POPULATION STUDIES OF CHRONIC RESPIRATORY DISEASE

A COMPARISON OF MINERS, FOUNDRYWORKERS, AND OTHERS IN STAVELEY, DERBYSHIRE

BY

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Mortality and morbidity statistics suggest that miners and foundryworkers are more prone to bronchitis than other industrial workers but it is not yet certain that this excess is due to occupational factors. The present investigation was designed to compare the prevalence of bronchitis and respiratory disability in a representative sample of miners, foundryworkers, and other industrial groups living in Staveley, Derbyshire, a town of some 18,000 inhabitants, and to study some of the possible aetiological factors. A random sample of 776 men, stratified by age into two groups, 25 to 34 and 55 to 64 years, and by occupation into four groups, non-dusty, miners and ex-miners, foundry and ex-foundryworkers, and other dusty jobs, was used. Respiratory symptoms were recorded on a standardized questionnaire and the ventilatory capacity was assessed by means of the forced expiratory volume (F.E.V._{0.75}) and recorded as the indirect maximum breathing capacity (M.B.C.).

Miners and ex-miners recorded a higher prevalence of respiratory symptoms and a lower mean M.B.C. than men who had worked only in dust-free occupations. In the older age group the differences were not large and were not statistically significant but in the younger men the difference in the mean M.B.C. was significant. Foundry and ex-foundryworkers with a pure industrial history recorded a similar prevalence of symptoms to the men who had never worked in dusty occupations and their mean M.B.C. was only slightly and insignificantly lower. A higher prevalence of symptoms and a lower mean M.B.C. was, however, recorded by the foundrymen who had also been exposed to other dusts or fumes and the occupational histories suggested that such exposure was more likely than foundry work to account for the findings.

The number of years spent on the coal-getting shift was used to assess the importance of exposure to coal dust. In the elderly miners without pneumoconiosis there was a significant increase in the prevalence of breathlessness, accompanied by a reciprocal fall in the mean M.B.C. with increasing years spent on the coal-getting shift; but in no other group was a consistent trend found.

In both age groups the prevalence of respiratory symptoms was lower and the mean M.B.C. higher in non-smokers than in smokers and ex-smokers. Heavy smokers (those smoking 15g. and over/day) recorded a higher prevalence of symptoms and a lower mean M.B.C. than light smokers, and the values for ex-smokers approximated to those of the non-smokers.

The wives of the elderly men in the sample were studied to try to determine how far the apparently high rates of bronchitis shown by national mortality statistics are attributable to social factors. The findings suggested that the wives of the men who worked in dusty jobs had a somewhat higher prevalence of cough and/or sputum and of chest illness during the past three years than the wives of those who had worked only in dust-free occupations.

It is difficult to assess the role of occupation in the aetiology of bronchitis. The national statistics indicate that miners and foundryworkers have an excess mortality and morbidity from bronchitis

compared with other workers and at first sight this suggests that these occupations are important factors in the development of this disease. Further contemplation of the statistics leads to considerable doubt about this apparently obvious conclusion. In both 1931 and 1951 (Registrar-General, 1938 and 1957-58) while the standardized mortality ratios (S.M.R.) for bronchitis of miners and foundryworkers was high, that of their wives was also high (Table 1), and this association is used by the Registrar-General as an argument in favour of aetiological factors other than occupation. Although the morbidity statistics (Ministry of Pensions and

studying bronchitis in foundryworkers. Previous studies in this industry (McLaughlin, Cheeseman, Garrod, Gloyne, Goodall, Harding, Jupe, Lawrie, Perry, Sutherland, and Woods, 1950; Meiklejohn, private communication) have been concerned mainly with pneumoconiosis. Apart from its inherent interest and the belief among employees that their jobs predispose them to bronchitis, we thought that an investigation of foundryworkers, who are less liable than miners to pneumoconiosis, might throw light on the problem of the disabled men whose radiographs show no evidence of pneumoconiosis. It also seemed important to try to confirm the apparent excess morbidity revealed by the national statistics and if possible to elucidate its cause.

Two approaches to the problem of bronchitis in foundryworkers are possible: a random sample of foundries might be chosen and the foundrymen working in them compared by foundry and job; or a community survey of a foundry town might be carried out on lines similar to those used previously in studying a mining town (Higgins *et al.*, 1956). There are two main disadvantages in studying a working population: exclusion of those who have retired prematurely on account of disease may lead one to underestimate disability due to occupation; the lack of a suitable control group prevents a comparison with those outside the industry living in the same neighbourhood. Such controls are essential in studying bronchitis which varies widely in prevalence from place to place. For these reasons we decided on the community survey, though we have always considered both methods desirable and indeed complementary.

The first problem was to select a suitable town. The size of the town was important. Its population should be between 15,000 and 60,000 inhabitants; larger than 60,000 would be impossible with our resources, smaller than 15,000 would be unlikely to provide sufficient foundryworkers. The proportion of foundryworkers in the total population should be high and the foundries should be reasonably typical from the point of view of type of casting and methods employed. So far as possible we wanted to avoid foundries in which considerable changes in method had taken place during the past 15 to 20 years. From information supplied by the Amalgamated Union of Foundryworkers and the local Ministry of Labour offices we reduced a large number of suggested towns to two possible ones, which we visited. Staveley in Derbyshire was finally chosen.

Staveley is an industrial town four miles to the north of Chesterfield in the centre of industrial England. It has a railway junction with large

TABLE 1
STANDARDIZED MORTALITY RATIOS (S.M.R.) FOR
BRONCHITIS OF MINERS AND FOUNDRYWORKERS AND
THEIR WIVES IN 1931 AND 1951 (AGED 20 TO 64 YEARS,
ENGLAND AND WALES)

Occupation	1931		1951	
	Men	Wives	Men	Wives
Miners (Occupational codes: 041, 042, 043 to 5, 047, and 049)	155	181	135	175
Hewers and getters (041, 042)	170	182	200	190
Other underground (043 to 5, 047)	126	162	93	177
Surface (049)	172	225	131	139
Iron and steel foundryworkers	179	288	177	217

National Insurance, 1954), also indicate that foundrymen have approximately twice, and miners between two and three times, as much sickness absence as the national average for all occupied males, this excess might be attributed to a tendency to take time off on account of the hard manual work of their jobs since their absence rate for all causes is also high (Fletcher, 1958).

Recent research has supported the view that miners are unduly prone to bronchitis. Böhme and Lent (1951), studying a large hospital group, found approximately twice as much bronchitis in miners as in men who had never worked in the mines. Pemberton (1956) after studying several different industrial groups in the United States concluded that miners had more "chronic bronchitis, emphysema, and bronchial spasm". Our own community surveys in the Rhondda Fach (Carpenter, Cochrane, Gilson, and Higgins, 1956) and in Leigh, Lancashire (Higgins, Oldham, Cochrane, and Gilson, 1956), have also indicated that miners and ex-miners have more bronchitis and respiratory disability than non-miners of comparable age. An unexpected finding in our studies which has not yet been adequately explained has been that disability tended to be greater in miners without pneumoconiosis than in those with early simple pneumoconiosis.

Little research has as yet been devoted specifically

marshalling yards on the main line from London to Sheffield. The population, predominantly working class, is about 18,000. The main industries are mining, foundrywork, chemicals, railways, and retail trade. The main industrial groups tend to live in housing estates near their work and mix relatively little. There is considerable visible atmospheric pollution from the iron and chemical works, the two collieries, and the railways.

The typical foundry processes—pattern making, preparing the moulds and cores, melting and pouring the metal, and removal of sand by “knocking out” or “stripping” and “dressing” or “fettling”—have been well described by McLaughlin *et al.* (1950). The foundries in Staveley are atypical in that sand-spun or metal-spun pipes form a high proportion of their output. These are produced by centrifugal casting, the molten metal being poured into rapidly rotating moulds. Sand moulds are used in the sand-spun process, and there is consequently a risk of pneumoconiosis; but no sand is used in the metal-spun method, which is therefore free from this risk.

A by-product plant, associated with the foundries, makes a wide variety of chemicals; among the more important from the health point of view are hydrochloric and sulphuric acids, caustic soda, and benzol. Apart from the possibility of exposure to chemical fumes, workers in this plant are liable to considerable dust exposure from the slag crusher and to both dust and heat while working on the coke ovens.

The Objects of the Investigation

The scope of the investigation, originally concerned with foundryworkers, was considerably enlarged by the wide variety of occupations represented in Staveley. The main objects were:—

(1) To compare the prevalence of respiratory symptoms and chronic bronchitis, and the ventilatory capacity in coal-miners, foundry, chemical, and railway workers with men who had worked only in dust-free occupations.

(2) To measure the prevalence of respiratory symptoms and chronic bronchitis in their wives.

(3) To assess the consistency between two doctors in recording answers to questions about respiratory symptoms and measuring the indirect maximum breathing capacity.

(4) To assess the aetiological significance of dust, tobacco smoking, and past respiratory illnesses.

The Census

We decided to study men aged 25 to 34 and 55 to 64 years. In each age group there were four main

occupational groups: (1) Foundry and ex-foundryworkers and (2) miners and ex-miners (those who had worked for one year or more in foundry work or mining); (3) men who had worked in both these occupations or in either of them and also in some other dusty job (coke ovens or furnaces) or in the chemical industry, and finally (4) men who had never worked in dusty occupations.

A private census was carried out. Every house situated within the local authority boundary was visited and a member of the household interviewed. The names, addresses, dates of birth of all men aged 25 to 34 and 55 to 64 were recorded, and a note was made if such men had ever worked in mining, foundry work, or other dusty occupation. The electoral roll was used to check that all houses had been visited. An average of 40 houses was visited and details completed by each home visitor each day and the census was completed by five home visitors in one month.

The census information was recorded on cards which were arranged into the eight age and occupational groups and a sample of the appropriate number was drawn using random numbers. We wanted 100 men in each age and occupational group; but the sample of elderly miners and ex-miners was increased to 150 to allow a subdivision of these with and without pneumoconiosis. There were only 89 elderly foundry and ex-foundryworkers and we therefore used the whole population in this group. The members of the samples were then allocated randomly to the two doctors, so that comparisons between the subgroups would be unaffected by observer differences and the differences themselves fairly estimated.

Methods

(1) Full occupational and residential histories were recorded for each man.

(2) A questionnaire about respiratory symptoms (Appendix), past chest illnesses, and smoking habits was completed by the appropriate doctor who did not know to which occupational group the men belonged.

(3) The forced expiratory volume (F.E.V._{0.75}) was measured and the mean of three readings after a practice blow converted to the indirect maximum breathing capacity (M.B.C.) by multiplying by 40. The forced vital capacity (F.V.C.) was also measured.

(4) Standing and sitting heights and weight were recorded to the nearest half inch and pound respectively.

(5) A postero-anterior chest radiograph was taken.

(6) While the survey of the men was taking place one of us (C.H.W.) visited the wives of the older men in their homes. The respiratory symptoms questionnaire was completed for the women and an estimate of their ventilatory capacity was obtained, using Wright's peak flowmeter (Wright and McKerron, 1959).

TABLE 2
RANDOM SAMPLE AND RESPONSE RATE

Age Group (Years)	Occupation	Number Living in Staveley	Number Sampled	Number Seen	Number Refused
25 to 34	Non-dusty	329	100	93	7
	Miners and ex-miners (pure)	284	100	94	6
	Foundry and ex-foundryworkers (pure)	155	100	94	6
	Others	272	100	94	6
	Total	1,040	400 (100%)	375 (94%)	25 (6%)
55 to 64	Non-dusty	163	100	94	6
	Miners and ex-miners (pure)	408	150	133	17
	Foundry and ex-foundryworkers (pure)	89	89	83	6
	Others	225	100	91	9
	Total	885	439 (100%)	401 (91%)	38 (9%)

TABLE 3
DIFFERENCES BETWEEN TWO OBSERVERS IN RECORDING RESPIRATORY SYMPTOMS

Age Group (Years)	Observer	Total Seen	Persistent Cough and Sputum	Wheezing in Chest (Positive to Question 16)	Breathlessness		Chest Illness			"Chronic Bronchitis" (Sputum and Illness)
					Grades 2 and Over	Grades 3 and Over	Once	More than Once	Total	
25 to 34	J.C.G.	190 (100%)	52 (27.4%)	67 (35.3%)	22 (11.6%)	0	21 (11.1%)	7 (3.7%)	28 (14.8%)	13 (6.8%)
	I.T.T.H.	185 (100%)	40 (21.6%)	87 (47.0%)	9 (4.9%)	0	14 (7.6%)	5 (2.7%)	19 (10.3%)	13 (7.0%)
55 to 64	J.C.G.	198 (100%)	83 (41.9%)	107 (54.0%)	84 (42.4%)	25 (12.6%)	19 (9.6%)	35 (17.7%)	54 (27.3%)	43 (21.7%)
	I.T.T.H.	203 (100%)	73 (36.0%)	120 (59.1%)	77 (37.9%)	32 (15.8%)	18 (8.9%)	30 (14.8%)	48 (23.7%)	36 (17.7%)

TABLE 4
DIFFERENCES BETWEEN TWO OBSERVERS IN MEAN INDIRECT M.B.C. MEASUREMENTS

Age Group (Years)	Occupation	Observer		Difference
		J.C.G.	I.T.T.H.	
25 to 34	Non-dusty	143.9	139.7	4.2
	Miners and ex-miners	135.5	133.1	2.4
	Foundry and ex-foundryworkers	143.3	136.1	7.2
	Others	137.7	137.7	0
	All occupations	140.3	136.6	3.7
55 to 64	Non-dusty	93.4	90.2	3.2
	Miners and ex-miners	85.8	87.2	1.4
	Foundry and ex-foundryworkers	88.7	81.0	7.7
	Others	91.3	73.7	17.6
	All occupations	89.1	83.8	5.3

Response Rate.—Table 2 shows that over 92% of the men in the sample cooperated. No special attempt was made on this occasion to interview those who refused to come to the centre by visiting them in their homes, since our previous experience has been that those who refuse do not appear to differ significantly in their bronchitis experience from those who attend.

Observer Differences in Recording Symptoms and M.B.C.—The whole sample, irrespective of occupation group, has been used to investigate the differences between the two doctors in recording the answers to the questions. There were 375 young and 401 elderly men and the numbers seen by each doctor in each age group and the comparison of the main symptoms used in the analysis is shown in Table 3. A more detailed comparison

of results with the questionnaire that was used is given in the Appendix.

The agreement between the observers was of course not perfect and for certain questions, notably those about colour of sputum, wheeze, and tightness, it was poor. For most questions it was in our opinion sufficiently close to justify combining the results. Differences in mean M.B.C. are shown in Table 4. Differences exceeding 5 litres/minute occurred in three out of eight of the age/occupation groups. There is no significant evidence that these variations between occupational groups are meaningful ($0.10 > P > 0.05$ for the men aged 25 to 34, $0.20 > P > 0.10$ for those aged 55 to 64) and the overall observer differences are also insignificant, though in the young men $P = 0.074$.

TABLE 5
RECONSTITUTED GROUPS AFTER EXCLUDING WORKERS WITH INCORRECT AGES AND
CORRECTING FOR OCCUPATION ERRORS

Age Group (Years)	Occupation	Number Interviewed	No. Excluded on Account of		Number Remaining	No. with Wrongly Classified Occupation			Number in Reconstituted Groups
			Age	Radio-graph		Removed	Added	Net Effect	
25 to 34	Non-dusty	93	2	0	91	8	31	+23	114
	Miners and ex-miners	94	1	0	93	11	12	+ 1	94
	Foundry and ex-foundry	94	2	0	92	16	15	- 1	91
	Others	94	1	0	93	38	15	-23	70
	All occupations	375	6	0	369	73	73	0	369
55 to 64	Non-dusty	94	2	1	91	24	14	-10	81
	Miners and ex-miners	133	2	1	130	4	23	+19	149
	Foundry and ex-foundry	83	3	2	78	22	9	-13	65
	Others	91	3	0	88	21	25	+ 4	92
	All occupations	401	10	4	387	71	71	0	387

TABLE 6
CONSTITUTION OF THE "OTHERS" GROUP IN TABLE 5

Age Group (Years)	Miners and Ex-miners with Experience of Other Dusty Occupations or of Chemical Industry	Foundry and Ex-foundryworkers with Experience of Other Dusty Occupations or of Chemical Industry	Men with Experience of Both Mining and Foundry Industries	Remainder	Total
25 to 34	13	13	17	27	70
55 to 64	26	25	17	24	92

TABLE 7
MINERS AND EX-MINERS AND FOUNDRY AND EX-FOUNDRYWORKERS WITH EXPERIENCE IN OTHER
DUSTY OCCUPATIONS FROM "OTHERS" GROUP ADDED TO RECONSTITUTED GROUPS*

Age Group (Years)	Occupation	No. in Reconstituted Group Already Given (Table 5)	No. in Mixed Groups to be Added*	No. Finally Analysed
25 to 34	Non-dusty	114	0	114
	Miners and ex-miners	94	13 + 17 = 30	124
	Foundry and ex-foundryworkers	91	13 + 17 = 30	121
	Others	70	Remainder: 27	27
	Total	369	87	386
55 to 64	Non-dusty	81	0	81
	Miners and ex-miners	149	26 + 17 = 43	192
	Foundry and ex-foundryworkers	65	25 + 17 = 42	107
	Others	92	Remainder: 24	24
	Total	387	109	404

*Seventeen men who had worked in both occupations were added to each occupation group in each age group.

Re-distribution of the Sample.—The initial classification of men by age and occupation was made on the basis of questions asked at the time of the census. Often this information was obtained, not from the man himself, but from a member of his family. Inevitably errors both of age and of occupational groupings were revealed when the man himself was interviewed. Men found at interview to be outside the desired age groups have been excluded, while those whose occupation was wrongly recorded at the time of the census have been re-allocated to their correct group as revealed at the interview. The sample actually interviewed and the numbers in the reconstituted groups after correcting for these census errors is shown in Table 5. Four men in the elder age group were also excluded because of their chest radiographs; two on

account of cardiac failure, one because he had had a pneumonectomy for lung cancer, and one because of Category 3 simple pneumoconiosis attributed to his work on the railway. They too are shown in Table 5.

In the light of the more accurate details elicited at the interview the group "others", comprising the four classes shown in Table 6, could now be re-allocated to their appropriate occupation groups, the miners and ex-miners who had also worked in the foundry industry or other dusty jobs to the mining group, the foundry and ex-foundry workers who had also worked in mining or other dusty jobs to the foundry group. The 17 men who had worked both in mining and in the foundry industry were of course included in both occupational groups which results in an excess of 17 men in the totals of each

age group. As a result of this partition only a small number of men of the "others" group remained and these are referred to in subsequent tables as the "remainder". This re-distribution of the "others" group is shown in Table 7 in which the numbers finally analysed are shown in the last column. The mining and foundry groups could be subdivided into men who had worked only in these occupations (or "pure" miners and ex-miners and "pure" foundryworkers) and men who had worked also in other dusty jobs or the chemical industry (or "mixed" groups).

Results

Prevalence of Pneumoconiosis.—The numbers by age and radiographic category of pneumoconiosis are given in Table 8. If we consider only the pure groups, 6% of the young miners had a small amount of simple pneumoconiosis. No pneumoconiosis was noted in the young foundrymen. Thirty-six per cent of the elderly miners and 23% of the elderly foundryworkers had pneumoconiosis. Two men in the sample had early progressive massive fibrosis. One of these had worked for seven years ramming moulds and one year as a general labourer in the sand-spun pipe shop and eight years as a locomotive fireman. The other had spent six years in mining, four of them on the coalface, 11 years as a furnaceman, and 22 as an iron ore crusher. He therefore appears under both occupation groups in the table.

Prevalence of Respiratory Symptoms and Mean M.B.C. According to Occupation.—Tables 9 and 10 give the prevalence of respiratory symptoms, bronchitis, and the mean indirect M.B.C. by age in the main occupational groups. Under "chronic bronchitis", as in previous studies, we have recorded those with persistent sputum and at least one chest illness sufficiently severe to keep a man off work for at least one week during the past three years.

The effect of age is clearly seen in these two tables. The fall in the mean M.B.C. from 143 litres/minute at mean age 30 to 90 litres/minute at mean age 60 in the group of men not exposed to dust is similar to that recorded for non-miners in the Rhondda

(Carpenter *et al.*, 1956). The tables also show a fairly consistent rise with age in the prevalence of respiratory symptoms and bronchitis in each occupation group. It should also be noted that whereas in the younger men the majority had experienced only one chest illness during the past three years, in the older men on the other hand recurrent attacks were more frequent.

The effect of occupation is less clear cut. The young miners recorded considerably more symptoms and bronchitis and had a significantly lower mean M.B.C. than the men not exposed to dust. A similar trend is apparent in the older miners but here differences between them and the non-dusty group are much less striking. In neither age group did miners with simple pneumoconiosis appear materially different from those without. Our findings in this respect therefore support Newell and Browne (1955), who concluded from their study of 5,117 working coal-miners in four collieries in County Durham that symptoms and disability (measured by withdrawal from coalface work to less strenuous employment) was not related to radiographic category of pneumoconiosis. The pure foundryworkers closely resembled the men not exposed to dust in their pattern of respiratory symptoms and bronchitis and recorded only an insignificantly lower mean M.B.C. On the other hand the mixed foundrymen, both young and old, had appreciably more symptoms and bronchitis and considerably lower mean M.B.C. values than the corresponding non-dusty groups. The small numbers with simple pneumoconiosis make comparisons on the basis of radiological abnormality impracticable. Our conclusion was that mining but not foundry work appeared to be associated with some increased liability to bronchitis and impairment of ventilatory capacity.

Jobs within a foundry are many and varied. In the present survey the only occupational subgroup sufficiently large for separate analysis was that of the men employed in moulding. The analysis does

TABLE 8
NUMBER OF PURE AND MIXED MINERS AND FOUNDRYWORKERS IN EACH RADIOGRAPHIC CATEGORY

Age Group (Years)		Miners and Ex-miners						Foundry and Ex-foundryworkers					
		Radiographic Category					Total	Radiographic Category					Total
		0	1	2	3	PMF		0	1	2	3	PMF	
25 to 34	Pure	89	4	1	0	0	94	91	0	0	0	0	91
	Mixed	30	0	0	0	0	30	30	0	0	0	0	30
	Total	119	4	1	0	0	124	121	0	0	0	0	121
55 to 64	Pure	96	27	22	4	0	149	50	11	2	1	1	65
	Mixed	37	2	2	1	1	43	35	4	1	1	1	42
	Total	133	29	24	5	1	192	85	15	3	2	2	107

TABLE 9

PREVALENCE OF MAIN SYMPTOMS, "CHRONIC BRONCHITIS", AND MEAN INDIRECT M.B.C. IN MEN AGED 25 TO 34 YEARS IN SAMPLE STUDIED IN STAVELEY

	Non-dusty Occupations	Miners and Ex-miners			Foundry and Ex-foundry-workers	
		Without Pneumoconiosis		With Pneumoconiosis	Without Pneumoconiosis	
		Pure	Mixed	Pure	Pure	Mixed
Number in sample	114	89	30	5	91	30
Number with:						
Persistent cough and sputum	18 (15.8%)	30 (33.7%)	11 (36.7%)	1	17 (18.7%)	13 (43.3%)
Chest illness:						
Once only	10 (8.8%)	6 (6.7%)	3 (10%)	0	8 (8.8%)	5 (16.7%)
More than once	0	7 (7.9%)	0	0	2 (2.2%)	1 (3.3%)
Total	10 (8.8%)	13 (14.6%)	3 (10%)	0	10 (11%)	6 (20%)
Breathlessness:						
Grades 2 and over	10 (8.8%)	6 (6.7%)	4 (13.3%)	0	6 (6.6%)	4 (13.3%)
Grades 3 and over	0	0	0	0	0	0
"Chronic bronchitis": (persistent sputum and chest illness)	2 (1.8%)	10 (11.2%)	1 (3.3%)	0	5 (5.5%)	4 (13.3%)
Mean indirect M.B.C.	143	133	137	150	140	137

TABLE 10

PREVALENCE OF RESPIRATORY SYMPTOMS, "CHRONIC BRONCHITIS", AND MEAN INDIRECT M.B.C. IN MEN AGED 55 TO 64 YEARS IN SAMPLE STUDIED IN STAVELEY

	Non-dusty Occupations	Miners and Ex-miners				Foundry and Ex-foundryworkers			
		Without Pneumoconiosis		With Pneumoconiosis		Without Pneumoconiosis		With Pneumoconiosis	
		Pure	Mixed	Pure	Mixed	Pure	Mixed	Pure	Mixed
Number in Sample	81	96	37	53	5	50	35	14	6
Number with:									
Persistent cough and sputum	26 (32.1%)	38 (39.6%)	16 (43.2%)	20 (37.7%)	5	15 (30%)	14 (40%)	5	5
Chest illness:									
Once only	7 (8.6%)	12 (12.5%)	2 (5.4%)	2 (3.8%)	1	4 (8%)	4 (11.4%)	0	3
More than once	10 (12.3%)	15 (15.6%)	6 (16.2%)	12 (22.6%)	2	4 (8%)	9 (25.7%)	1	2
Total	17 (21%)	27 (28.1%)	8 (21.6%)	14 (26.4%)	3	8 (16%)	13 (37.1%)	1	5
Breathlessness:									
Grades 2 and over	27 (33.3%)	31 (32.3%)	17 (45.9%)	25 (47.2%)	4	22 (44%)	18 (51.4%)	4	4
Grades 3 and over	9 (11.1%)	8 (8.3%)	6 (16.2%)	9 (17%)	1	7 (14%)	8 (22.9%)	2	1
"Chronic bronchitis": (persistent sputum and chest illness)	12 (14.8%)	18 (18.8%)	6 (16.2%)	13 (24.5%)	3	5 (10%)	10 (28.6%)	0	4
Mean indirect M.B.C.	90	87	80	87	70	85	80	82	71

P.M.F. Excluded.

Duplicates Included.

TABLE 11

PREVALENCE OF RESPIRATORY SYMPTOMS AND "CHRONIC BRONCHITIS", AND MEAN INDIRECT M.B.C. IN MISCELLANEOUS OCCUPATION GROUPS SEEN IN STAVELEY (AGED 55 TO 64 YEARS)

	Chemical Workers	Coke Oven Workers	Furnacemen
Number	29	14	18
Those with:			
Persistent cough and sputum	13 (44.8%)	5 (35.7%)	8 (47.1%)
Chest illness:			
Once	2 (6.9%)	3 (21.4%)	0
More than once	10 (34.5%)	0	4 (23.5%)
Total	12 (41.4%)	3 (21.4%)	4 (23.5%)
Breathlessness:			
Grades 2 and over	16 (55.2%)	6 (42.9%)	9 (50%)
Grades 3 and over	9 (31%)	1 (7.1%)	2 (11.8%)
"Chronic bronchitis"	12 (41.4%)	2 (14.3%)	4 (23.5%)
Mean indirect M.B.C.	75	68	80

not suggest that these men had any undue liability to respiratory symptoms or bronchitis. The ventilatory capacity of the elderly moulders (89 litres/

minute) was very similar to that found in the men engaged in dust-free jobs.

Among the mixed groups of miners and foundry-

workers three occupations appeared to justify separate analysis. These were chemical workers employed in the by-product plant, coke oven workers, and furnace men. The chemical workers were liable to exposure to fumes of sulphuric and hydrochloric acids, benzol acid from caustic soda baths and Table 11 shows that in the 55 to 64 age group they had an unduly high prevalence of symptoms and bronchitis and a low M.B.C. Unfortunately neither of the other two groups was sufficiently large to enable one to do more than suggest that these men might have some reduction in ventilatory capacity. It appeared to us that the higher prevalence of symptoms and lower mean M.B.C. in the mixed mining and foundry groups was more likely to be due to risk associated with one of these three occupations than to either mining or foundry work.

Tobacco Smoking.—Smoking habits were recorded after the respiratory symptoms. Unless the subject volunteered the information the doctor completing the respiratory symptoms questionnaire did not know whether he was questioning a smoker or non-smoker. Nevertheless the freedom from symptoms of the elderly non-smokers was often so striking that accurate prediction was possible. The relation of symptoms to smoking in the whole sample using the smoking classification employed previously (Doll and Hill, 1950) is given in Table 12. The findings for all occupational subgroups have been combined. Smokers recorded more symptoms than non-smokers and there is a well-marked trend of increasing cough and sputum with increasing tobacco consumption. Similarly in the case of the

ventilatory capacity, the mean M.B.C. of the smokers was lower than that of the non-smokers and in both age groups the heavier smokers recorded a lower mean M.B.C. than the lighter. Perhaps the most striking observation is the considerable difference in the prevalence of cough and sputum between the non-smokers and light smokers in the 55 to 64 age group.

Dust Exposure.—We have only indirect measures of dust dosage. Two that can be used are the number of years spent underground and the number of years on the coal-getting shift and of the two the latter is clearly the better index of dust dosage. The relation of symptoms and M.B.C. to this index is given in Tables 13 and 14 for the pure miners.

In the younger age group no striking change either in prevalence of symptoms or mean M.B.C. with duration of facework was apparent. But in the older men without pneumoconiosis there was a trend in the prevalence of symptoms, best seen in the case of breathlessness, accompanied by a reciprocal fall in the mean M.B.C. with increasing years spent on the coal-getting shift. Neither effect was seen in the elderly miners with simple pneumoconiosis.

Investigation of Wives.—There were 338 wives of the elderly men in the sample, of whom 334 (99%) were seen and four refused interview. The numbers according to their husband's occupation are shown in Table 15. A much lower prevalence of cough and sputum was recorded for the wives than for their husbands. Table 16 shows the comparison of cough and/or sputum and Table 17 that of chest

TABLE 12
RELATION OF RESPIRATORY SYMPTOMS, "CHRONIC BRONCHITIS", AND INDIRECT M.B.C. TO SMOKING IN
SAMPLE OF MEN STUDIED IN STAVELEY

Age Group (Years)		Non-smokers	Smokers		Ex-smokers	Total
			Light (1 to 14g./day)	Heavy (15g./day and over)		
25 to 34	Number	56	193	89	31	369
	Those with:					
	Persistent cough and sputum	5 (8.9%)	43 (22.3%)	39 (43.8%)	4 (12.9%)	91 (24.7%)
	Chest illness	4 (7.1%)	25 (13%)	11 (12.4%)	7 (22.6%)	47 (12.7%)
	Breathlessness: Grades 2 and over "Chronic bronchitis"	3 (5.4%) 2 (3.6%)	17 (8.8%) 13 (6.7%)	11 (12.4%) 7 (7.9%)	0 4 (12.9%)	31 (8.4%) 27 (7.3%)
	Mean indirect M.B.C.	145	140	133	143	
55 to 64	Number	29	157	136	62	384*
	Those with:					
	Persistent cough and sputum	1 (3.4%)	61 (38.9%)	70 (51.5%)	13 (21%)	145 (37.8%)
	Chest illness	2 (6.9%)	41 (26.1%)	39 (28.7%)	13 (21%)	95 (24.7%)
	Breathlessness: Grades 2 and over "Chronic bronchitis"	5 (17.2%) 1 (3.4%)	63 (40.1%) 32 (20.3%)	62 (45.6%) 30 (22.1%)	20 (32.3%) 8 (12.9%)	150 (39.1%) 71 (18.5%)
	Mean indirect M.B.C.	101	87	80	89	

* = Three exclusions (one not recorded and two P.M.F.)

TABLE 13

PREVALENCE OF RESPIRATORY SYMPTOMS AND MEAN INDIRECT M.B.C. ACCORDING TO NUMBER OF YEARS SPENT WORKING ON THE COAL-GETTING SHIFT IN MEN AGED 25 TO 34 YEARS WITHOUT PNEUMOCONIOSIS

	Years spent on Coalface			
	0	1 to 9	10 to 19	Total
All	41	38	10	89
Those with:				
Persistent cough and sputum	13 (31.7%)	17 (44.7%)	0	30 (33.7%)
Chest illness	6 (14.6%)	6 (15.8%)	1 (10%)	13 (14.6%)
Breathlessness	1 (2.4%)	5 (13.2%)	0	6 (6.7%)
"Chronic bronchitis"	5 (12.2%)	5 (13.2%)	0	10 (11.2%)
Mean indirect M.B.C.	134	133	135	133

TABLE 14

PREVALENCE OF RESPIRATORY SYMPTOMS AND MEAN INDIRECT M.B.C. ACCORDING TO NUMBER OF YEARS SPENT WORKING ON COAL-GETTING SHIFT IN MEN AGED 55 TO 64 YEARS

	Years spent on Coalface				
	0	1 to 9	10 to 19	20 and over	Total
(a) Without pneumoconiosis					
All	38	17	25	16	96
Those with:					
Persistent cough and sputum	14 (36.8%)	6 (35.3%)	11 (44%)	7 (43.8%)	38 (39.6%)
Chest illness	11 (28.9%)	3 (17.6%)	9 (36%)	4 (25%)	27 (28.1%)
Breathlessness	8 (21.1%)	5 (29.4%)	9 (36%)	9 (56.3%)	31 (32.3%)
"Chronic bronchitis"	8 (21.1%)	2 (11.8%)	5 (20%)	3 (18.8%)	18 (18.8%)
Mean indirect M.B.C.	95	89	82	74	87
(b) With simple pneumoconiosis					
All	3	8	15	14	53
Those with:					
Persistent cough and sputum	1	1	7	6	20 (37.7%)
Chest illness	1	1	6	5	14 (26.4%)
Breathlessness	3	4	7	5	25 (47.2%)
"Chronic bronchitis"	1	1	5	1	13 (24.5%)
Mean indirect M.B.C.	78	96	87	85	87

TABLE 15

ANALYSIS OF WIVES OF ELDERLY MEN BY HUSBANDS' OCCUPATION

Occupation	No. of Men	No. of Bachelors and Widowers*	No. of Wives Seen
Non-dusty	81	15	66
Miners and ex-miners	192	26	166
Foundry and ex-foundry-workers	90†	9	81
Remainder	24	3	21
Total	387	53	334

*Including four men whose wives refused interview.

†The 17 men (see Table 7) have been allocated here to one occupation group only.

illness in the wives according to the occupation of their husbands. In each table the first column shows the number of couples and the second and third columns the prevalence of the symptoms in the men and women respectively. The tables show that the wives of the men who worked in dusty occupations recorded a higher prevalence of cough and/or sputum and chest illness than did the wives of the men who had worked only in dust-free jobs. In the

case of chest illness the difference does not quite reach the 5% level of significance. The last two columns show the prevalence of symptoms in the wives according to whether their husbands had or were free from the symptom. They show that the prevalence of both cough and/or sputum and of chest illness was slightly higher in the wives of the men with those symptoms but in neither case does the difference reach the 5% level of significance.

TABLE 16
PREVALENCE OF PERSISTENT COUGH AND/OR SPUTUM IN MEN AGED 55 TO 64 YEARS AND THEIR WIVES,
ACCORDING TO OCCUPATION

Occupation	No. of Couples	Husbands Positive	Wives Positive	Husbands and Wives Positive	Husbands Negative with Wives Positive
Miners and ex-miners	166	102 (61.4%)	42 (25.3%)	29 (28.4%)	13 (20.3%)
Foundry and ex-foundryworkers	81	44 (54.3%)	18 (22.2%)	9 (20.5%)	9 (24.3%)
Remainder	21	13 (61.9%)	5 (23.8%)	5 (38.5%)	0
Total dusty	268	159 (59.3%)	65 (24.3%)	43 (27%)	22 (20.2%)
Non-dusty	66	27 (40.9%)	10 (15.2%)	4 (14.8%)	6 (15.4%)
Total	334	186 (55.7%)	75 (22.5%)	47 (25.3%)	28 (18.9%)

TABLE 17
PREVALENCE OF CHEST ILLNESSES (ONE OR MORE IN PAST THREE YEARS) IN MEN AGED 55 TO 64 YEARS AND
THEIR WIVES, ACCORDING TO OCCUPATION

Occupation	No. of Couples	Husbands Positive	Wives Positive	Husbands and Wives Positive	Husbands Negative with Wives Positive
Miners and ex-miners	166	46 (27.7%)	35 (21.1%)	11 (23.9%)	24 (20%)
Foundry and ex-foundryworkers	81	20 (24.7%)	14 (17.3%)	3 (15%)	11 (18%)
Remainder	21	4 (19%)	5 (23.8%)	1 (25%)	4 (23.5%)
Total dusty	268	70 (26.1%)	54 (20.1%)	15 (21.4%)	39 (19.7%)
Non-dusty	66	13 (19.7%)	6 (9.1%)	3 (23.1%)	3 (5.7%)
Total	334	83 (24.9%)	60 (18%)	18 (21.7%)	42 (16.7%)

Discussion

Methodology.—Instead of establishing the population of Staveley by means of a private census we might have sampled from the electoral roll using a method similar to that employed in our survey in Leigh (Higgins *et al.*, 1956). The practicability of such a method in the present survey turned on the number of foundryworkers living in Staveley. From the information available we predicted that this number would be so small that we should have to visit over half the houses in the town. Rather than visit at random until the required number of foundryworkers had been obtained we decided that it would be quicker to visit every house systematically. In fact only 89 elderly foundry and ex-foundryworkers were encountered in the whole town and we should therefore have had to visit all the houses in either case.

The preliminary information about age and occupation necessary for drawing a stratified sample might have been obtained by means of a postal census. We considered this method but rejected it because we had no idea what sort of response we could expect. Since then Gray (1957) has reported a response rate of over 90% to postal enquiry and a postal census might certainly be attempted in future surveys.

The most accurate way to obtain a random sample of the population of a particular community, stratified for age and for occupation, is to interview all the potential members of the sample per-

sonally, accepting no secondhand information. This was the procedure employed in the Rhondda Fach and Vale of Glamorgan (Cochrane, Cox, and Jarman, 1952, 1955; Cochrane, Miall, and Clarke, 1956) and in Annandale (Cochran, Clayson, and Fletcher, 1957). In each case an occupational history was obtained from every man when he attended for chest radiography. In the present investigation census information about men in the two age groups was often obtained from a near relative. To have insisted on seeing each man individually would, we felt, have prolonged the census unjustifiably. Errors were inevitably introduced into the provisional age and occupational groups which we sampled. Correction of these inaccuracies complicated the subsequent treatment of the sample but there was in fact little difference in our finding in the uncorrected and corrected samples.

We have mentioned the theoretical justification for trying to assess chronic respiratory disease in the community rather than in a working population of foundrymen. The present survey indicates the practical limitations to this approach. Our preliminary enquiries suggested that in no town in the country other than Staveley would this method have been possible. Even in Staveley there were fewer elderly pure foundry and ex-foundryworkers than we really needed. There were certainly insufficient to study the various occupational groups within the industry, adequate numbers for which could only be obtained by studying a working population.

Aetiology of Bronchitis.—Of the various factors—age, sex, infection, allergy, social circumstances, familial susceptibility, occupation, exposure to dusts, atmospheric pollution, and tobacco smoking—considered to be important in the aetiology of bronchitis, the present discussion will be limited mainly to the last four.

The Influence of Occupation.—This was studied in mine and foundryworkers and in certain chemical workers.

MINING.—We believed before we went to Staveley that mining was associated with an increased liability to chronic non-specific respiratory disease. We expected that the higher prevalence of symptoms and reduced ventilatory capacity observed in miners when compared with non-miners in the Rhondda and in Leigh (Carpenter *et al.*, 1956; Higgins *et al.*, 1956) would again be found in Staveley. But this generalization from our two earlier surveys was not justified. In Staveley the elderly miners and ex-miners were not strikingly different from the men who had never worked in dusty occupations, judged either on their prevalence of respiratory symptoms or on their mean M.B.C. The findings in the 25 to 34 age group were certainly more in line with our previous findings in the Rhondda Fach, the miners appearing appreciably less fit than the non-dusty group. It is difficult to see why the young miners but not the old should be disabled. One possibility is that by separating miners into pure and mixed groups we may have underestimated the amount of disease in the elderly group. Symptomatically the differences are not striking but the mixed groups, both with and without pneumoconiosis, did record a lower mean M.B.C. than the pure groups. Even when the two groups are combined the resulting M.B.C. does not suggest that the elderly miners in Staveley were particularly disabled. Another possibility is that the young miners are affected by some factor that does not affect the older men. One might postulate that they are more likely to be affected by any increase in dustiness due to recent mechanization since more will be working on the coalface. It is also possible that occupational selection during and immediately after the war of the less fit members of the community into mining may have occurred.

Differential migration (Cochrane, 1958) may possibly account for some of the regional difference between miners and ex-miners. The Rhondda was much more affected than Staveley by the depression in the inter-war years and to the extent that the healthier members may have left the community we may now be dealing with a survivor population.

The regional standardized mortality ratios (S.M.R.) for working miners for bronchitis in the

TABLE 18

STANDARDIZED MORTALITY RATIOS (S.M.R.) OF MINERS, AGED 20 TO 64 YEARS, FOR BRONCHITIS IN DIFFERENT MINING AREAS IN 1951 (REGISTRAR-GENERAL, 1958)

Area	Registered Deaths	Expected Deaths	S.M.R.
Brecknockshire, Carmarthen, Pembrokeshire (anthracite)	21	17	124
Brecknockshire and Carmarthen-shire (remainder)	17	5	340
Glamorgan (anthracite)	33	13	254
Glamorgan (remainder)	263	127	207
Monmouthshire	99	56	177
Cumberland	7	9	78
Durham	217	196	111
Northumberland	98	77	127
Yorkshire, West Riding	309	231	134
Cheshire and Lancashire	132	90	147
Derbyshire (except South Derbyshire)	56	70	80
Leicestershire, Warwickshire, and South Derbyshire	48	52	92
Nottinghamshire	83	73	114
North Staffordshire	33	28	118
Staffordshire (remainder), Shropshire, and Worcestershire	57	46	124
Kent	12	10	120
Gloucestershire and Somerset	26	15	173
Remainder, <i>i.e.</i> , Pembrokeshire (remainder) and all other counties	29	20	145

different coalfields (Table 18) lend some support to the view that mining may be less injurious to health in Staveley than in other areas. Only in the central Midlands (Derbyshire, Leicestershire, and Warwickshire) and Cumberland are the S.M.R.s less than 100.

FOUNDRY WORK.—In neither of the two age groups did the pure foundryworkers appear to have a higher prevalence of respiratory symptoms and bronchitis or a lower ventilatory capacity than the men in non-dusty occupations. On the other hand, the group of mixed foundryworkers did appear materially worse on both counts. The problem of whether their foundry experience was responsible for their excess of symptoms and disability or whether exposure to other dust or fume, in mining, chemicals, or on the coke ovens, was more important is obviously difficult. It seemed to us that the latter explanation was more probably correct.

MISCELLANEOUS OCCUPATIONS.—One of the most interesting chance observations in this survey was the high prevalence of disease and low ventilatory capacity in the chemical workers. National statistics do not suggest that men engaged in the chemical industry are unduly subject to bronchitis but the national figures include widely varying groups of workers. Further study of men exposed to certain chemicals certainly seems indicated from our limited experience. It is interesting that 38 (9%) of the men aged 55 to 64 in our sample said that they had been exposed to poison gas in the first world war. Their mean M.B.C. was 68 litres/min., which is strikingly below the average for the group.

The Influence of Dust Exposure.—The figures for symptoms according to the number of years spent

TABLE 19
PREVALENCE OF RESPIRATORY SYMPTOMS AND "CHRONIC BRONCHITIS", AND MEAN INDIRECT M.B.C. IN
NON-MINERS AGED 55 TO 64 YEARS IN FOUR RANDOM SAMPLES

Sample	Rural		Urban	
	Annandale	Vale of Glamorgan	Leigh	Staveley
Number in sample	87	86	84	81
Number with:				
Persistent cough and sputum	17 (19.5%)	22 (25.6%)	15 (17.9%)	26 (32.1%)
Chest illness:				
Once	12 (13.8%)	10 (11.6%)	6 (7.1%)	7 (8.6%)
More than once	4 (4.6%)	4 (4.7%)	11 (13.1%)	10 (12.3%)
Total	16 (18.4%)	14 (16.3%)	17 (20.2%)	17 (21%)
Breathlessness:				
Grades 2 and over	25 (28.7%)	21 (24.4%)	19 (22.6%)	27 (33.3%)
"Chronic bronchitis"	6 (6.9%)	5 (5.8%)	9 (10.7%)	12 (14.8%)
Mean indirect M.B.C.	95	89	85	90

on the coal-getting shift do not suggest that the total quantity of coal dust played a very large part in the development of symptoms. It is possible that selection may occur whereby those who are affected by the coal dust tend to leave the face to work in less dusty parts of the mine. This could conceal any association between dust and respiratory symptoms.

Perhaps the most convincing evidence for an injurious effect of coal dust was the progressive fall in the mean M.B.C. accompanied by a reciprocal rise in the prevalence of breathlessness with increasing years spent on the coal-getting shift observed in the elderly miners without pneumoconiosis. These M.B.C. changes, which we were unable to show either in miners with pneumoconiosis or in the younger men, were similar to previous findings in the Rhondda and Leigh and are fully discussed elsewhere (Cochrane *et al.*, in the press). They may be compared with the observations on working coal-miners in Czechoslovakia of Kadlec and Vyskocil (1950), who showed a reduction in mean ventilatory capacity with increasing dust exposure for miners both with and without pneumoconiosis. A decline in lung function independent of age with increasing time spent working underground was also noted in a group of German miners studied by Carstens, Brinkmann, Lange, Meisterernst, and Schlicht (1958). These men were, however, seen in the course of hospital practice and it is impossible to say how much selection was therefore involved.

Effect of Tobacco Smoking.—The importance of tobacco smoking in the aetiology of bronchitis has been stressed by many authorities (Oswald and Medvei, 1955; Pemberton and Macleod, 1956; Phillips, Phillips, and Thompson, 1956; Ogilvie and Newell, 1957; Brown, McKeown, and Whitfield, 1957) and has been considered in earlier papers from this Unit (Higgins, 1959). The results in the present survey entirely support our previous conclusions that smoking is associated with an increase in

respiratory symptoms and a reduction in ventilatory capacity. So important is the influence of tobacco smoking that it is essential to allow for differences in smoking in comparable groups before drawing conclusions about the importance of other factors.

Atmospheric Pollution.—Our studies of random samples in areas of widely differing pollution enable us to evaluate the possible effect of long sustained atmospheric pollution on respiratory health. Table 19 summarizes the results in four areas, two rural and two urban, for the men aged 55 to 64 years. No striking difference between town and country was observed in the prevalence of persistent cough and sputum or breathlessness; but the proportion of recurrent chest illnesses was higher in the two towns and this is reflected in a higher bronchitis rate. The mean M.B.C. was significantly lower in Leigh, the most polluted area, than in the two unpolluted rural areas, but in Staveley where pollution was also high the M.B.C. is the same as in the rural areas.

In a survey of this kind it is clearly impossible to mention everyone who has contributed to its success. We should, however, like to thank Dr. A. I. G. McLaughlin of the Medical Research Council's Department for Research in Industrial Medicine and Mr. J. Gardner, General Secretary of the Amalgamated Union of Foundry workers, for much helpful information about the foundry industry. We are indebted to our colleagues at the Pneumoconiosis Research Unit for their advice and criticism, to the radiographic and epidemiological teams, and especially to Mr. P. D. Oldham for statistical assistance.

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APPENDIX

Respiratory Symptoms Questionnaire

Name..... Sex..... Date of birth.....
 Address..... Date of questionnaire.....
 Serial No..... Observer.....

Cough

1. Do you usually have a cough? Yes/No
 Do you cough at all on getting up or first thing in the morning?
 2. Only in the winter? Yes/No
 3. Or throughout the year? Yes/No
 Do you go on coughing during the day (night)?
 4. Only in the winter? Yes/No
 5. Or throughout the year? Yes/No

Phlegm

6. Do you usually bring up phlegm from your chest? (Not from back of nose) Yes/No
 Do you bring up any phlegm at all on getting up or first thing in the morning?
 7. Only in the winter? Yes/No
 8. Or throughout the year? Yes/No
 If yes, do you go on bringing it up during the day (or night)?
 9. Only in the winter? Yes/No
 10. Or throughout the year? Yes/No
 Is this phlegm:
 11. Always clear, white, gray or blackish? Yes/No
 12. Occasionally yellow or green at least in parts? Yes/No
 13. Usually yellow or green? Yes/No
 14. How long have you had this cough/phlegm?
 15. Have you ever coughed up any blood? Yes/No

Wheezing

16. Does your breathing ever sound wheezy or whistling? Yes/No
 If yes:
 17. Occasionally (for example when you have a cold)? Yes/No
 18. Most days (or nights)? Yes/No

Tightness

19. Does your chest ever feel tight? Yes/No
 If yes:
 20. Occasionally? Yes/No

21. Most days (or nights)? Yes/No

Chest Illnesses

22. During the past three years have you had a chest illness which has kept you in bed, off work, or indoors at home? Yes/No
 23. (Check: Not even 'flu')
 Number of illnesses

Doctor's Diagnosis	Year	Duration (Days)	Increased Cough	Increased Phlegm	Yellow Phlegm

Previous Illnesses

Have you ever had:

- Date
 24. Pneumonia..... Yes/No
 25. Pleurisy..... Yes/No
 26. Bronchitis..... Yes/No
 27. Asthma..... Yes/No
 28. Tuberculosis..... Yes/No
 29. Heart trouble..... Yes/No
 30. If relevant, were you gassed in the first world war? Yes/No
 31. Were you laid up with it? Yes/No
 Type of gas?.....

Breathlessness

33. Is your breathing as good as that of other people of your age at work, on hurrying, climbing hills or stairs?
 34. Can you keep up with people of your own age on the level without shortness of breath?
 35. Can you walk a mile (or $\frac{1}{2}$ an hour) on the level at your own pace without stopping for breath?
 36. Do you have to stop after about 100 yards on the level because of breathlessness?

37. Are you breathless on talking, after dressing or at rest? ☐

Smoking

45. Do you smoke?

Yes/No

Weather

38. Does the weather affect your chest?

Yes/No

39. What sort of weather?

Fog Damp Cold Other

40. In what way?

Increase of cough/sputum

Wheeze Dyspnoea Other

Colds

41. How many colds do you have each year? ☐

Yes/No

42. Do colds usually go to your chest?

Yes/No

43. Do you get bouts of cough and phlegm for 3 weeks in winter?

Yes/No

Conclusion

44. Does observer consider subject to be bronchitic?

Yes/No

47. If yes: Changes since

Now 1940

Cigarettes per

day

Oz. tobacco/week

(hand rolled)

Oz. tobacco/week

(pipe)

Cigars (No./week)

Age of starting regular smoking

Age of stopping regular smoking

If relevant:

48. Did you stop smoking because of your chest?

Yes/No

APPENDIX TABLE
OBSERVER DIFFERENCES IN RECORDING RESPIRATORY SYMPTOMS

Question No.	Total No. Seen	Aged 25 to 34				Aged 55 to 64			
		Interviewed by J.C.G.		Interviewed by I.T.T.H.		Interviewed by J.C.G.		Interviewed by I.T.T.H.	
		No.	%	No.	%	No.	%	No.	%
		190	100.0	185	100.0	198	100.0	203	100.0
1	Cough	63	33.2	49	26.5	98	49.5	95	46.8
2		48	25.3	42	22.7	90	45.5	87	42.9
3		39	20.5	38	20.5	77	38.9	79	38.9
4		27	14.2	24	13.0	40*	20.2	60	29.6
5		24	12.6	22	11.9	34†	17.2	56	27.6
6	Sputum	83	43.7	67	36.2	101	51.0	88	43.3
7		53	27.9	49	26.5	87	43.9	83	40.9
8		46	24.2	46	24.9	68	34.3	78	38.4
9		50	26.3	42	22.7	55	27.8	55	27.1
10		48	25.3	41	22.2	48	24.2	54	26.6
11	Cough and sputum	52	27.4	40	21.6	83	41.9	73	36.0
12	Colour	60†	31.6	32‡	17.3	82†	41.4	60†	29.6
13		20	10.5	20	10.8	21	10.6	34	16.7
15	Haemoptysis	33	1.6	14	7.5	4	2.0	9	4.4
16	Wheeze	14	7.4	12	6.5	19	9.6	25	12.3
17		67*	35.3	87*	47.0	107	54.0	120	59.1
18		57†	30.0	79†	42.7	81	40.9	75	36.9
19	Tightness	10	5.3	8	4.3	26	13.1	45	22.2
20		47†	24.7	69†	37.3	85	42.9	97	47.8
21		44*	23.2	62*	33.5	67	33.8	71	35.0
22	Wheeze and tightness	3	1.6	7	3.8	18	9.1	26	12.8
	Chest illness	21‡	11.1	49	26.5	60	30.3	78	38.4
	Once	21	11.1	14	7.6	19	9.6	18	8.9
	More than once	7	3.7	5	2.7	35	17.7	30	14.8
	Total	28	14.8	19	10.3	54	27.3	48	23.7
	With increased cough	26	13.7	18	9.7	49	24.7	45	22.2
	With increased sputum	23	12.1	17	9.2	44	22.2	45	22.2
	Breathlessness	168	88.4	176	95.1	114	57.6	126	62.1
33	Grade 1	22*	11.6	9*	4.9	84	42.4	77	37.9
34	2 and over	—	—	—	—	25	12.6	32	15.8
35	3 and over	—	—	—	—	8	4.0	12	5.9
36	4 and over	—	—	—	—	51	25.8	59	29.1
38	Weather	17	8.9	13	7.0	54	27.3	49	24.1
43	Bouts	18	9.5	18	9.7	53	26.8	49	24.1
44	Bronchitis	11	5.8	11	5.9	—	—	—	—
	"Chronic bronchitis" (sputum and chest illness)	13	6.8	13	7.0	43	21.7	36	17.7

*Significant 5% level

† Significant 2% level

‡ Significant 1% level