(3) Patients with sarcoidosis do not require sanatorium treatment with its unwarranted exposure to tuberculosis and the associated psychological trauma. The patient should be speedily rehabilitated to his normal occupation even when receiving steroid hormones.

(4) The majority of patients enjoy a spontaneous and permanent remission without treatment. The cortisone group of drugs have undesirable side-effects and should be reserved for the minority with a definite indication.

(5) When sarcoidosis is suspected, histological confirmation should be sought by all available means. This applies especially to the patient with bilateral hilar lymphadenopathy in whom malignant reticulosis may be confused with sarcoidosis and unnecessary radiotherapy contemplated.

Summary

One hundred and fifty cases are described in which clinical or radiological features of sarcoidosis were supported by histological evidence of sarcoid tissue. Diverse modes of presentation include intrathoracic, cutaneous, ophthalmic, glandular, hepatic, renal, and cerebral manifestations. Radiological and immunological aids to diagnosis are discussed. Histological evidence of sarcoid tissue remains the most satisfactory confirmation of the disease. In 100 patients it was obtained by biopsy of lymph node, skin, liver, or other affected tissues, and the Kveim test was positive in 83 of 110 subjects examined.

Antituberculous drugs did not affect the course of the disease and need not be given routinely. In the early stages the cortisone group of drugs have a beneficial effect on the clinical, radiological, and histological changes. Results of treatment are disappointing in the chronic fibrotic stage. Steroid treatment is given only when specifically indicated and is directed towards the prevention of these late sequelae.

I am grateful to Dr. H. L. Marriott and Professor A. Kekwick for their constant support and advice and to other clinicians who have referred patients. I am indebted to Dr. Louis Siltzbach, New York, for drawing my attention to his technique for skin biopsy with the Hayes-Martin drill, and to Dr. A. D. Thomson, Bland-Sutton Institute of Pathology, for histological interpretations.

REFERENCES

Ainslie, D., and James, D. G. (1956). *British Medical Journal*, **1**, 954.
Crick, R., Hoyle, C., and Mather, G. (1955). Ibid., **2**, 1180.
Curtis, A. C., Taylor, H. jun., and Grekin, R. H. (1947). *J. invest. Derm.*, **9**, 131.
Daniels, A. C. (1949). *Dis. Chest*, **16**, 360.
DeNardi, J. M., Van Ordstrand, H. S., Curtis, G. H., and Zielinski, J. (1953). *Arch. Industr. Hyg.*, **8**, 1.
Friou, G. J. (1952). *Yale J. Biol. Med.*, **24**, 533.
Gleckler, W. J. (1956). *Ann. intern. Med.*, **44**, 174.
Gormsen, H. (1948). *Acta med. scand., Suppl.* **213**, 154.
Henneman, P. H., and Carroll, E. L. (1955). *J. clin. Invest.*, **34**, 939.
Hoyle, C., Dawson, J., and Mather, G. (1954). *Lancet*, **2**, 164.
Israel, H. L., Sones, M., and Harrell, D. (1954). *J. Amer. med. Ass.*, **156**, 461.
James, D. G., and Pepys, J. (1956). *Lancet*, **1**, 602.
—— and Thomson, A. D. (1955). *Quart. J. Med.*, **24**, 49.
—— —— and Willcox, A. (1956). *Lancet*, **2**, 218.
Jüngling, O. (1920-1). *Fortschr. Röntgenstr.*, **27**, 375.
Kennedy, A. C. (1950). *Glasg. med. J.*, **31**, 10.
Leitner, S. I. (1949). *Der Morbus Besnier-Boeck-Schaumann*. Basel.
Mather, G., Dawson, J., and Hoyle, C. (1955). *Quart. J. Med.*, **24**, 331.
Nelson, C. T. (1949). *J. invest. Derm.*, **13**, 81.
Norviit, L., Carstensen, B., Odelberg, A., and Wahlgren, F. (1952). *Nord. Med.*, **48**, 1099.
Quinn, E. L., Bunch, D. C., and Yagle, E. M. (1955). *J. invest. Derm.*, **24**, 595.
Salvesen, H. A. (1935). *Acta med. scand.*, **86**, 127.
Schier, W. W., Roth, A., Ostroff, G., Schrift, M. H. (1956). *Amer. J. Med.*, **20**, 94.
Siltzbach, L. E., and Som, M. L. (1952-3). *J. Mt Sinai Hosp.*, **19**, 473.
Sneddon, I. B. (1955). *British Medical Journal*, **1**, 1448.
Sones, M., and Israel, H. L. (1954). *Ann. intern. Med.*, **40**, 260.
Van Ordstrand, H. S., Effler, D. B., McCormack, L. J., and Hazard, J. B. (1955) *A.M.A. Arch. industr. Hlth.* **12**, 26.

RESPIRATORY SYMPTOMS AND PULMONARY DISABILITY IN AN INDUSTRIAL TOWN

SURVEY OF A RANDOM SAMPLE OF THE POPULATION

BY

I. T. T. HIGGINS, M.D., M.R.C.P.
P. D. OLDHAM, M.A.
A. L. COCHRANE, M.B., D.P.H.

AND

J. C. GILSON, M.B., M.R.C.P.

Medical Research Council, Pneumoconiosis Research Unit, Llandough Hospital, near Penarth

Interest is increasing in the prevalence and causes of chronic bronchitis. Bronchitis was the commonest cause of spells of sickness incapacity in males reported to the Ministry of Pensions and National Insurance during 1953–4 (M.P.N.I., 1955), and accounts for about 10% of all claims.

Diseases that are generally prevalent can be considered to be influenced by occupation only if their occurrence among workmen differs from that found in the general population. Respiratory symptoms and pulmonary disability are common in coal-miners, but before we can attribute them to mining we must first show that their prevalence is higher in miners than in non-miners. The ideal investigation would require a random allocation of school-leavers to mining and other occupations, and subsequent comparison of the incidence of respiratory diseases in the two groups. In default of this we can only study the prevalence in already constituted groups as comparable as possible in age and all environmental conditions except those associated with mining. It is then always necessary to remember that their comparability is but an assumption and that the voluntary choice of occupation may itself be related to the medical status of the men.

In November, 1954, the Pneumoconiosis Research Unit carried out a survey of the 55- to 64-year-old male population of Leigh in Lancashire. One of the objects of this survey was to compare the prevalence of respiratory symptoms and disability in miners with that found in men who had worked only in other occupations.

Leigh was chosen for a number of reasons, including the expectation of finding approximately equal numbers of miners and non-miners in the older age group. It is not an area where coal-miners' pneumoconiosis is a particular problem. It is 13 miles west of Manchester, about in the middle of the Lancashire/Cheshire conurbation of towns—a region with a high mortality from bronchitis (Lane, 1954). It is, however, relatively circumscribed and away from the area of heaviest pollution.

This paper gives the results of our investigation and suggests a possible approach to the difficult problem of controls.

The Sample

At the time the survey was planned the only information available about the age and sex distribution of the population of Leigh was that given by the Registrar-

General (1949) from estimates obtained from the National Register in December, 1947. According to these the male population of Leigh was 22,909, of whom 2,341 were between 55 and 64. A sample of about 250 men in this age group, or roughly one in ten, was considered adequate.

The only list from which sampling could be carried out was the Electoral Roll. This gives the names of those eligible to vote at the time of compilation. It appears as a list of streets, with the occupants of each house listed alphabetically within houses, in the order of the houses in the street. Within each ward the occupants of houses are given a serial number.

As a basis for a random sample of individuals the Electoral Roll is unsatisfactory, since the population of the town at the time of the survey may differ from that at the time of compilation of the list. However, it is satisfactory as a basis for a random sample of houses, provided a supplementary list of new houses is available. The procedure adopted was to sample at random from the serial numbers of individuals, to regard the selected numbers as selecting a house, and to include in the final sample all men in the chosen houses who were of the correct age. By this method the chance of selecting a house is roughly proportional to the number of its inhabitants, so that, again roughly, each individual has the same chance of being included in the sample. Each new house was arbitrarily allotted two serial numbers since the vast majority were in a new "residential neighbourhood unit" built by the borough council and occupied by young married couples.

The principal deviation from randomness to be expected in this method of sampling is that all relatives of the right age group living together in a chosen house were automatically included in the sample. Thus if there is any tendency for relatives to resemble each other in their sickness experience the sample would tend to be less diversified than a truly random one. In fact, it was seldom that more than one man of appropriate age was found in a chosen house. Samples of 100 houses from the whole of Leigh were chosen in this fashion in succession. The visiting in each sample was completed before the next was begun. After fifteen such samples had been visited 245 men between 55 and 64 had been found, and the sampling was stopped. Since 14% of males over 20 were aged 55–64 in 1947 it was expected that about 14% of houses would yield a suitable subject; in fact, 16% (245 in 1,500) did so.

Of the 245 men chosen, 24 (9.8%) refused to co-operate in the survey. The sample was divided according to occupation as in Table I. In different electoral wards the lapse rate ranged from 0 to 31%.

TABLE I.—*Random Sample of Men Aged* 55–64

Group	Examined	Lapsed	Total
Miners and ex-miners ..	135 (92·5%)	11 (7·5%)	146
Non-miners	86 (86·7%)	13 (13·1%)	99
Total	221 (90·2%)	24 (9·8%)	245

The difference in lapse rate is insignificant ($0{\cdot}30 > P > 0{\cdot}20$).

The wards differ in their level of prosperity. The proportion of electors entitled to be called for jury service (which has been suggested by Gray *et al.* (1951) and Corlett (1952) as an index of the economic status of a district) ranges in different wards from 1.4 to 62.3 per 1,000. The correlation between lapse rate and jury index was, however, quite insignificant.

Procedure and Method

Every male inhabitant aged 55–64 of the selected houses was interviewed personally by a member of the Field Survey team. He was asked to co-operate in an investigation into the effect of dust on the lungs. Each man who consented was given an appointment to attend at a central hall where the various investigations were carried out. Transport was offered. Whether or not he consented he was asked if he had ever worked for one year or more in mining or cotton, to enable a provisional occupational classification to be made. Any man who failed to keep his appointment was promptly revisited, usually on the same day. He was either persuaded to accompany the home visitor immediately, or was given another appointment. The following were the methods adopted.

1. Occupational histories from the time of leaving school were taken.

2. Respiratory symptoms were recorded, using a questionary (see Appendix). Particular attention was paid to a history of chest illness during the past three years, to the constant occurrence of cough and phlegm, and to wheezing and tightness in the chest. Breathlessness was graded, using the questions recommended by Fletcher (1952). In addition, questions relating to some aetiological factors thought to be important in causing bronchitis were asked. All the questionaries were completed by one observer to avoid the differences in recording level that are known to occur between different observers (Cochrane *et al.*, 1951).

3. Sitting height to the nearest half-inch and weight to the nearest pound were measured.

4. Ventilatory capacity was measured by recording the volume of air expelled in the first 0.75 second of a forced expiration, using a modified Gaensler (1951) apparatus. The mean of three or four readings was taken (excluding the first) and the resulting volume was expressed in litres/minute as the maximum voluntary ventilation (M.V.V.) (indirect) in the way described by Kennedy (1953).

5. A postero-anterior *x*-ray film of the chest was taken of each man, using a mobile *x*-ray van. Duplicate *x*-ray readings were carried out according to the practice adopted at this unit.

Results

Exclusions.—We have excluded from the analysis those men whose chest *x*-ray films showed significant disease, other than coal-miners' pneumoconiosis and emphysema, that might be expected to affect the ventilatory capacity. There were five such men : three miners and two non-miners. The reasons for their exclusion and the mean value of various measurements are shown in Table II. The exclusion of these men makes no material difference to the general results.

TABLE II.—*Mean Measurements of* 5 *Exclusions*

Group	No.	Age (Years)	Sitting Height		Weight		M.V.V. (l. min.)
			in.	cm.	lb.	kg.	
Miners and ex-miners	3*	57·7	34·5	87·6	136·0	61·7	74·0
Non-miners	2†	61·0	33·3	84·5	152·5	69·2	69·5

* One case each of bronchial carcinoma, general cystic disease of the lungs, and extensive pleural thickening.
† One case each of extensive pleural thickening and category 2 simple pneumoconiosis in an engine-driver.

Men with Exposure to Cotton Dust.—24 miners and 28 non-miners had worked for one or more years in cotton (average period 16 years). The average working time of those who had worked only in cotton was 25 years, and all except two were spinners. Most of those with a mixed occupational history had worked in dustier parts of the mills, but their mean exposure was only six years. The mean values of the main measurements are given in Table III. The results do not differ significantly from those found in men who had never been exposed to cotton dust. It therefore seems justifiable to include them in their appropriate groups.

Prevalence of Pneumoconiosis.—Among the miners and ex-miners there were 31 men whose *x*-ray films showed

TABLE III.—*Mean Values of Those Men who had Worked in Cotton*

	No.	Age	Sitting Height		Weight		M.V.V. (l./min.)	Bronchitis
			in.	cm.	lb.	kg.		
Miners ..	24	59·4	34·0	86·3	142·4	64·6	71·5	7 (29·2%)
Non-miners	28	59·4	33·6	85·3	141·5	64·2	87·1	3 (10·7%)

pneumoconiosis, a prevalence of 23%: 21 (15.6%) had simple and 10 (7.4%) complicated pneumoconiosis. These figures may be compared with a prevalence of 30.3% simple pneumoconiosis and 21% progressive massive fibrosis found in the 55–64 age group by Cochrane *et al.* (1952) in the Rhondda Fach Valley, in South Wales. The miners with pneumoconiosis are analysed separately. There are therefore three groups for comparison: (1) 84 non-miners, (2) 101 miners or ex-miners without pneumoconiosis, and (3) 31 miners or ex-miners with pneumoconiosis. Their mean ages, weights, and sitting heights are given in Table IV.

TABLE IV.—*Mean Anthropometric Measurements of the Three Groups (Aged 55–64)*

Group	No.	Age (Years)	Sitting Height		Weight	
			in.	cm.	lb.	kg.
Non-miners ..	84	59·4	33·9	86·1	145·6	66·0
Miners without pneumoconiosis	101	59·1	34·2	86·8	147·8	67·0
Miners with pneumoconiosis	31	58·6	34·1	86·6	152·4	69·1

Prevalence of Respiratory Symptoms.—Table V shows the prevalence of respiratory symptoms found in each of the age groups (simple and complicated pneumoconiosis being differentiated). As the number of men with pneumoconiosis was small the results in this group should be interpreted with caution. The first two grades of breathlessness in Fletcher's classification require the subject to estimate his performance in walking uphill. In the flat country in and around Leigh answers to such questions are of doubtful validity. Only those men who were unable to keep up with other men of their own age on the level (Grade 3 or more) were therefore considered to be breathless.

Non-miners and Miners Without Pneumoconiosis.—In every case the miners recorded a higher prevalence of symptoms than the non-miners. The difference was greatest in the case of breathlessness, the miners recording a prevalence more than three times as high as the non-miners ($P<0.01$). Cough and sputum and wheezing and tightness were recorded approximately twice as frequently among the miners ($P<0.01$).

Miners With and Without Pneumoconiosis.—A similar prevalence of chest illness and of wheezing and tightness in the chest was found in these two groups. Cough and sputum, on the other hand, were recorded less often among those with pneumoconiosis and only slightly more frequently than among the non-miners. In the miners with simple pneumoconiosis the prevalence of breathlessness was only slightly higher than that found in the non-miners (9.5% compared with 7.2%); in those with complicated pneumoconiosis the prevalence of breathlessness was higher than in any other group—namely, 40%.

It is clear, therefore, that miners, irrespective of the presence of pneumoconiosis, had a higher prevalence of all symptoms and were more breathless than the non-miners.

Prevalence of Chronic Bronchitis

There is no generally accepted definition of chronic bronchitis, though cough, sputum, and disability are usually implied. German authorities reviewed by Worth and Schiller (1954) stress the importance of physical signs in the chest in addition to cough and sputum; but they also point out that added sounds may be evanescent. In view of the unreliability of physical signs in the diagnosis of chronic bronchitis (Schilling *et al.*, 1955), we omitted a clinical examination and based the diagnosis on answers to the questionary.

For this analysis we have defined chronic bronchitis as the constant production of phlegm and one or more chest illnesses during the past three years. Table VI shows that by this definition the miners had more than twice as much bronchitis as the non-miners—23.5% compared with 10.7%.

TABLE VI.—*Prevalence of Chronic Bronchitis*

	No.	Chronic Bronchitis	
Non-miners	84	9	(10·7%)
Miners	132	31	(23·5%)
Without pneumoconiosis ..	101	27	(26·7%)
With ,, ..	31	4	(12·9%)

The prevalence of bronchitis in the miners without pneumoconiosis (26.7%) was the cause of most of this difference. In those miners with pneumoconiosis the prevalence of bronchitis was only slightly higher than in the non-miners (12.9% compared with 10.7%). The difference between the non-miners and the miners without pneumoconiosis is highly significant ($0.01>P>0.001$); that between the non-miners and all the miners, irrespective of *x*-ray category, is also statistically significant ($0.05>P>0.01$).

The radiographs were classified for emphysema on the usual criteria—a low diaphragm, narrow vertical heart, abnormal vascular pattern, and bullous changes (Simon and Galbraith, 1953). The prevalence of emphysema was not significantly different in miners and non-miners; however, the detection of the early stages of emphysema radiologically is unreliable (Knott and Christie, 1951) and we had no lateral films.

Ventilatory Capacity

The ventilatory capacity measurements according to occupation and *x*-ray category are shown in Fig. 1. The mean value for the non-miners was 85 litres/minute, and for the miners without pneumoconiosis 76 litres/minute. The difference is highly significant ($0.01>P>0.001$). The mean M.V.V. of all miners irrespective of pneumoconiosis was 77.3 litres/minute, and the difference between this and the non-miners is also significant ($0.05>P>0.01$).

The effect of pneumoconiosis on the ventilatory capacity is also shown in Fig. 1. A reduction of 6 litres/minute for each category of simple pneumoconiosis was observed. A further reduction of 7 litres/minute was found in the mean M.V.V. of miners with P.M.F.

Fig. 2 shows the percentage frequency distribution of the ventilatory capacity for the non-miners and the miners without pneumoconiosis. The distribution in the miners is displaced to the left. Thus the percentage of men with values of less than 50 litres/minute was 7.1% in the non-miners, compared with 16.8% in the miners. It is our clinical impression that those with an M.V.V. of less than 50 litres/minute are usually definitely crippled by their respiratory insufficiency.

TABLE V.—*Prevalence of Respiratory Symptoms in the Three Groups (% in Parentheses) (Aged 55–64)*

Group	No.	No Symptoms	Chest Illness	Cough	Sputum	Cough and Sputum	Yellow Sputum	Wheeze	Tightness	Wheeze and Tightness	Breathlessness
Non-miners	84	30 (35·7)	17 (20·2)	25 (29·8)	28 (33·3)	15 (17·9)	10 (11·9)	32 (38·1)	30 (35·7)	19 (22·6)	6 (7·2)
Miners and ex-miners category 0/—/–	101	20 (19·8)	32 (31·7)	49 (48·5)	57 (56·4)	38 (37·6)	22 (21·8)	59 (58·4)	53 (52·5)	43 (42·6)	25 (24·8)
Miners and ex-miners with pneumoconiosis	31	7 (22·6)	10 (32·3)	9 (29·0)	13 (41·9)	6 (19·3)	6 (19·3)	17 (54·8)	14 (45·2)	14 (45·2)	6 (19·3)
Simple pneumoconiosis ..	21	4 (19·0)	7 (33·3)	7 (33·3)	9 (42·9)	4 (19·0)	5 (23·8)	11 (52·4)	8 (38·1)	7 (33·3)	2 (9·5)
Complicated ,, ..	10	3 (30·0)	3 (30·0)	2 (20·0)	4 (40·0)	2 (20·0)	1 (10·0)	6 (60·0)	6 (60·0)	5 (50·0)	4 (40·0)

The men with chronic bronchitis are indicated by the black columns. Bronchitis is associated with a low ventilatory capacity. Thus the mean of the non-miners with bronchitis was 60 compared with the group mean of 85 litres/minute ($P<0.001$); that of the miners with bronchitis was 65 compared with the group mean of 76 litres/minute ($0.01>P>0.001$).

Chronic bronchitis as we have defined it has a greater effect on ventilatory capacity than one category of simple pneumoconiosis (Table VII). The mean M.V.V. of miners with bronchitis was 65 litres/minute and for those without bronchitis about 80 litres/minute—a difference of 15 litres compared with the 6 litres/minute per category of simple pneumoconiosis.

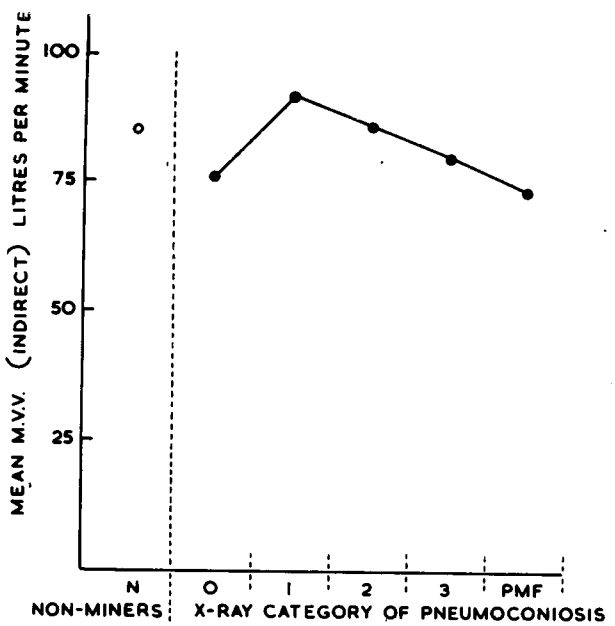

FIG. 1.—Relationship between *x*-ray category and maximum voluntary ventilation. (Age 55–64.)

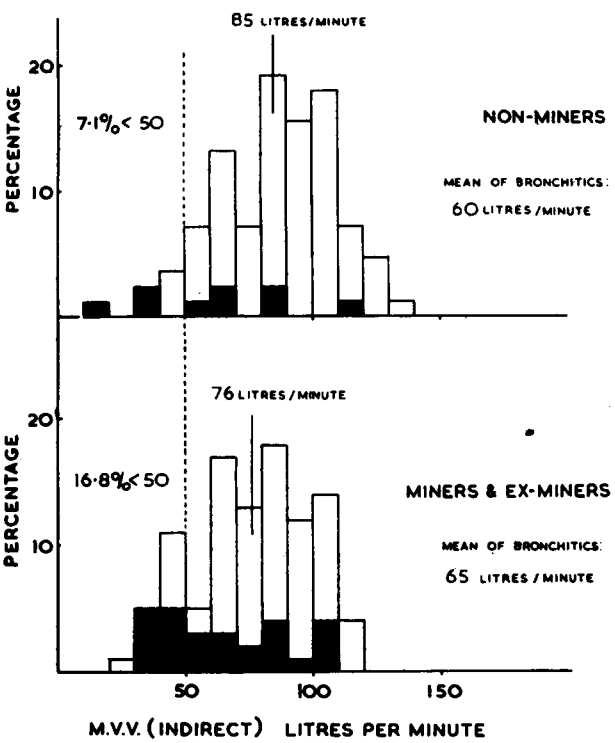

FIG. 2.—Frequency distributions of M.V.V. Men with chronic bronchitis are indicated by black columns.

TABLE VII.—*Mean M.V.V. (Indirect) in Litres/Minute in the Three Groups, Showing the Effect of Bronchitis on the Ventilatory Capacity*

	Group Mean	Without Bronchitis	With Bronchitis
Non-miners	85	88	60
Miners and ex-miners, category 0/– –/–	76	80	65
Miners and ex-miners with pneumoconiosis	82	84	65

Analysis by Social Class, Smoking Habits, and Dust Exposure

Our survey also enabled us to investigate the possible aetiological importance of a limited number of other factors.

Social Class.—Table VIII shows the number of men in each group in each of five social classes. Social class as classified on the Registrar-General's scale was determined from the occupations in which a man had spent most of his working life. This may differ from that obtained by the Registrar-General based on occupation at the time of the census. This difference may be of some importance, because

TABLE VIII.—*Social Class*

	Registrar-General's Social Classes			Total
	III	IV	V	
Non-miners ..	56	11	9	76*
Bronchitics ..	5	2	1	8
Miners and ex-miners category 0/– –/– ..	34	52	15	101
Bronchitics ..	14	10	3	27
Miners and ex-miners with pneumoconiosis	18	12	1	31
Bronchitics ..	1	3	0	4
Total	108	75	25	208
Bronchitics ..	20 (18·5%)	15 (20·0%)	4 (16·0%)	39 (18·8%)

* 8 non-miners were in classes I and II.

those with severe bronchitis may be in a lower social class on account of their disability. The miners' social class was lower than that of the non-miners. Furthermore, the social class of the miners without pneumoconiosis was lower than that of the miners with pneumoconiosis (66.4% compared with 41.9% in classes IV and V). A relation between the prevalence of bronchitis and social class might therefore be inferred. However, the overall prevalence of 18.5, 20.0, and 16.0% in classes III, IV, and V suggests that there was in fact little relation between chronic bronchitis and social class in the group studied.

Smoking Habits.—Men have been classified according to the quantity of tobacco smoked. A smoker is defined as one who at any period of his life had smoked 1 g. of tobacco a day for a year. One cigarette a day is equivalent to 1 g. of tobacco a day; 1 oz. (28 g.) of tobacco a week is equivalent to 4 g. of tobacco daily (Doll and Hill, 1950). The results are shown in Table IX. The proportions in each group among miners and non-miners were similar.

Smokers were compared with non-smokers irrespective of occupation and *x*-ray category; there were no bronchitics among 28 non-smokers but 40 bronchitics among 188 smokers. The numbers expected in the two groups, assuming that there is no association between smoking and bronchitis, are 5.2 and 34.8. The observed differences from those expected are statistically significant ($0.02>P>0.01$). For all groups together a clear relationship between the amount of tobacco smoked (above 1 g. a day) and bronchitis is disturbed by the lower prevalence in those smoking the largest amount.

Dust Exposure.—Only indirect measures of dust exposure were possible—namely, the number of years spent (1) underground, and (2) on the coal-getting shift. The bronchitics among the miners without pneumoconiosis had spent an insignificantly longer time both underground and on the coal-getting shifts. Those men with category 1 and 2 simple pneumoconiosis and bronchitis had spent only a short time

TABLE IX.—*Smoking Habits Classified According to Number of Grammes of Tobacco Smoked a Day*

Group	No.	Smoking Habits (g. of Tobacco)				
		0	1–	5–	15–	25–
Non-miners	84	12 (14·3%)	2 (2·4%)	42 (50·0%)	19 (22·6%)	9 (10·7%)
Bronchitics	9	0	0	3	5	1
Miners and ex-miners without pneumoconiosis	101	13 (12·9%)	3 (3·0%)	51 (50·5%)	24 (23·8%)	10 (9·9%)
Bronchitics	27	0	0	16	8	3
Miners and ex-miners with pneumoconiosis	31	3 (9·7%)	2 (6·5%)	18 (58·1%)	5 (16·1%)	3 (9·7%)
Bronchitics	4	0	0	3	1	0
All groups	216	28	7	111	48	22
Bronchitics	40 (18·5%)	0	0	22 (19·8%)	14 (29·0%)	4 (18·2%)

on the coal-getting shift. The numbers are, however, too small to draw any firm conclusions about the relation to dust exposure and bronchitis.

Discussion

Lapses

The homes of all those who lapsed from the investigation were visited. Some information was obtained either from the men themselves or from their wives. While information divulged through the crack of a closing door is of doubtful value, sufficient details were obtained to conclude that no great bias was introduced by the lapses.

Lapses could be reduced if the population sampled could be studied in their homes instead of having to attend at a central hall. Portable tests of ventilatory capacity now make this a foreseeable possibility. Radiography would, however, have to be omitted. Our results suggest that such an omission would not have affected our conclusions about miners and non-miners, but a diagnosis of pneumoconiosis would, of course, have been impossible.

Mortality Statistics

A high mortality from bronchitis for coal-miners was noted by Collis (1931), who also drew attention to the wide differences that occurred in different coalfields. In 1930–2 the S.M.R. from bronchitis and pneumonia for all coal-miners (ages between 20 and 65) working underground was 119, but for miners in Lancashire and Cheshire it was 165. In 1950 the S.M.R. for bronchitis in hewers and getters was 180; that in other mine-workers in coal was 98. It would appear, therefore, that the excess mortality due to bronchitis affects the former group. However, undoubtedly in the past deaths due to pneumoconiosis and even respiratory tuberculosis have been attributed to bronchitis (Cummins, 1935; Sen, 1937), and it is probable that some inflation of the bronchitis mortality statistics by faulty certification still occurs. Nevetheless, the figures do suggest that bronchitis may be more prevalent in miners than in the general population. It should, however, be noted that a high mortality due to bronchitis is found in those coalfields which are situated in areas where bronchitis death rates are high also in the non-mining population (Goodman *et al.*, 1953), and that the wives of coal-miners share this excessive mortality from bronchitis to a large extent (Registrar-General, 1938).

Morbidity Statistics

Remarkably few estimates of the relative prevalence of bronchitis in miners and comparable non-miners have been published. In 1924 Schurmann (quoted by Worth and Schiller, 1954) found that the prevalence of bronchitis in underground workers was double that of mine office workers who had never been exposed to dust. More recently Boehme and Lent (1951), in a large group of hospital patients, found an overall prevalence of bronchitis of 29.1% in miners compared with 15.5% in non-miners, the figures in the 50–60 age group being 32.6 and 14.6% respectively. Our findings in the 55–64 age group in a geographically defined community support these conclusions and indicate a close agreement in the magnitude of the difference found by Boehme and Lent.

Conflicting results have been obtained for the prevalence of bronchitis in miners with and without pneumoconiosis. In this country Hart and Aslett (1942) found that among South Wales coal-workers aged 40–64 years the prevalence of chronic bronchitis increased with radiological category. In Germany, Trautmann (1949) found that in "silikose" stage I and II the prevalence of bronchitis was not especially high, but that in stage III it might reach nearly 60%. Beckmann (1951) found a higher prevalence of bronchitis in those with "silikose" than in those without; while Zorn (1949) and Worth and Dickmans (1950) noted an increasing prevalence of bronchitis with increasing grade of "silikose." On the other hand, Boehme and Lent (1951), in a group of miners who were no longer capable of full work, found a higher percentage of bronchitis in those without "silikose" than in those with stages I and II. The results of German investigations are reviewed by Friehoff (1952) and Worth and Schiller (1954). It is clear, as Boehme and Lent themselves realize, that the results may be greatly influenced by the population studied.

In the present survey chronic bronchitis was slightly commoner among the miners without pneumoconiosis than among those with pneumoconiosis, but the number of the latter was small and they mostly had simple pneumoconiosis. It is interesting to observe in this connexion that in their 55-year-old group Gilson *et al.* (1955) recorded a higher prevalence of cough and sputum in working miners without pneumoconiosis than in those with either simple or complicated pneumoconiosis.

The general prevalence of respiratory symptoms has seldom been published. Stuart-Harris (1954) reported cough and sputum in 55% of men aged 50–60 in an industrial population. Of these, 35.5% had a symptom group called the "triple complex," consisting of cough, sputum, and disability. An approximately comparable figure obtained from our results gives a prevalence of 26% for the three groups together, and 34% for miners and ex-miners without pneumoconiosis.

Ventilatory Capacity

Our findings of a significant reduction in ventilatory capacity in miners compared with non-miners are in agreement with the few other workers who have compared miners with men who have never mined (Vokac, 1950; Kadlec and Vyskocil, 1950; Salvini and Capodaglio, 1955). Significant differences in ventilatory capacity between miners without pneumoconiosis and non-miners of comparable age have been recorded previously at this unit (Gilson *et al.*, 1955).

The finding that miners with early simple pneumoconiosis recorded a higher mean M.V.V. than those without is discussed in detail in another paper (Carpenter *et al.*, 1956). Taken together with the observation that such miners appear to have fewer respiratory symptoms and less chronic bronchitis, the suggestion is made that the fitter men with the larger ventilatory capacities, who are more likely to work on the coal-face where the concentration of dust is highest, are consequently more liable to pneumoconiosis than their fellows.

The effect of simple pneumoconiosis on the ventilatory capacity of the sample studied was not great, and it seems unlikely that this form of pneumoconiosis *per se* causes much disability. The effect of chronic bronchitis and respiratory symptoms in reducing the M.V.V. were, how-

ever, more considerable. These findings support the conclusions of those workers who have found that disability in miners is related more closely to "emphysema" than to fibrosis (Wright, 1956; Lavenne and Belayew, 1953; Foubert *et al.*, 1954).

Aetiological Factors

Smoking.—Cigarette-smoking is generally regarded as aetiologically important in the development of chronic bronchitis. Palmer (1954) found a significantly greater incidence of bronchitis in smokers than in non-smokers and noted an increase with increasing tobacco consumption. Oswald *et al.* (1953) considered that cigarette-smoking was an important aggravating factor.

Greene and Berkowitz (1954), using a "pre-operative test cough" of "proved sensitivity and reliability," recorded prevalences of "smokers' bronchitis" in 76–80% of people of either sex smoking 20 or more cigarettes daily. On the other hand, neither Fry (1954), in general practice, nor Gregory (1955), in a gas-workers' survey, was able to show a convincing relationship between smoking and bronchitis. Nor was there any association between the mortality rates of doctors due to respiratory disease other than carcinoma and their smoking habits (Doll and Hill, 1954). Differences may be due to the wide differences in diagnosis of bronchitis. Significant results are most likely to be obtained by those who include "smokers' cough" in their definition of bronchitis.

In a previous investigation in the Rhondda Valley we were unable to show a relation between smoking habits and bronchitis (Cotes *et al.*, 1956). In the present study, however, smoking appeared to be a possible factor. Smoking cannot, however, account for the differences either in respiratory symptoms of ventilatory capacity between miners and non-miners, since the smoking habits of the two groups were very similar.

Social Class

The relationship between bronchitis and social class is seen in the mortality statistics. These are considered in detail for 1930–2 by Goodman *et al.* (1953). The S.M.R.s for bronchitis in men aged 20–64 according to class in 1950 showed that there was no longer so great a difference between classes III and IV as there had been in 1930–2, and this was due to a reduction in the S.M.R. in class IV.

Oswald *et al.* (1953) were unable to show any close association between bronchitis and social class. Fry (1954) also failed to observe any relationship. Our findings indicate that the importance of social class could easily be exaggerated. Thus the higher prevalence of bronchitis among miners might be attributed to their lower social class. That this was not so is clear from the prevalence of bronchitis within the social classes, which showed no such relation.

Exposure to Dust

Since the main differences between miners and non-miners are life underground and exposure to coal-dust it is likely that one or both of these factors is associated with the differences that we have observed. Of the two, exposure to dust might perhaps be expected to be the more important. An association between dust exposure and bronchitis, based on the presence of rhonchi in the lungs, has been stressed by several authors (Dautrebande *et al.*, 1948; Lent, 1950; Dautrebande, 1952) but refuted by others (Beckmann, 1951; Pestiaux *et al.*, 1955; Worth *et al.*, 1955). In the present survey, no clear relation between bronchitis and dust exposure could be shown in the mining group. This may be because bronchitis is a condition in the cause of which many factors are involved. The interaction of these factors may tend to obscure the importance of any one of them. Alternatively, the general belief that dust is important in causing bronchitis may be mistaken.

The possibility that miners may be more apt than other members of the community to complain of symptoms has been suggested (Halliday, 1943; Heron and Braithwaite, 1953; Ross *et al.*, 1954). In a previous survey we observed a tendency for men who had been compensated to record a lower breathlessness grade than might have been expected from their ventilatory capacity, and it seemed probable that other respiratory symptoms might be correspondingly exaggerated. In the present study, compensation issues were rarely raised and we had no evidence to suggest that miners were more symptom-prone than non-miners. Ventilatory capacity measurements supported the questionary findings.

Summary

A study of respiratory disability in 90% of a random sample of 245 men aged 55–64 in Leigh (Lancs) has been made.

Miners and ex-miners had significantly more "chronic bronchitis" and a lower ventilatory capacity than men who had never worked in the mines; and they also recorded a higher prevalence of all respiratory symptoms.

Miners without pneumoconiosis were on the average more disabled than those with early simple pneumoconiosis.

The differences between miners and non-miners could not be ascribed to differences in social class or smoking habits, and in the miners there was no obvious relationship between length of exposure to dust and bronchitis.

We are indebted to our colleagues at the Pneumoconiosis Research Unit for their help, advice, and criticism. The chest radiography was carried out by Mr. W. G. Clarke and the radiographic team, and much of the home visiting by the epidemiological team. The ventilatory capacity measurements were made by Mr. A. J. Merrick. We also wish to thank the Mayor and inhabitants of Leigh, without whose active co-operation this survey would not have been possible.

References

Beckmann, H. (1951). *Beitr. Silikose-Forsch.*, **11**, 26.
Boehme, A., and Lent, H. (1951). Ibid., **11**, 1.
Carpenter, R. G., Gilson, J. C., and Higgins, I. T. T. (1956). *Brit. J. industr. Med.*, **13**, 166.
Cochrane, A. L., Chapman, P. J., and Oldham, P. D. (1951). *Lancet*, **1**, 1007.
—— Cox, J. G., and Jarman, T. F. (1952). *British Medical Journal*, **2**, 843.
Collis, E. L. (1931). *Bull. Hyg. (Lond.)*, **6**, 663.
Corlett, T. (1952). *Appl. Statist.*, **1**, 34.
Cotes, J. E., Higgins, I. T. T., and Thomas, A. J. (1956). *British Medical Journal*, **1**, 601.
Cummins, S. L. (1935). Ibid., **2**, 287.
Dautrebande L. (1952). *Aspects nouveaux de la lutte contre les poussières.* Bruxelles.
—— Alford, W. C., Highman, B., Downing, R., and Weaver, F. L. (1948). *J. appl. Physiol.*, **1**, 339.
Doll, R., and Hill, A. B. (1950). *British Medical Journal*, **2**, 739.
—— —— (1954). Ibid., **1**, 1451.
Fletcher, C. M. (1952). *Proc. roy. Soc. Med.*, **45**, 577.
Foubert, P., Nadiras, P., and Batique, L. (1954). *Rev. méd. minière*, **7**, 3.
Friehoff, F. (1952). *Beitr. Silikose-Forsch.*, **26**, 79.
Fry, J. (1954). *British Medical Journal*, **1**, 190.
Gaensler, E. A. (1951). *Science*, **114**, 444.
Gilson, J. C., Hugh-Jones, P., Oldham, P. D., and Meade, F. (1955). *Spec. Rep. Ser. med. Res. Coun. (Lond.)*, No. 290.
Goodman, N., Lane, R. E., and Rampling, S. B. (1953). *British Medical Journal*, **2**, 237.
Gray, P. G., Corlett, T., and Jones, P. (1951). The Proportion of Jurors as an Index of the Economic Status of a District. The Social Survey, London.
Greene, B. A., and Berkowitz, S. (1954). *Ann. intern. Med.*, **40**, 729.
Gregory, J. (1955). *Trans. Ass. industr. med. Offrs*, **5**, 2.
Halliday, J. L. (1943). *Psychosom. Med.*, **5**, 71.
Hart, P. D'Arcy, and Aslett, E. A. (1942). *Spec. Rep. ser. med. Res. Coun. (Lond.)*, No. 243
Heron, A., and Braithwaite, D. (1953). *Brit. J. industr. Med.*, **10**, 27.
Kadlec, K., and Vyskocil, J. (1950). *Pracovni Lékarství*, **6**, 348.
Kennedy, M. C. S. (1953). *Thorax*, **8**, 73.
Knott, J. M. S., and Christie, R. V. (1951). *Lancet*, **1**, 881
Lane, R. E. (1954). *Trans. Ass. industr. med. Offrs*, **4**, 58.
Lavenne, F., and Belayew, D. (1953). Institut d'Hygiène des Mines, No. 106. Hasselt.
Lent, H. (1950). *Beitr. Silikose-Forsch.*, **10**, 1.
Ministry of Pensions and National Insurance (1955). *Digest of Incapacity Statistics.* Report of the Ministry of Pensions and National Insurance for the years 1953-4. London.
Oswald, N. C., Harold, J. T., and Martin, W. J. (1953). *Lancet*, **2**, 639.
Palmer, K. N. V. (1954). *British Medical Journal*, **1**, 1473.
Pestiaux, J., Gielen, E., Degueldre, G., and Lavenne, F. (1955). Institut d'Hygiène des Mines, No. 130. Hasselt.
Registrar-General (1938). *Decennial Supplement Part II, Occupational Mortality England and Wales.* H.M.S.O., London.
—— (1949). *Estimates of Sex and Age Distribution of the Civilian Population.* H.M.S.O., London.
Ross, W. D., Miller, L. H., Leet, H. H., and Princi, F. (1954). *J. Amer. med. Ass.*, **156**, 484.
Salvini, M., and Capodaglio, E. (1955). *Med. d. Lavoro*, **46**, 352.
Schilling, R. S. F., Hughes, J. P. W., and Dingwall-Fordyce, I. (1955). *British Medical Journal*, **1**, 65.
Sen, P. K. (1937). *J. industr. Hyg.*, **19**, 225.
Simon, G., and Galbraith, H. J. B. (1953). *Lancet*, **2**, 850.
Stuart-Harris, C. H. (1954). *Brit. J. Tuberc.*, **48**, 169.
Trautmann, H. (1949). *Beitr. Silikose-Forsch.*, **4**, 13.

Vokac, Z. (1950). *Pracovní Lékarství*, **6**, 336.
Worth, G., and Dickmans, H. (1950). *Tuberkulosearzt*, **4**, 495.
—— and Schiller, E. (1954) *Die Pneumokoniosen*. Stauffen-Verlag, Köln.
—— Valentin, H., Gasthaus, L., Hoffmann, H., and Veurath, H. (1955). *Arch. Gewerbepath. Gewerbehyg.*, **14**, 37.
Wright, G. W. (1946). *Occup. Med.*, **2**, 546.
Zorn, O. (1949). *Beitr. Silikose-Forsch.*, **2**, 1.

APPENDIX

RESPIRATORY SYMPTOMS

Name..... *X-ray No*.....

	Yes	No
I. During the past 3 years, have you been ill with your chest? If yes:—		
Once only?		
More than once?		
Did you have increased cough?		
Did you have increased phlegm?		
II. (*a*) Apart from chest illnesses, do you usually have a cough? If yes:— Do you suffer from a persistently troublesome cough?		
(*b*) Apart from chest illnesses, do you usually bring up phlegm? If yes:— In the winter?		
Throughout the year?		
Is the phlegm usually yellow?		
If not: Did it become so during your illness?		
III. Do you ever get wheezing in your chest? If yes:—		
Slight–moderate?		
Severe?		
With chest illnesses?		
Does your chest ever feel tight? If yes:—		
Slight–moderate?		
Severe?		
With chest illnesses?		
IV. Have you ever had:— Year: Pneumonia?		
Pleurisy?		
Acute bronchitis?		
V. Do you consider that you suffer from:— Chronic bronchitis?		
Asthma?		
VI. (1) Is your breath as good as that of other people of your own age at work, on walking, hurrying, climbing stairs, or hills?		
(2) Are you able to walk with normal people of your own age on the level, but unable to keep up on hills or hurrying?		
(3) Are you unable to keep up with normal people walking on the level but able to walk a mile or more at your own speed?		
(4) Are you unable to walk more than 200 yards on the level without a pause for breath?		
(5) Are you breathless on talking, after undressing, or at rest?		
VII. Have you had to change your job on account of being too short of breath when at work? If yes: Year changed.....		
Job at which you failed.....		
.....	.....	.....
VIII. Smoking:— Have you ever smoked?		
Now?		
Amount smoked now:— Estimated average during past 10 years if different:		
Cigarettes per day		
Oz. tobacco/week (hand-rolled)		
Oz. tobacco/week (pipe)		
Age at starting:..... Age at stopping:		
IX. Does observer consider subject to be bronchitic?		
X. Are you getting a pension for any chest disease?		
Have you ever applied for a pension?		

IRRADIATION-INDUCED MALIGNANT HYPERTENSION: CURED BY NEPHRECTOMY

BY

W. M. LEVITT, M.D., F.R.C.P., F.F.R.

Associate Physician, Department of Radiotherapy, St. Bartholomew's Hospital

AND

SAMUEL ORAM, M.D., F.R.C.P.

Physician, King's College Hospital

The following case is considered worthy of record as, to the best of our knowledge, it is the first example demonstrating the possibility of saving life by timely nephrectomy where renal damage produced by irradiation has resulted in malignant hypertension.

Case History

A man aged 33 had his left testis removed for seminoma in 1941. Soon afterwards he complained of abdominal pain and distension and began to lose weight. A mass was found in the upper abdomen, but nothing was done until May, 1943, by which time the mass had become very large, extending well across the midline. He was given deep *x*-ray therapy by one of us (W. M. L.) in May and June, 1943, following which the mass disappeared, and he returned to normal health and full work. The total dosage to the left renal region was under 3,000 r. He remained well and at full work until July, 1954, when he was seen by one of us (S. O.), complaining of severe splitting vertical midline headache which had begun about a year previously and which was relieved by aspirin after about half an hour. Some six months ago a second type of headache had appeared, which was associated with a bounding pulse. Two weeks prior to the consultation he had found difficulty with his vision.

Because of various medical examinations for insurance purposes his blood pressure in 1950 was known to have been 150/90 mm. Hg; in 1952 it was 160/90 and in 1953 165/95.

There was a history of scarlet fever at the age of 18, but this was not complicated by nephritis, and there was no past history of pyelitis or urinary infection. There was no family history of hypertension or cardiovascular disease, and both his parents were alive, his father aged 76 and his mother 74.

On examination on July 22, 1954, the positive physical signs were that his apex beat was 4½ in. (11.4 cm.) to the left of the midline in the fifth intercostal space, and a double thrust was visible and the cardiac impulse was forceful. A clear protodiastolic triple rhythm was audible, together with a faint systolic murmur at the apex. His aortic second sound was loud and musical. There were no aortic murmurs. His pulse was 78, of regular rhythm and large volume, but the vessel wall was not clinically thickened. His femoral, dorsalis pedis, and posterior tibial pulses were easily palpable. His blood pressure at rest was 215/130 mm. Hg.

On July 30 he was examined ophthalmologically by Mr. Ronald Crick, who reported some general retinal oedema with extreme attenuation of the arteries, which were hardly visible, and some dilatation of the veins. There was some deflection at the arterial crossings, with hard white exudate near the disk edges and more fluffy exudate farther out, with some flame-shaped haemorrhages. His disks showed a blurred margin, the right more than the left, with slight papilloedema. There was no nipping of the veins. The retinopathy was of Grade III–IV, and the whole process suggested a relatively acute and recent process.

There were no abnormal physical signs in the central nervous system, lungs, or elsewhere.

On clinical grounds, with knowledge of the gradual increase in blood pressure over the preceding three years, his