange of labour between mills. Calculation of the length of exposure to risk in each would have been an elaborate procedure, and, also, in the case of sickness it would have been quite arbitrary whether it was debited to the mill in which the man was at work at its onset or to a mill which he had recently left—which might belong to a different category when judged by the counts spun. A second, and still more important, source of fallacy was found in the absence of

reply in some cases, especially for workers who had died. To ignore these would be possibly to exclude the very persons with whom the study was largely concerned. On the other hand it was possible to attempt one very broad comparison. In the Oldham district is situated a large part of the "American" section of the industry. In Bolton the mills are mainly devoted to spinning with Egyptian cotton the finer counts of yarn. Neither district is *absolutely* confined to one type; in Oldham there are some fine spinning mills while in Bolton there are to be found coarse spinning mills, but, as a whole, Oldham may fairly be taken for the "coarse" category and Bolton as the "fine." Between the two towns the interchange of labour is relatively slight (the males who worked in both towns during 1923-27 numbered only one or two), and the town of residence was known for all members, alive or dead. As a rough comparison, therefore, of the coarse and fine spinning mills the claim rates for the cardroom group of workers were worked out for Oldham and its immediately surrounding district (*e.g.*, Middleton, Hollinwood) and for Bolton. Unfortunately the numbers involved (in the Oldham group there were 914 workers and in Bolton 265) were so small that the rates were too unreliable to allow any deductions to be made, and they have therefore been rejected. In other words, this investigation did not allow the sickness experience to be related to the type of cotton and number of counts spun.

Unemployment and rates of pay.—A sickness rate may be the result of many factors, *e.g.*, working environment, living environment, poverty and unemployment. With regard to the last mentioned factors it is possible that a man who is unemployed or on low wages is more inclined to "sign on" and draw benefit when ill than a man in full employment earning high wages. The former has little to lose, the latter loses according to the difference between his wages and the level of the sickness benefit he can draw. It does not seem likely that such factors are operative in producing the differences found between strippers and grinders and other cardroom workers on the one hand and the rest of the workers in the spinning mills on the other. Their influence, it would seem, would be operative on most forms of sickness and not so very especially on the respiratory forms. It may be of service, however, to consider these points.

The living environment does not differ materially between the groups. They are all situated in the same Lancashire towns and under much the same housing and sanitary conditions. In wage the cardroom workers have some advantage. During the years 1923-27 the average earnings of a stripper and grinder for a *full working week* were £3 4s. The carder would receive considerably more than this and the undercarder a little more. In the ring-room the overlooker would be about on a par with the carder or undercarder, but the jobbers would earn less than the strippers and grinders. The average wage in the ring-room would be about £2 2s. per week against about £3 in the cardroom. The cardroom

workers would be also better off than the warehouse group which is composed chiefly of cop packers on a wage of about £2 14s. for a full week.

Actually, of course, in these years a full week was not being worked. There was a considerable amount of unemployment and short-time (the latter at least an average of 25 per cent. of full time). On the other hand this factor affects all groups nearly equally, since the work of one group is dependent upon that of the other. If the cardroom is unemployed the spinners and warehouse workers must shortly become unemployed too. What lack of balance there is affects the preparatory workers slightly more than the spinning section, but the difference is not sufficient for this factor to be an important one in discussing such disparate sickness rates. In addition it must be remembered that the factor of the working environment, which is the crucial point in the inquiry, is weakened by the amount of short-time worked and unemployment experienced. The cardroom workers are not exposed for so long a day to the environment of which they make complaint. If their conditions of work are responsible for their high level of respiratory illness, it is possible that, in this period of years, their sickness rates are below normal through absence of normal exposure.

A psychological factor might contribute to the strippers' and grinders' excess of bronchitis. If it is generally believed amongst these workers that they are likely to suffer from such illness they may be more prone to "sign on" at such attacks or to translate other symptoms into respiratory symptoms, while there might be a tendency for local medical practitioners to certify respiratory sickness more easily amongst operatives whom they know are exposed to a dusty environment. Though such psychological tendencies might contribute to the rates found it cannot be held possible that they could produce such very large discrepancies as have been found.

There is, therefore, on the whole, no evidence of any important influences to explain the differing sickness rates of the groups except that of the environmental conditions of work.

FEMALES.

Occupations.

In the description given of the processes carried out and the environment in the cotton spinning mill (*vide* pp. 7-11) it was pointed out that women are largely employed in three distinct parts of the mill. These are (1) as machine "tenters" in that section of the cardroom (or infrequently in another room altogether) which contains the ribbon lap machines, draw-frames, and speed-frames; (2) as ring spinners in the ring spinning room; and (3) as winders and reeler in the winding, warping and reeling department. The machine tenters in the cardroom, it was pointed out, are exposed, to a minor extent, to the dust and fibre evolved in the carding and stripping and grinding processes. The can tenters who remove the full cans of slivers from the carding machines and

replace them with empty ones are, probably, of the women, most exposed to the dust. The tenters on the frames the other side of the cardroom are involved only in so far as the dust is blown from one side of the room to the other. On the other hand they may be exposed to additional floating fibre produced in their own processes. As regards *dust* the problem for all the women in the cardroom must certainly be far less acute than it is for the male strippers and grinders.

The occupations of the female members of the Association of Card, Blowing and Ring Room Workers were ascertained by questionnaire as described on p. 23. Particulars were obtained for 28,634 out of the 30,101 members, or for 95 per cent. For the remaining 1,467 occupation at entry into the Society was used. Some of these may have transferred to other occupations before or during the period of years investigated, but the total proportion involved is so small that it could have no appreciable effect upon the sickness rates found. For members of the Operative Spinners' and Amalgamated Weavers' Societies occupation at entry into the Society was used in all cases, and, again some of these may have transferred before 1923 to other occupations. The numbers found in each occupation are set out in Table XVIII. Just over 20,000 members of the Association of Card, Blowing and Ring Room Workers were found in the cardroom, made up of a small proportion of can tenters near the carding engines and a very large proportion of machine tenters on the speed and draw frames and combing machines. Only 147 workers were returned as being employed in the blowing and cotton rooms. These have been added to the cardroom group, being too few in number to serve any other purpose. This Society provided also a comparative group of approximately 5,000 spinners. To the second control group of winders, reelers, etc., the Cardroom Association contributed 1,151 members, and the Operative Spinners 179 and Amalgamated Weavers 1,347. Thus there are three main occupational groups to examine, as follows :—

Cardroom workers	20,500
(all members of Cardroom Association, A.S. 1265).	
Spinners and allied workers	5,243
(all members of Cardroom Association, A.S. 1265).	
Winders, reelers and allied workers	2,677
(members of Cardroom Association, A.S. 1265, Operative Spinners, A.S. 1144 and Amalgamated Weavers, A.S. 1111).	

Table XVIII shows that there is a certain amount of transference of workers between the cardroom and the spinning and winding rooms. In the years covered by the inquiry 160 workers were found in the spinning room, and 353 workers in the winding room, who had previously worked in the cardroom. The proportion of spinners who had at one time been cardroom workers is not high so that this comparative group is probably little affected by such transference. With winders on the other hand the propor-

tion is very considerable—out of 1,504 such workers belonging to the Cardroom Association 353 or roughly one quarter had once been in the cardroom. Over half of this control group is made up of members of the Amalgamated Weavers' and Operative Spinners' Societies whose occupation was taken as the occupation *at entry* into those Societies. It is thus quite probable that some of these workers had previously worked in the cardroom but no such information being available (except for members of the Cardroom Association) they have been included in the winders' group. For this reason, that it may contain a proportion of workers who once worked in the cardroom, the winders' group is a less satisfactory comparative group than is the spinners' group, which is unlikely to contain any appreciable number of transferred workers. It is also a less reliable control group because half of the exposed persons belong to other Approved Societies, and differences of administration may affect sickness rates appreciably. The spinners and cardroom workers all belong to the same society, *i.e.*, the Association of Card, Blowing and Ring Room Operatives. The members of the Cardroom Association who were thus found in spinning or winding rooms but who previously worked in cardrooms have not been included in the comparative groups. They were too few in number to be treated separately, but analysis has been made of those members who were found in 1923-27 outside the trade but who were originally in the cardroom. Those outside the trade who gave no reference to previous mill work have been excluded altogether from the investigation, as have also the few workers in other mill employment and the prolonged cases of workmen's compensation.

TABLE XVIII.—*The numbers found in each occupational group amongst female members of the Card, Blowing and Ring Room Insurance Approved Society.*

Can tenters, engine head tenters, speed frame and draw frame tenters (<i>i.e.</i> , slubbers, rovers, combers, etc.) ..	20,353	
Cotton room, cotton mixing and cotton chamber workers	93	
Blowing room operatives	54	
		20,500
Ring spinners, ring-room workers and thread doublers..	5,243	
Winders, beamers, reelers and warpers	1,151	
Outside the trade in 1923-27, but previously in the cardroom		1,162
Spinning room workers in 1923-27 who previously worked in the cardroom	160	
Winding-room workers in 1923-27 who previously worked in the cardroom	353	
Outside the trade in 1923-27 and no reference to previous mill work	1,404	
Odd jobs in mill: warehouse workers, roller coverers, and other odd jobs	92	
On workmen's compensation benefits during all or most of 1923-27	36	
		2,045
Total ..		30,101

Sickness.

No occupational mortality statistics exist for women and there is no other evidence as to their health in these particular employments and environments. Reference to the sickness statistics collected in this inquiry may, therefore, be immediately made. The analysis has been carried out separately for single (including widowed) and married women, since it is well known that the incidence of sickness differs widely in the two groups. Single women who married during 1923 to 1927 were transferred to the married group at the appropriate date and their exposure continued in the married group.* In Table XIX are set out the figures relating to all causes of sickness for the three occupational groups of single women. In Table XX similar figures are given for the disablement experience of the single women.

The analysis followed precisely the same course as was adopted for the men, the only differences being the separation of the single from the married, and some change in the age groups made expedient by the numbers exposed to risk. There were sufficient women aged 20 to 29 to make it possible to divide this age group into two, 20-24 and 25-29 years, while there were too few over age 50 to make any further subdivision advisable. In addition there were too few *married* women of ages 16 to 19 to serve any purpose at all (especially as their sickness was predominantly that associated with pregnancies), so that no rates are given for married women under 20 years of age.

*Women, Single and Widowed.**Sickness and Disablement rates of the occupational groups from all causes of illness, and from respiratory causes.*

Table XIX shows that, from all causes of sickness taken together, the cardroom workers suffer less than either the ring spinning group or the winding and reeling group. The figures suggest that their rates may be in excess in the final age groups but the numbers exposed at these ages in the control groups are too small to allow the differences to be stressed. For the same reason the disablement figures are not very satisfactory. Taken as a whole the cardroom workers seem to have higher rates than the ring spinners, but higher rates than the winders in only two of the six age groups so that it is difficult to accept the differences as significant.

* To save time women who became widows during the period of investigation were *not* transferred from the married to the single group. The number was small and their transference or non-transference was immaterial.

Women who at or after marriage were transferred to Class K were made exits at date of marriage and not kept in the exposed to risk for their period in Class K.

When the sickness experience is divided into sickness from respiratory causes (these causes being, as with the men, bronchitis, bronchial catarrh, asthma, emphysema, congestion of the lungs and pneumonia) and sickness from non-respiratory causes (Tables XXI to XXV), the results found are as follows:—the workers in the cardroom have, up to age 50, *less* sickness from *non-respiratory causes* than the ring spinners. At ages 50–69 they have some excess. From *respiratory causes* there is little difference between the two groups before age 24, but after that age the cardroom workers have a *distinct excess* of such forms of illness (*vide* Table XXIV and fig. (ii)). In other words although these single women between the ages of 25 and 49 in the cardroom suffer less than the ring spinners from non-respiratory causes of illness they certainly suffer more from respiratory forms.

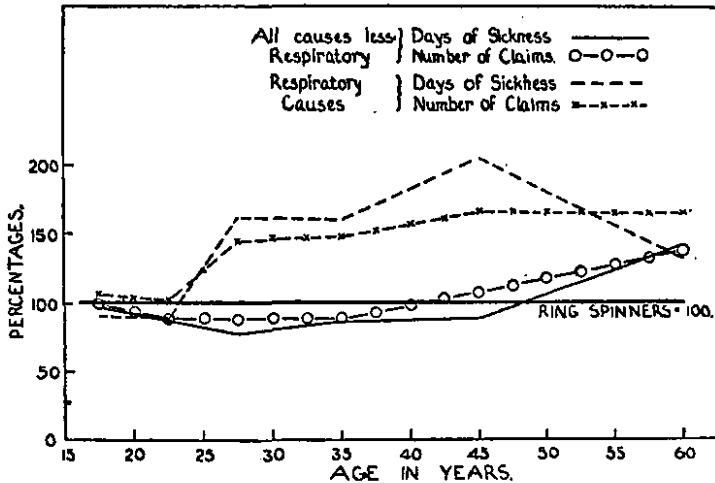


FIG. (ii).

1923–27. Sickness rates found for Cardroom Workers, FEMALES, single and widowed (days of sickness per person-year and number of claims per 100 person-years), expressed as percentages of the rates found for Ring Spinners and Allied Workers.

Comparing them with the winders and reelers it is seen that the sickness rates from *all causes less respiratory causes* of winders and reelers do not differ very widely from the rates of the cardroom workers. Up to age 40 the cardroom workers suffer to a slightly less extent. The percentages in Table XXIV show that the difference, except at ages 25–29, is not large. At ages 40–49 the cardroom workers show some excess (though shorter claims, *vide* Table XXVI); at ages above 50 there is again little difference. From *respiratory causes* the cardroom workers show some excess of claims in every age group—including the earlier ages, under 24—and an excess of days of sickness in four of the six age groups.

The exposed to risk in the winders' occupational group is small and discussion of the level of the rates in particular age groups is not justifiable.

The general conclusion is that the cardroom workers have a little less sickness than both spinners and winders and reelers *except* in the case of respiratory diseases. Of respiratory diseases the cardroom workers have some excess, but by no means the excess found for the males. The male strippers' and grinders' rates from respiratory diseases after age 30 were found to be two and three times as high as the corresponding rates for ring-room and warehouse operatives. Comparison of figures (i) and (ii) shows that the excess amongst these females (single and widowed) is considerably less than this.

The disablement rates are, as already pointed out, based upon too small numbers to allow detailed consideration. The cardroom workers have an excess of respiratory disablement when compared with the winders but not when compared with the spinners. Little reliance can be placed upon this result.

The duration of sickness claims.—Table XXVI shows that the excess of short-period respiratory illness amongst cardroom workers is due more to a *larger number of claims* being made than to a disproportionate *length of claim*. The cardroom workers have, from ages 25 to 50, it is true, an average length of sickness somewhat higher than that of the spinners, but this excess (109, 109 and 122 per cent. of the spinners' duration in the three age groups) is less than their excess in number of claims (146, 149 and 166 per cent. of the spinners' claims). Compared with the winders and reelers their average duration of claim is higher in four out of the six age groups, but, again, except at ages 16-19, the excess in duration is not so large as the excess in claims made. It therefore appears that the excess of respiratory illness amongst the single women is due partially to *more* claims being made, and partially to *longer* claims being made, the former being the more important factor.

With the men the larger number of claims made in the cardroom was further analysed to show that it was composed both of more persons claiming and of more persons making repeated claims. This analysis has not been carried out for the women partly because their excess of illness from respiratory causes is so much less than the excess amongst the men, and partly because so many women transfer from the single to the married group during the inquiry that the definition of a repeated claimant, if the single and married groups are kept distinct, must be very artificial.

TABLE XIX.—*Females, single and widowed, 1923-27.—The SICKNESS experience from all causes.*

Workers in the Cardroom.				Ring Spinners and Allied Workers.				Winders, Reelers and Allied Workers.			
Age Group (age last birthday at beginning of year of exposure).	Person- years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person- year of exposure.	Person- years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person- year of exposure.	Card- room Workers as per- centage of these Ring Spinners and Allied Workers.	Person- years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person- year of exposure.	Card- room Workers as per- centage of these Winders, Reelers and Allied Workers.
16-19	14,213·5	91,898	6·47	4,468·5	30,365	6·80	95	2,157·5	14,054	6·51	99
20-24	11,336·0	85,632	7·55	3,689·0	32,211	8·73	86	2,070·0	16,974	8·20	92
25-29	6,322·0	42,197	6·67	1,447·5	11,898	8·22	81	935·5	8,447	9·03	74
30-39	8,109·5	65,325	8·06	1,954·0	17,333	8·87	91	1,316·5	10,934	8·31	97
40-49	4,376·5	44,794	10·24	617·0	6,411	10·39	99	577·5	4,777	8·27	124
50-89	3,434·5	59,245	17·25	246·0	3,066	12·46	138	266·0	4,620	17·37	99
Total number of persons exposed	13,251			3,423				1,974			

TABLE XX.—*Females, single and widowed, 1923-27.—The DISABLEMENT experience from all causes.*

Workers in the Cardroom.				Ring Spinners and Allied Workers.			Winders, Reelers and Allied Workers.		
Age Group (age last birthday at beginning of year of exposure).	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.
16-19	8,422.5	7,668	.91	2,835.0	1,850	.65	1,399.5	1,512	1.08
20-24	11,265.5	36,288	3.22	3,660.0	10,158	2.78	2,049.0	7,186	3.50
25-29	6,255.0	28,566	4.57	1,428.0	7,340	5.14	918.5	2,198	2.39
30-39	7,977.5	50,385	6.32	1,881.5	8,809	4.68	1,290.5	5,225	4.05
40-49	4,300.5	46,462	10.80	604.5	3,819	6.32	554.5	6,593	11.89
50-69	3,367.0	113,479	33.70	239.5	3,905	16.30	259.0	8,093	31.25

TABLE XXI.—*Females, single and widowed, 1923-27.—The number of person-years of exposure to risk, the duration of SICKNESS suffered and the number of claims made from (1) all causes of sickness less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group. (Age last birthday at beginning of year of exposure).	Workers in the Cardroom.			Ring Spinners and Allied Workers.			Winders, Reelers and Allied Workers.		
	Person-years of exposure to risk.	Total duration of Sickness in days. Total number of Claims made.		Person-years of exposure to risk.	Total duration of Sickness in days. Total number of Claims made.		Person-years of exposure to risk.	Total duration of Sickness in days. Total number of Claims made.	
		All Causes less respiratory.	Respiratory Causes.		All Causes less respiratory.	Respiratory Causes.		All Causes less respiratory.	Respiratory Causes.
16-19	14,213·5	84,560 3,385	7,338 221	4,468·5	27,805 1,076	2,560 65	2,157·5	13,336 510	718 31
20-24	11,336·0	78,662 2,811	6,970 218	3,689·0	29,664 1,050	2,547 69	2,070·0	16,226 548	748 28
25-29	6,322·0	37,921 1,234	4,276 121	1,447·5	11,286 323	612 19	935·5	7,735 214	712 15
30-39	8,109·5	57,145 1,672	8,180 228	1,954·0	16,105 458	1,228 37	1,316·5	9,997 278	937 30
40-49	4,376·5	36,937 968	7,875 201	617·0	5,870 126	541 17	577·5	4,012 89	765 22
50-69	3,434·5	43,228 922	16,017 368	246·0	2,204 48	862 16	266·0	3,333 75	1,287 27
Total number of persons exposed	13,251			3,423			1,974		

TABLE XXII.—*Females, single and widowed, 1923–27.—The number of person-years of exposure to risk, the duration of DISABLEMENT suffered and the number of claims made from (1) all causes of disablement less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group. (Age last birthday at beginning of year of exposure).	Workers in the Cardroom.			Ring Spinners and Allied Workers.			Winders, Reelers and Allied Workers.		
	Person-years of exposure to risk.	Total duration of disablement in days. Total number of Claims made.		Person-years of exposure to risk.	Total duration of disablement in days. Total number of Claims made.		Person-years of exposure to risk.	Total duration of disablement in days. Total number of Claims made.	
		All Causes less respiratory.	Respiratory Causes.		All Causes less respiratory.	Respiratory Causes.		All Causes less respiratory.	Respiratory Causes.
16–19	8,422·5	6,463 67	1,205 18	2,835·0	1,308 20	542 2	1,399·5	1,400 16	112 4
20–24	11,265·5	33,174 216	3,114 25	3,660·0	8,259 72	1,899 14	2,049·0	7,095 53	91 2
25–29	6,255·0	25,845 119	2,721 20	1,428·0	6,840 38	500 4	918·5	2,146 24	52 1
30–39	7,977·5	46,903 215	3,482 28	1,881·5	7,704 57	1,105 11	1,290·5	5,066 38	159 2
40–49	4,300·5	36,989 170	9,473 50	604·5	3,767 22	52 1	554·5	3,196 25	3,397 19
50–69	3,367·0	85,414 349	28,065 144	239·5	1,822 12	2,083 9	259·0	7,408 29	685 4

TABLE XXIII.—*Females, single and widowed, 1923–27.*—SICKNESS RATES. *The number of days of sickness per person-year of exposure and the number of claims per 100 person-years of exposure from (1) all causes of sickness less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group.	Workers in the Cardroom.		Ring Spinners and Allied Workers.		Winders, Reelers, and Allied Workers.	
(Age last birthday at beginning of year of exposure.)	Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.	
(1)	All Causes less Respiratory. (2)	Respiratory Causes. (3)	All Causes less Respiratory. (4)	Respiratory Causes. (5)	All Causes less Respiratory. (6)	Respiratory Causes. (7)
16–19 ..	5.95	.52	6.22	.57	6.18	.33
	23.82	1.55	24.08	1.45	23.64	1.44
20–24 ..	6.94	.61	8.04	.69	7.84	.36
	24.80	1.92	28.46	1.87	26.47	1.35
25–29 ..	6.00	.68	7.80	.42	8.27	.76
	19.52	1.91	22.31	1.31	22.88	1.60
30–39 ..	7.05	1.01	8.24	.63	7.59	.71
	20.62	2.81	23.44	1.89	21.12	2.28
40–49 ..	8.44	1.80	9.51	.88	6.95	1.32
	22.12	4.59	20.42	2.76	15.41	3.81
50–69 ..	12.59	4.66	8.96	3.51	12.53	4.84
	26.85	10.71	19.51	6.50	28.20	10.15

TABLE XXIV.—*Females, single and widowed, 1923-27.—The sickness rates of workers in the cardroom expressed as a percentage of the similar rates of other groups (females) of cotton operatives (1) for all causes of sickness less particular respiratory causes, (2) for particular respiratory causes.*

Age Group. (Age last birthday at beginning of year of exposure.)	Rates for Workers in the Cardroom as percentage of rates for ring spinners and allied workers.				Rates for Workers in the Cardroom as percentage of rates for winders, reelers and allied workers.			
	All Causes less Respiratory.		Respiratory Causes.		All causes less Respiratory.		Respiratory Causes.	
	Days of Sickness.	Number of Claims.	Days of Sickness.	Number of Claims.	Days of Sickness.	Number of Claims.	Days of Sickness.	Number of Claims.
16-19 ..	96	99	91	107	96	101	158	108
20-24 ..	86	87	88	103	89	94	169	142
25-29 ..	77	87	162	146	73	85	89	119
30-39 ..	86	88	160	149	93	98	142	123
40-49 ..	89	108	205	166	121	144	136	120
50-69 ..	141	138	133	165	100	95	96	106

TABLE XXV.—*Females, single and widowed, 1923-27.—Disablement rates.—The number of days of disablement per person-year of exposure and the number of claims per 100 person-years of exposure for (1) all causes of disablement less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group. (Age last birthday at beginning of year of exposure).	Workers in the Cardroom.		Ring Spinners and Allied Workers.		Winders, Reelers, and Allied Workers.	
	Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.	
	All Causes less Respiratory. (2)	Respiratory Causes. (3)	All Causes less Respiratory. (4)	Respiratory Causes. (5)	All Causes less Respiratory. (6)	Respiratory Causes. (7)
16-19 ..	.77 .80	.14 .21	.46 .71	.19 .07	1.00 1.14	.08 .29
20-24 ..	2.94 1.92	.28 .22	2.28 1.97	.52 .38	3.48 2.59	.04 .10
25-29 ..	4.13 1.90	.44 .32	4.79 2.66	.35 .28	2.34 2.61	.06 .11
30-39 ..	5.88 2.70	.44 .35	4.09 3.03	.59 .58	3.93 2.94	.12 .15
40-49 ..	8.60 3.95	2.20 1.16	6.23 3.64	.09 .17	5.76 4.51	6.13 3.43
50-69 ..	25.37 10.37	8.34 4.28	7.61 5.01	8.70 3.78	28.60 11.20	2.64 1.54

(5085)

TABLE XXVI.—*Females, single and widowed, 1923-27.—The average duration of each sickness claim* (first 26 weeks of incapacity) from (1) all causes of sickness less particular respiratory diseases and (2) particular respiratory diseases, amongst the occupational groups in spinning mills. In days.*

Age Group.	18-19		20-24		25-29		30-39		40-49		50-69	
(Age last birthday at beginning of year of exposure).	All Causes less Respiratory.	Respiratory Causes	All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes
Workers in the cardroom ..	25	33	28	32	31	35	34	36	38	39	47	44
Ring Spinners and allied workers ..	26	39	28	37	35	32	35	33	47	32	46	54
Winders, reelers and allied workers ..	26	23	30	27	36	47	36	31	45	35	44	48
<i>Cardroom Workers as percentage of ring spinners etc.</i>	<i>98</i>	<i>85</i>	<i>100</i>	<i>88</i>	<i>89</i>	<i>109</i>	<i>97</i>	<i>109</i>	<i>81</i>	<i>122</i>	<i>102</i>	<i>81</i>
<i>Cardroom Workers as percentage of winders, reelers etc.</i>	<i>98</i>	<i>143</i>	<i>93</i>	<i>110</i>	<i>86</i>	<i>74</i>	<i>97</i>	<i>116</i>	<i>84</i>	<i>111</i>	<i>107</i>	<i>92</i>

* *Vide* footnote to Table XIV.

D2

2

Women, Married.

Sickness and Disablement rates from all causes of illness and from respiratory causes.—Table XXVII shows the sickness rates for married women from all causes of illness. As with the single women, the cardroom workers have a better experience than the other two occupational groups, at least up to age 50. After that age, when compared with the spinners, they have a heavier rate of sickness. In disablement (Table XXVIII) taking into account the small numbers exposed to risk, no significant difference in the three sets of rates is apparent. When the sickness is analysed into the two cause groups, respiratory and non-respiratory (Tables XXIX–XXXIII and fig. (iii)) it is seen that up to age 50 the married women in the cardroom have only about 80 to 90 per cent. of the sickness of the ring spinners from the *non-respiratory causes*. At ages 50–69 they have some excess of these non-respiratory forms of illness. *From respiratory causes* they suffer less in the first years of exposure, 20–24, slightly more at ages 25–29, less again at ages 30–39, and considerably more after age 40 is reached. Compared with the second group, the winders and reelers, the married cardroom workers have less non-respiratory illness throughout working life and less respiratory illness except in the two age groups 30–39 and 40–49.

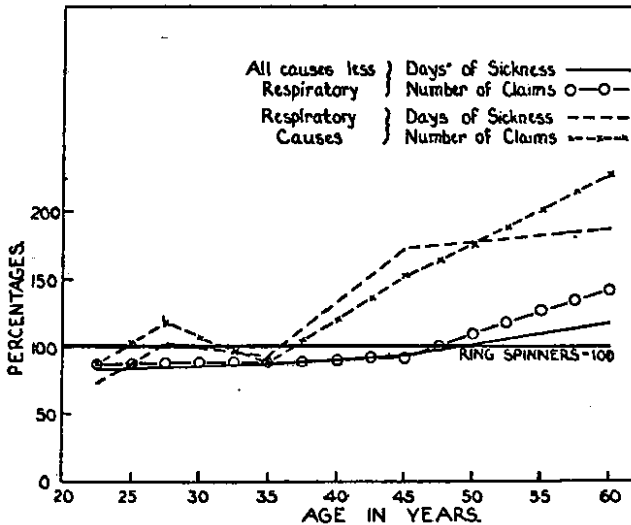


FIG. (iii).

1923–27. Sickness rates found for Cardroom Workers, FEMALES, married, (days of sickness per person-year and number of claims per 100 person-years), expressed as percentages of the rates found for Ring Spinners and Allied Workers.

Amongst the single women in the cardroom an excess of respiratory illness, it will be remembered, was observed after age 25. Judging by the comparison with the larger control group here, the spinners, the married women in the cardroom show no greater incidence of these diseases as early in life as this, and it is not until age 40 is reached that an excess is apparent. Possibly a break in their exposure to risk in the first years of married life may delay the onset of the respiratory illnesses. This excess found at the older ages, is, as with the single women, certainly due rather to an abnormal number of claims being made and not to an exceptional (average) length of claim (Table XXXIV). The disablement rates are based upon too few lives to allow discussion.

Consideration of the elimination of the incapacitated from the cardroom.—It was shown for the men (pp. 44-45, Table XVII) that there was probably an elimination of workers from the cardroom whose health was impaired by its environment, or who found that they were unable to work there. A similar investigation has been made for the women, single and married, and the results are given in Tables XXXV and XXXVI. The "ex-cardroom" group consists of those workers who stated on the questionnaire relating to the occupations that they were not in a cardroom during 1923-27 but had once worked there. Comparing these workers (single women—Table XXXV) with the cardroom workers it is seen that they have appreciably higher rates from all causes less respiratory diseases in every age group except the last. This is similar to the result found for the men and suggests again that amongst those who have left an employment there tend to be congregated those who left because of general unfitness—apart from any environmental causes. From respiratory causes they have also higher rates than the cardroom workers in most of the age groups, rates which are therefore, as a whole, still higher than those for spinners or winders and reelers. In other words single women who have ever worked in the cardroom show a considerable excess of respiratory illness—either because there is an elimination of persons whose health has been damaged by the environment of the cardroom, or because persons with bronchitic and asthmatic tendencies find work in its atmosphere uncongenial or impossible and thus tend to be found in the "ex-cardroom" group. For married women this selective effect is not so apparent (as would be expected since married women would tend to move in and out of employment more readily and for more reasons other than health than single women). The rates in their case from all causes less respiratory diseases do not differ very significantly between the cardroom and the ex-cardroom workers. The rates for respiratory causes are, taken as a whole, at least as high in the two groups.

TABLE XXVII.—*Females, married, 1923-27.—The SICKNESS experience from all causes.*

Age Group (age last birthday at beginning of year of exposure).	Workers in the Cardroom.			Ring Spinners and Allied Workers.				Winders, Reelers and Allied Workers.			
	Person- years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person- year of exposure.	Person- years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person- year of exposure.	Card- room Workers as per- centage of these Ring Spinners and Allied Workers.	Person- years of exposure to risk.	Total duration of sickness in days.	Number of days of sickness per person- year of exposure.	Card- room Workers as per- centage of these Winders, Reelers and Allied Workers.
20-24	3,404.5	60,999	17.92	1,238.5	27,680	22.35	80	341.0	6,604	19.37	93
25-29	7,487.5	109,349	14.60	1,929.0	32,934	17.07	86	734.0	12,366	16.85	87
30-39	12,980.5	184,184	14.19	3,558.0	58,328	16.39	87	1,199.5	16,983	14.16	100
40-49	5,633.0	81,394	14.45	987.5	14,106	14.28	101	438.5	7,587	17.30	84
50-69	2,476.0	48,897	19.75	266.0	4,000	15.04	131	189.0	3,953	20.92	94
Total number of persons exposed..	9,237			2,386				928			

TABLE XXVIII.—*Females, married, 1923-27.—The DISABLEMENT experience from all causes.*

Age Group (age last birthday at beginning of year of exposure).	Workers in the Cardroom.			Ring Spinners and Allied Workers.			Winders, Reelers and Allied Workers.		
	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.	Person- years of exposure to risk.	Total duration of disablement in days.	Number of days of disablement per person- year of exposure.
20-24	2,998·5	8,098	2·70	1,101·5	3,743	3·40	292·5	1,291	4·41
25-29	6,488·5	16,401	2·53	1,618·5	3,542	2·19	613·0	1,371	2·24
30-39	11,510·0	59,159	5·14	3,013·0	15,994	5·31	1,033·5	6,567	6·35
40-49	5,267·5	43,188	8·20	912·0	8,451	9·27	402·0	2,893	7·20
50-69	2,381·0	67,226	28·23	252·5	6,774	26·83	176·0	4,757	27·03

TABLE XXIX.—*Females, married, 1923–27.—The number of person-years of exposure to risk, the duration of Sickness suffered and the number of claims made from (1) all causes of sickness less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group.	Workers in the Cardroom.			Ring Spinners and Allied Workers.			Winders, Reelers and Allied Workers.		
	Person-years of exposure to risk.	Total duration of Sickness in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of Sickness in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of Sickness in days. Total number of claims made.	
		All Causes less Respiratory.	Respiratory Causes.		All Causes less Respiratory.	Respiratory Causes.		All Causes less Respiratory.	Respiratory Causes.
20–24	3404·5	56,922 1,628	4,077 113	1238·5	25,608 678	2,072 48	341·0	6,138 166	466 12
25–29	7487·5	101,332 2,752	8,017 236	1929·0	30,909 818	2,025 52	734·0	10,958 272	1,408 23
30–39	12980·5	167,092 4,318	17,092 460	3558·0	53,169 1,374	5,159 147	1199·5	15,925 407	1,058 31
40–49	5633·0	68,069 1,712	13,325 345	987·5	12,743 323	1,363 40	438·5	6,771 151	816 15
50–69	2476·0	35,522 828	13,375 297	266·0	3,233 62	767 14	189·0	2,832 60	1,121 23
Total Number of persons exposed ..	9,237			2,386			928		

TABLE XXX.—*Females, married, 1923-27.—The number of person-years of exposure to risk, the duration of Disablement suffered, and the number of claims made from (1) all causes of disablement less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group. (Age last birthday at beginning of year of exposure).	Workers in the Cardroom.			Ring Spinners and Allied Workers.			Winders, Reelers and Allied Workers.		
	Person-years of exposure to risk.	Total duration of disablement in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of disablement in days. Total number of claims made.		Person-years of exposure to risk.	Total duration of disablement in days. Total number of claims made.	
		All Causes less Respiratory.	Respiratory Causes.		All Causes less Respiratory.	Respiratory Causes.		All Causes less Respiratory.	Respiratory Causes.
20-24	2998·5	7,650 113	448 11	1101·5	3,308 45	437 6	292·5	1,291 12	— —
25-29	6488·5	14,585 169	1,816 18	1618·5	3,115 36	427 4	613·0	1,159 14	212 4
30-39	11510·0	52,662 406	6,497 60	3013·0	13,984 130	2,010 16	1033·5	6,167 39	400 5
40-49	5267·5	35,783 222	7,405 51	912·0	5,908 41	2,543 10	402·0	2,885 25	8 1
50-69	2381·0	44,982 228	22,244 107	252·5	6,629 32	145 3	176·0	3,156 18	1,601 9

TABLE XXXI.—*Females, married, 1923-27. Sickness rates.—The number of days of sickness per person-year of exposure and the number of claims per 100 person-years of exposure from (1) all causes of sickness less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group.	Workers in the Cardroom.		Ring Spinners and Allied Workers.		Winders, Reelers and Allied Workers.	
(Age last birthday at beginning of year of exposure.)	Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of sickness per person-year of exposure. Number of claims per 100 person-years of exposure.	
(1)	All Causes less Respiratory. (2)	Respiratory Causes. (3)	All Causes less Respiratory. (4)	Respiratory Causes. (5)	All Causes less Respiratory. (6)	Respiratory Causes. (7)
20-24 ..	16.72	1.20	20.68	1.67	18.00	1.37
	47.82	3.32	54.74	3.88	48.68	3.52
25-29 ..	13.53	1.07	16.02	1.05	14.93	1.92
	36.75	3.15	42.41	2.70	37.06	3.13
30-39 ..	12.87	1.32	14.94	1.45	13.28	.88
	33.27	3.54	38.62	4.13	33.93	2.58
40-49 ..	12.08	2.37	12.90	1.38	15.44	1.86
	30.39	6.12	32.71	4.05	34.44	3.42
50-69 ..	14.35	5.40	12.15	2.88	14.98	5.93
	33.44	12.00	23.31	5.26	31.75	12.17

TABLE XXXII.—*Females, married, 1923-27.*—The sickness rates of workers in the cardroom expressed as a percentage of the similar rates of other groups (females) of cotton operatives (1) for all causes of sickness less particular respiratory causes, (2) for particular respiratory causes.

Age Group.	Rates for Workers in the Cardroom as percentage of rates for ring spinners and allied workers.				Rates for Workers in the Cardroom as percentage of rates for winders, reelers and allied workers.			
	All Causes less Respiratory.		Respiratory Causes.		All Causes less Respiratory.		Respiratory Causes.	
	Days of Sickness.	Number of Claims.	Days of Sickness.	Number of Claims.	Days of Sickness.	Number of Claims.	Days of Sickness.	Number of Claims.
20-24 ..	81	87	72	86	93	98	88	94
25-29 ..	84	87	102	117	91	99	56	101
30-39 ..	86	86	91	86	97	98	150	137
40-49 ..	94	93	172	151	78	88	127	179
50-69 ..	118	143	188	228	96	105	91	99

TABLE XXXIII.—*Females, married, 1923–27.—Disablement rates.—The number of days of disablement per person-year of exposure and the number of claims per 100 person-years of exposure for (1) all causes of disablement less particular respiratory causes and (2) particular respiratory causes, amongst the three main occupational groups in spinning mills.*

Age Group.	Workers in the Cardroom.		Ring Spinners and Allied Workers.		Winders, Reelers and Allied Workers.	
(Age last birthday at beginning of year of exposure.)	Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.		Number of days of disablement per person-year of exposure. Number of claims per 100 person-years of exposure.	
(1)	All Causes less Respiratory. (2)	Respiratory Causes. (3)	All Causes less Respiratory. (4)	Respiratory Causes. (5)	All Causes less Respiratory. (6)	Respiratory Causes. (7)
20–24 ..	2·55 3·77	·15 ·37	3·00 4·09	·40 ·54	4·41 4·10	— —
25–29 ..	2·25 2·60	·28 ·28	1·92 2·22	·26 ·25	1·89 2·28	·35 ·65
30–39 ..	4·58 3·53	·56 ·52	4·64 4·31	·67 ·53	5·97 3·77	·39 ·48
40–49 ..	6·79 4·21	1·41 ·97	6·48 4·50	2·79 1·10	7·18 6·22	·02 ·25
50–69 ..	18·89 9·58	9·34 4·49	26·25 12·67	·57 1·19	17·93 10·23	9·10 5·11

TABLE XXXIV.—*Females, married, 1923-27.—The average duration of each sickness claim * (first 26 weeks of incapacity) from (1) all causes of sickness less particular respiratory diseases and (2) particular respiratory diseases, amongst the occupational groups in spinning mills. In Days.*

Age Group (age last birth- day at begin- ning of year of exposure).	20-24.		25-29.		30-39.		40-49.		50-69.	
	All Causes less Respir- atory.	Respir- atory Causes.	All Causes less Respir- atory.	Respir- atory Causes.	All Causes less Respir- atory.	Respir- atory Causes.	All Causes less Respir- atory.	Respir- atory Causes.	All Causes less Respir- atory.	Respir- atory Causes.
Workers in the cardroom ..	35	36	37	34	39	37	40	39	43	45
Ring spinners and allied workers ..	38	43	38	39	39	35	39	34	52	55
Winders, reelers and allied workers ..	37	39	40	61	39	34	45	54	47	49
Cardroom work- ers as percent- age of ring spinners, etc.	92	84	97	87	100	106	103	115	83	82
Cardroom work- ers as percent- age of winders, reelers, etc. . .	95	92	93	56	100	109	89	72	91	92

* *Vide* footnote to Table XIV.

TABLE XXXV.—*Females, single and widowed, 1923–27.—Sickness amongst workers not in the cardroom during 1923–27, but who had previously worked in that room (ex-cardroom workers), compared with the sickness of cardroom workers in 1923–27.*

Age Group. (Age last birthday at beginning of year of exposure).	Ex-Cardroom Workers.					Cardroom Workers.	
	Person-years of exposure to risk.	Total duration of Sickness in days. Total number of claims made.		Number of days of Sickness per person-year. Number of claims per 100 person-years.		Number of days of Sickness per person-year. Number of claims per 100 person-years.	
		All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
16–19 ..	370·0	4,214	346	11·39	·94	5·95	·52
		138	9	37·30	2·43	23·82	1·55
20–24 ..	515·0	4,866	108	8·48	·21	6·94	·61
		158	5	30·68	·97	24·80	1·92
25–29 ..	570·0	4,994	652	8·76	1·14	6·00	·68
		152	15	26·67	2·63	19·52	1·91
30–39 ..	708·0	6,576	1,470	9·29	2·08	7·05	1·01
		176	51	24·86	7·20	20·62	2·81
40–49 ..	309·5	3,205	1,048	10·36	3·39	8·44	1·80
		80	28	25·85	9·05	22·12	4·59
50–69 ..	219·0	2,342	1,081	10·69	4·94	12·59	4·66
		46	20	21·00	9·13	26·85	10·71
Total number of persons exposed ..	717						

TABLE XXXVI.—*Females, married, 1923–27.—Sickness amongst workers not in the cardroom during 1923–27, but who had previously worked in that room (ex-cardroom workers), compared with the sickness of cardroom workers in 1923–27.*

Age Group. (Age last birthday at beginning of year of exposure).	Ex-Cardroom Workers.						Cardroom Workers.	
	Person-years of exposure to risk.	Total duration of Sickness in days. Total number of claims made.		Number of days of Sickness per person-year. Number of claims per 100 person-years.		Number of days of Sickness per person-year. Number of claims per 100 person-years.		
		All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.	All Causes less Respiratory.	Respiratory Causes.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
20–24 ..	117·0	1,787	159	15·27	1·36	16·72	1·20	
		50	6	42·73	5·12	47·82	3·32	
25–29 ..	361·5	5,749	312	15·90	·86	13·53	1·07	
		131	11	36·24	3·04	36·75	3·15	
30–39 ..	635·5	8,794	1,127	13·84	1·77	12·87	1·32	
		223	23	35·09	3·62	33·27	3·54	
40–49 ..	327·0	3,698	456	11·31	1·39	12·08	2·37	
		83	10	25·38	3·06	30·39	6·12	
50–69 ..	155·0	2,177	683	14·05	4·41	14·35	5·40	
		39	12	25·16	7·74	33·44	12·00	
Total number of persons exposed ..	536							

Unemployment and Rates of Pay.

As was pointed out for the men, these differences in the sickness rates for women, married and single, from respiratory complaints cannot be easily explained in terms of any other factors except that of the working environment. There is very little difference in wage levels or amount of unemployment between the three occupational groups in 1923-27. The cardroom workers and ringroom workers are on approximately the same level of income—for a full working week the *average* wage would be about thirty shillings. The average wage in the winding and reeling department would be somewhat higher—about thirty-three shillings. Such differences are obviously negligible, as also would be the differences in amount of short-time, since each department is dependent upon the other.

Discussion of the Results.

It was pointed out in the section dealing with the men that evidence that disability was still being produced by the cardroom environment (*i.e.*, since the introduction of localized exhaust ventilation) was lacking. The fact that there is some excess of respiratory complaints amongst women, though a much slighter excess than that found for the men, suggests either (*a*) considerably less dust is needed to impair health than that evolved under the old processes of stripping and grinding, since the women never are or were exposed to the maximum found near to the carding engines, but only to that blown across to the other side of the cardroom; or (*b*) floating cotton fibre to which the women are considerably exposed is a principal or contributory factor. This inquiry cannot prove the truth of either of these suggestions, but they are put forward to show that the women do afford some evidence that it is not necessary to have such exposure to dust as existed for the men before 1912 for damage to health to be caused. It is possible that the less exposure (*i.e.*, less than the men) which the women experienced before 1912 is sufficient. Whether the present environment for women is deleterious cannot be proved, as with the men, until a population exists which has been exposed for a considerable number of years to modern conditions only.

Summary of Main Points and Conclusions.

(1) 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. These led in 1927 to the appointment of a Departmental Committee of inquiry, one of the terms of reference being to report upon the Sickness rates of cardroom operatives in comparison with those of the general population in the same localities. It was found

impracticable to secure sickness statistics for such a general population and other cotton operatives in the same spinning mills were substituted as the comparative group (pp. 5-6).

(2) A preliminary study of the occupational death rates for men in the years 1921-23, published by the Registrar-General for England and Wales, shows that strippers and grinders (*i.e.*, the cardroom workers who are exposed to dust to the maximum extent), other workers in the cardroom, and blowing-room hands all have, in comparison with other operatives in the cotton industry, and in comparison with all males (occupied and retired) in England and Wales, high death rates from respiratory diseases, the unfavourable position being most pronounced for the strippers and grinders. The latter also compare unfavourably at the older ages, with the general population of the towns in which they live (pp. 12-17 and Tables I, II and III). Circulatory and allied diseases also seem to be important for cotton workers, but for the cardroom hands at least not nearly so acutely as the respiratory group of illnesses (with the exception of tuberculosis, the rates for which are low) (pp. 17-19 and Table IV).

(3) The *ad hoc* sickness investigation here reported corroborates for the men the results shown by the occupational death rates. The conclusions that follow are based upon the short-period sickness statistics only, *i.e.*, the first 26 weeks of illness. The disablement rates, *i.e.*, illness after the first 26 weeks were unreliable owing to the small numbers involved. From all causes of sickness the strippers and grinders suffer approximately the same up to age 30 as the comparative group working in the ring-room and warehouse. After that age they have some excess of illness. When however this sickness experience is divided into non-respiratory and respiratory causes it is found that strippers and grinders and other cardroom workers have somewhat *less* sickness than male workers in the ring-room and warehouse from *all causes of sickness excluding a group of respiratory diseases*. On the other hand from *these particular respiratory diseases* they have, after age 30, a pronounced excess of illness, their rates being two to three times as high as the rates found for the workers in the ring-room and warehouse. Between the cardroom workers and the blowing-room and cotton room operatives very little discrepancy is found. This latter group is also involved in the preliminary cleansing processes and is subject to a transference of workers who have been in the cardroom. Whether their higher respiratory rates are due to the inclusion amongst them of cardroom workers who have left the cardroom with damaged health or to their own environment being detrimental to health cannot be proved. (pp. 29-32 and Tables VII, IX, XI and XII, and fig. I).

(4) Figures for disablement (long-period incapacity after the first 26 weeks of sickness) are not reliable for populations as small

as those here exposed to risk. Broadly they seem to confirm the conclusion reached from the more stable short-period sickness rates (pp. 29-32 and Tables VIII, X and XIII).

(5) The excess of respiratory illness amongst the male cardroom workers is due to a *greater number of claims* being made by these workers and *not* to abnormally long periods of such incapacity. On the whole the average duration of their illness from such causes is somewhat shorter than that of the ring-room and warehouse workers. This larger number of claims is derived both from an actually larger number of *persons* claiming and also from an excess of persons making repeated claims for such reasons (pp. 32 and 41 and Tables XIV, XV and XVI).

(6) A comparison was attempted between the men working in towns mainly confined to spinning coarse and fine counts, but the material was insufficient to prove whether there existed any difference in incidence of illness (pp. 48-49).

(7) The sickness experience both of single and of married women (treated separately) showed that the female cardroom workers had up to age 50, somewhat *less* incapacity than ring spinners and than winders and reelers from *all causes of illness*. When the sickness was divided into respiratory and non-respiratory forms, single women showed an excess of respiratory sickness after age 25, and married women a similar excess after age 40. This excess was considerably less than that found for the men, being rather in the neighbourhood of 60 to 75 per cent. over the spinners' rates. This excess was derived more from a greater number of claims being made than from an abnormal length of incapacity though both factors contributed to the higher incidence (pp. 53-65 and Tables XIX to XXXIV, and Figs 2 and 3).

(8) A consideration of workers, male and female, who at one time worked in the cardroom but who were not in the cardroom during the period of inquiry (but who remained members of the Approved Society under consideration), showed that these workers likewise have unduly high rates from respiratory illness. This suggests some elimination from the cardroom of workers whose health has been damaged by its environment, or of workers with bronchitic tendencies who find its conditions unsuitable for them (pp. 44-45 and p. 65 and Tables XVII, XXXV and XXXVI).

(9) The excess of respiratory illness found amongst the cardroom workers cannot easily be explained by any other factors except environment (pp. 49-50 and p. 76).

(10) Since 1912, when localized exhaust ventilation and vacuum for stripping were being introduced, conditions in the cardroom have been materially altered. The point that arises is whether present day conditions are such as to cause any excess of respiratory disease, or whether the excess found at the older ages is due only to the very dusty conditions in which these older operatives once worked. Evidence that suggests that present day conditions

may be unfavourable to health is (1) the blowing-room hands show an excess of such diseases and the dust does not reach its maximum there; but this evidence is weakened by the undoubted transference of cardroom workers to the blowing room, and the possible transference of those already suffering from respiratory complaints; (2) the women show some excess of respiratory complaints and these workers never were exposed to the full dust of the carding machines, but only to what was blown from the machines to the other side of the room. On the other hand it may be that the floating cotton fibre is an agent in the production of these diseases and to this the women are considerably exposed.

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 and vacuum for stripping were 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 in 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.

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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References to posture, etc., occur also in Reports Nos. 15 and 16.

(viii). *Miscellaneous.*

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NOTE.—Most of the reports in the following list deal exclusively with the industries under which they are placed. In certain instances, however, reports have been prepared on some general subject, but yet make sufficient reference to a particular industry to justify inclusion under the appropriate heading. These reports are distinguished by an *.

A.—MINING INDUSTRY.

- No. 39.—The Relation of Atmospheric Conditions to the Working Capacity and Accident Rates of Miners.
- No. 51.—A Study of Absenteeism in a Group of Ten Collieries.

B.—METAL AND ENGINEERING INDUSTRIES.

- No. 1.—The Influence of Hours of Work and of Ventilation on Output in Tinsplate Manufacture.
- No. 2.—The Output of Women Workers in Relation to Hours of Work in Shell-making.
- No. 3.—A Study of Improved Methods in an Iron Foundry.
- No. 5.—Fatigue and Efficiency in the Iron and Steel Industry.
- †No. 6.—The Speed of Adaptation to Altered Hours of Work.
- 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.
 No. 21.—Atmospheric Conditions in Cotton Weaving.
 No. 23.—Variations in Efficiency in Cotton Weaving.
 No. 37.—Fan Ventilation in a Weaving Shed.
 No. 40.—The Effect of Eyestrain on the Output of Linkers in the Hosiery Industry.
 No. 48.—Artificial Humidification in the Cotton Weaving Industry. Its Effect upon the Sickness Rates of Weaving Operatives.
 *No. 49.—On the Relief of Eyestrain amongst Persons Performing very Fine Work.

D.—BOOT AND SHOE INDUSTRY.

- No. 10.—Preliminary Notes on the Boot and Shoe Industry.
 No. 11.—Preliminary Notes on Atmospheric Conditions in Boot and Shoe Factories.
 *No. 25.—Two Contributions to the Study of Rest Pauses in Industry.
 *No. 26.—On the Extent and Effects of Variety in Repetitive Work.
 *No. 35.—A Physiological Study of the Ventilation and Heating in Certain Factories.

E.—POTTERY INDUSTRY.

- No. 18.—Two Investigations in Potters' Shops.

F.—LAUNDRY INDUSTRY.

- No. 22.—Some Studies in the Laundry Trade.
 *No. 36.—On the Design of Machinery in Relation to the Operator.

G.—GLASS INDUSTRY.

- No. 24.—A Comparison of Different Shift Systems in the Glass Trade.

H.—LETTERPRESS PRINTING INDUSTRY

- *No. 16.—Three Studies in Vocational Selection.
 *No. 26.—On the Extent and Effects of Variety on Repetitive Work. The Relation between Illumination and Efficiency in Fine Work (Typesetting by Hand). The Effects of Different Systems of Lighting on Output and Accuracy in Fine Work (Typesetting by Hand).
 No. 54.—An Investigation into the Sickness Experience of Printers (with special reference to the Incidence of Tuberculosis).

I.—LEATHER-MAKING INDUSTRY.

- *No. 36.—On the Design of Machinery in Relation to the Operator.

J.—LIGHT REPETITION WORK.

- No. 14.—Time and Motion Study.
 No. 25.—Two contributions to the Study of Rest Pauses in Industry.
 No. 26.—On the Extent and Effects of Variety in Repetitive Work.
 No. 30.—An Experimental Investigation into Repetitive Work.
 No. 32.—Studies in Repetitive Work with special reference to Rest Pauses.
 No. 52.—The Comparative Effects of Variety and Uniformity in Work.
 No. 56.—The Effects of Monotony in Work. (A Preliminary Inquiry).

K.—MUSCULAR WORK.

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