RHEUMATISM IN MINERS

PART 1: RHEUMATIC COMPLAINTS

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Much has been written about the heavy toll of rheumatism in industry (Kahlmeter, 1923; Newman, 1924; Horder, 1944), but there is little precise information as to its incidence in the general population. Such information as exists indicates that some 3% of the insured population are incapacitated each year because of the rheumatic diseases (Report on Incapacitating Sickness in the Insured Population of Scotland, 1930-36). The proportion of the population consulting general practitioners is rather similar, varying from 2.8% in the south of England to 4.3% in the north of Scotland (Newman, 1924; Davidson and Duthie, 1937). The consultation and incapacity rates, however, are but a poor guide to incidence, and this applies perhaps to the rheumatic diseases more than to any others. Popular belief in the incurability of these disorders is strongly held and induces an attitude of resignation which the medical profession has so far done little to dispel.

The nearest attempt to a determination of total rheumatic incidence is that reported by Stocks (1949) based on a sickness survey for the Central Office of Information. From this survey a monthly incidence of 18% of rheumatic diseases in the population is deduced. This, however, is based on self-diagnosis.

On the incidence of rheumatism in miners information is even less definite, but there have been indications that it is higher than in the general population. Thus in Scotland in 1938, 5% of miners were incapacitated from this cause. This figure may be compared with an incapacity rate of 3% in metal and transport workers and in general labourers, and 2% in the remaining occupation groups studied. The incapacity rate was thus roughly twice as great in miners, and the increase was distributed equally amongst joint, muscular, and neuritic forms (Scottish Report on Chronic Rheumatic Diseases, 1945).

Method of Study

The present investigation was undertaken at the request of the Miners' Welfare Commission and was carried out in the Manchester coal fields. A preliminary survey in a number of pits in the area revealed the practical difficulties which would result from the application of random sampling methods to an underground population, and it was decided to survey the entire population of one mine. For this purpose the Bedford Colliery at Leigh was chosen. In addition a survey was made of the following groups: (1) the workers at an engineering yard belonging to the National Coal Board; (2) office staff employed at the Area Headquarters of the National Coal Board; (3) the Bedford miners' families; and (4) a random sample of the town of Leigh.

Bedford Colliery.—Bedford is a medium-sized colliery employing just over 1,000 men. Of these some 80% work underground, 43% at the coal face, and the remainder on the roadways or at miscellaneous sites. At the time of the survey three seams were being worked. Two of these were machine-operated and had a roof-height of 3 ft. 3 in. The third was higher, 6 to 8 ft., and worked by hand. It has since been closed. Temperatures underground were moderate, varying from 75 to 86°F. at the coal face, and the workings were dry. Part of the journey to the coal face was by man-train so that not more than one and a half miles had to be walked to the furthest face. This is an average distance under present conditions, and in fact this colliery may be taken as fairly representative of mining practice in the district.

Engineering Yard.—The Walkden yard is owned by the National Coal Board and is designed to carry out light constructional and repair work. It employs blacksmiths, machinists, carpenters,

painters, and others. In all, there are 575 male employees in addition to 14 female office staff. Of the males, 76 had at some time worked underground so that there were 499 non-mining males in this survey.

Walkden Offices.—These constitute the headquarters of the area and have a staff of 370, mostly clerks and typists. There are 232 males and 138 females. Of the males 28 had at some time worked underground so that there were 204 non-mining males in this study. As the Bedford miners and the workers at the Walkden yard and offices were all interviewed by the same person (J. S. L.), they form directly comparable groups of miners and non-miners, and problems of observer error are thus minimized.

Bedford Families.—As most of the Bedford miners live in the town of Leigh the work of visiting their homes was greatly facilitated. All relatives over the age of 15 were seen during the course of the families' survey and also relatives by marriage provided that they were normally resident in the miner's home. Of the persons interviewed in the families' survey approximately 40% were wives of the miners, 20% sons and daughters, 13% fathers and mothers, and 8% brothers and sisters. The remaining 20% were in-laws and other relations.

Leigh Survey.—Leigh is an industrial town of some 48,000 inhabitants, situated 12 miles west of Manchester. The town is low-lying on clay soil, its highest point being only 135 feet above sea level. The two main industries are cotton weaving and spinning, and coal mining, and these occupations absorb the majority of workers and school-leavers. Among the other industries to be found in the town are engineering, a brush works, a clothing factory, iron foundries, an agricultural implement factory, and a cable works.

Many of the houses are over 60 years old and lack baths or hot water. These houses are usually of the "two up—two down" type and many are damp; indeed it is probable that some 75% of houses in Leigh have some degree of dampness.

In the Leigh survey a random sample of households was selected from the electoral roll of the Borough, supplemented by a list supplied by the housing department of the newly erected and occupied houses not yet included in the electoral roll. Every tenth address was taken, making a total of 1,393 houses, and all individuals normally resident in the house and over the age of 15 were asked to cooperate in the survey. The random sample contained a number of Bedford Colliery families, 63 in all, and these, having already been

included in the families' survey, were not counted again in the Leigh survey, the figures for each survey being therefore unduplicated.

Composition of Groups Studied.—For the purposes of this study the males have been divided into miners and non-miners, and the females into those from mining and non-mining families. Miners were defined as those who had at some time in their lives worked wholtime underground for at least a month. Mining families in the Leigh survey were those in which at least one member of the family had worked for not less than five years underground. For the Bedford Colliery this criterion was not used and the families of all workers were included with the mining families. The following are the final groupings.

Males

Miners :				
Bedford Colliery	..	..	..	987
Families' survey (working at collieries other than Bedford)	..	..	..	220
Leigh survey (working at collieries other than Bedford)	..	..	..	535
Total miners	..	..	..	1,742
Non-miners :				
Leigh survey	..	..	..	929
Walkden Yard	..	..	..	499
Walkden Offices	..	..	..	204
Families' survey	..	..	..	299
Total non-miners	..	..	..	1,931

Females

Mining Families :				
Families' survey	..	..	..	1,296
Leigh survey	..	..	..	639
Total females from mining families	..	..	..	1,935
Non-mining families, Leigh survey				
Family status unknown, Leigh survey	..	..	..	328

Interviews.—Employees at the Bedford Colliery, the Walkden yard and offices were interviewed at work. Those off work because of illness or injury were visited in their homes.

Members of the Bedford miners' families and of the families included in the random sample of Leigh were interviewed in the first place by the medico-social worker or her assistant, and if found to complain of rheumatic pain or any doubtful pain in the back or limbs, were then seen by the physician of the Walkden clinic or some other member of the staff of the Rheumatism Research Centre. Before these visits were started, however, it was considered advisable that the credentials of the survey and the objects to be achieved should be

known to the people of Leigh. This was done by publicity in the press and the survey was also mentioned in a broadcast on the subject of rheumatism. An approach was also made to the medical profession through the local branch of the B.M.A. In addition, an explanatory letter was sent to the head of each family to be interviewed and an appointment arranged. A home visit followed and an appointment could then be made to see members of the family who were out. All were seen personally; in no instance was reliance placed on the information of others.

Questionnaire.—The questions on rheumatic complaints were based on the preceding five-year-period (1945–1949). This period was chosen for two reasons. It covered the time during which the Essential Works Order was in operation. Under this Order all men leaving the mining industry for reasons of ill-health had to be examined by a medical referee so that records were available to assess wastage from rheumatism. The second advantage was that, as the beginning of the period coincided with the end of the war, it offered a useful aid to memory for persons interviewed.

A standard questionnaire was adopted for all initial interviews whether by the medico-social worker or by the physician. Each person was asked if he or she had, during the past five years, suffered from rheumatism, or from lumbago, sciatica, fibrositis, arthritis, neuritis, or any other aches and pains. If a positive answer was obtained the following information was also collected: the site of pain, its duration and severity as judged by loss of working time. In addition all persons were asked about their working conditions. The occupation of the individual was noted in three categories: (1) predominant work, (2) work at the onset of rheumatism, (3) present work. The duration of the predominant work was ascertained and, in the case of miners, the duration of work underground and at the coal face. The number of changes of work was also noted. Questions were asked about stresses and strains at work, position at work, heavy lifting, or the repeated use of a single joint or muscle group. Miners were questioned about the duration of their work in (a) a kneeling and (b) a stooping position, and they were asked the average distance walked underground. Details of exposure to damp and cold at work were asked of all persons together with the duration of exposure to wet conditions. Lastly any history of injury was inquired into and also any family history of rheumatic complaints. In addition, an assessment of dampness in the houses was provided by the Council inspector.

Diagnostic Problems.—Clinical examination was limited to those giving a history of rheumatic pain. The term “rheumatic pain” has been used in its widest sense to include all pain in the back and limbs not due to recent injury or unaccustomed exercise, or to acute infection or other non-rheumatic disease.

Unfortunately the diagnostic criteria for most rheumatic diseases are not clearly defined. The more advanced stages of diseases such as rheumatoid arthritis, ankylosing spondylitis, and osteo-arthritis can be recognized with some certainty, but the large variety of more transient painful syndromes which are usually called “fibrositis,” “neuritis,” “lumbago” are less certain both as to diagnostic criteria and to basic pathological changes. Where the history and physical signs were definite enough for a diagnosis, such as rheumatoid or osteo-arthritis, to be made with reasonable confidence, this was recorded as the cause of pain, but where the diagnosis was uncertain, the cause of pain was given as “undetermined,” thus avoiding such terms as “lumbago” and “fibrositis.”

During the past decade much attention has been given to disorders of the intervertebral discs, and it has become fashionable to attribute certain types of brachial, sciatic, and back pain to prolapse or degenerative changes in these discs. Though it must be admitted that the diagnosis in these cases is usually somewhat uncertain, it was felt that an attempt should be made to separate these conditions from the mass of painful disorders of undetermined nature. A category for disc disorders has therefore been included. Only a few of those placed in this category were considered to have had a definite disc prolapse. The majority were of the type having a history of recurrent low back pain, and many would formerly have been classified as osteo-arthritis of the spine or spondylosis. We shall return to the question of nomenclature in degenerative spinal disease in the second part of this study.

A number of other diagnostic categories, e.g., osteo-chondritis, gout, synovitis, and fat hernia, was included in this survey of rheumatism. Where the pain was considered to result from an obvious neurosis it was recorded as such.

As those without complaint of pain were not examined, no information on asymptomatic forms of arthritis was obtained from this part of the survey which was concerned purely with rheumatic complaints. This aspect will also be dealt with in the second part of this study.

Memory of Absence from Work.—A survey such as this, based as it is so largely on the informant's memory, is subject to considerable inaccuracy.

The inaccuracies involved in memory, even of recent illness, have been shown clearly by Stocks (1949) in his analysis of "Sickness in the Population of England and Wales in 1944-1947". In this survey sickness rates were always found to be higher for the month just completed than for previous months, so that it was evident that even an illness which had occurred two months earlier was incompletely recalled.

To check on this question of memory in relation to loss of working time a brief survey was carried out amongst the male workers in a nearby factory where accurate sickness records were available. Of 53 men who had lost work because of rheumatic complaints during the previous five years, 28 (53%) remembered correctly their lost time from rheumatism. Omitting those who were off work for less than one week and classifying the remainder into those losing one to 12 weeks and those losing more than 12 weeks as in the survey, it was found that of 41 in the first category only 25 remembered correctly, but that all three in the second category remembered correctly.

Whether a survey so widely publicized as our main surveys at Walkden and Leigh is subject to the same degree of error is uncertain. It might be expected that where informants have had ample time to turn the matter over in their minds beforehand their replies would be more accurate, but evidence from replies at a second interview of 195 Bedford and Walkden workers, of whom 15 remembered rheumatic complaints which they had previously failed to mention, indicates that some at least of the rheumatic complaints had been forgotten. The validity of comparisons between groups of workers must therefore depend, except in the case of those causing prolonged incapacity, on a similar "proneness to remember" in each group. Evidence for such a similarity will be found in the studies on complaint rate and incapacity rate in the second part of this study. Other sources of error due to sampling and observer-bias are discussed in Appendix 2.

Completeness of the Survey.—At the Bedford Colliery and at Walkden cooperation was excellent. Only one man at the Colliery and eight office workers refused to be interviewed. At the Walkden yard there were no refusals. This part of the survey is thus 99% complete. The unit used in the Leigh and families' surveys was the household, and, as far as households are concerned, these surveys are 98% complete, all but 59 of the possible 2,300 households having been included. The reasons for exclusion of the 59 households are as follows:

Refusal to help in the survey	35
Unable to trace address (families' survey) ..	14
Illness of only other in family besides miner ..	3
House empty or pulled down (Leigh survey) ..	4
Not residential (Leigh survey)	3
	<hr/> 59

In addition, in 49 instances one member of a family refused to cooperate or had to be given up after seven or eight unsuccessful visits, and 12 were not interviewed owing to illness, the total amounting to 1% of those who should have been seen. The response was somewhat less good to requests for permission to arrange for doctors' visits. There were 27 refusals amongst the men and 50 amongst the women, and altogether 132 persons who should have been seen by the doctor were not seen for the following reasons:

	Males	Females
Refusal to see the doctor	27	50
Left address or died before doctor's visit ..	9	16
Given up after repeated visits	14	12
Ill	2	—
Unable to see because of work hours	2	—
	<hr/> 54	<hr/> 78

It is considered, however, that the proportion of refusals is not such as to interfere with the validity of the results.

Results

Total Rheumatic Complaints.—The incidence of rheumatic complaints as a whole is shown in Fig. 1. As rheumatic complaints are largely a factor of age and the age distribution is not identical in miners and non-miners, each decade is considered separately.

In males the incidence of rheumatic complaints shows no great difference between miners and non-miners. Only in the fourth decade do the miners complain of substantially more rheumatic pain. The difference is statistically significant, and some explanation for it must be sought. The most probable is that there is an earlier onset in miners of some form of rheumatism which does not normally make its appearance till after the age of 40. This will be further discussed when the site of pain and diagnosis have been considered.

The females as a whole show an incidence of rheumatic complaints in all age groups closely similar to that encountered in the non-mining males. When, however, women from mining and non-mining families are compared, striking differences are found. At all ages the incidence of rheumatic complaints is lower in the females from mining families, and in the fourth decade it is halved, a

FIG. 1.—Incidence of rheumatic complaints in miners and non-miners and in the female members of mining and non-mining families. (The data upon which this figure is based are given in Appendix 1, Tables A and B. Figures above columns are the exact percentages.)

highly significant difference. This low incidence in mining families is not confined to females. In Table 1 the male non-miners are divided into those from mining and non-mining families where information on this point is available. As in the case of females there is a lower incidence at all ages in the mining families, but particularly in the fourth decade. This difference between mining and non-mining families is one of the most interesting and significant of our findings.

Site of Pain.—Sites of pain have been grouped into five general classifications designed to bring out the points of importance and at the same time to give figures of sufficient magnitude to permit of statistical

study. Thus sites to which pain is referred from the lower spine and pelvic girdle are grouped together, as are sites of reference from the upper spine and shoulder girdle. The knees are considered separately, as they are likely to be of particular importance in miners. In the next part multiple sites are shown, and finally those other sites, for example, the elbows, wrists, fingers, ankles and feet, whose numerical or other importance does not warrant separate classification. The results are given in Fig. 2.

In males pain is most frequently encountered in the back-hip-sciatic distribution and this site is more prominently affected in miners than in other males. This preponderance in miners is found at all ages

TABLE 1

INCIDENCE OF RHEUMATIC COMPLAINTS IN MALE NON-MINERS IN 1945-49

Age Group	Mining Families		Non-mining Families	
	Rheumatic		Rheumatic	
	Total	No.	Total	No.
15-19	118	4	51	3
20-29	191	17	117	16
30-39	58	5	134	42
40-49	30	8	160	67
50-59	25	9	92	38
60+	18	6	124	53
Total	440	49	678	219

SS = 0.01 > P > 0.001.

except the under-20s but is most marked in the fourth decade. Indeed it is to pain in this site that the high incidence of rheumatic complaints in miners at this age is largely due.

Next in frequency, the neck-shoulder-brachial pain shows a similar incidence in miners and non-miners. Other sites of pain are very much less common but pain in the knees is more frequent in miners.

In females multiple pain is a more frequent complaint than pain at a single site, neck-shoulder-brachial pain coming second, and low-back-sciatic third. All sites of pain occur with greater frequency in females from non-mining families, and in the discrepancy already noted at the fourth decade all sites participate.

In both males and females pain in the knees is uncommon except in the older age groups, and it is in these older age groups that the difference in knee pain between miners and non-miners and between mining and non-mining families is encountered.

It may thus be concluded that males suffer chiefly from low-back-sciatic pain and females from multiple pain, and that in miners there is an even greater preponderance of back-sciatic pain than in other males.

Diagnosis.—Data on diagnosis are shown in Fig. 3. Of the defined disorders, those affecting the intervertebral discs predominate in males and particularly in miners who show a higher incidence at all age groups. Between the ages of 30 and 60 disc disorders were twice as common in the mining

group. Next in frequency comes osteo-arthritis which is also more frequent in miners and is found chiefly in those over the age of 50. Rheumatoid arthritis is not commonly encountered in the males and even less so in miners. The remaining defined disorders are too infrequent for statistical study, and have been grouped together in the last column. In a large proportion of cases the pain had to be classified as undetermined. Such pain was equally distributed between miners and non-miners, and showed a maximum incidence in the fourth and fifth decades.

Amongst the females osteo-arthritis was the most frequently diagnosed of the defined rheumatic disorders. As in males it was encountered chiefly in those over the age of 50, and was slightly more common in those from non-mining families. Rheumatoid arthritis was very much more frequent in females than in males, but disc disorders were comparatively uncommon and seldom encountered in females from mining families. As in males the undetermined group was the largest, and here the discrepancy between those from mining and non-mining families was highly significant, largely accounting for the difference already noted for rheumatism as a whole. As in males the highest incidence is between the ages of 30 and 50. It may be concluded therefore that in females from mining families there is a lower incidence of undetermined pain and pain due to disc degeneration and osteo-arthritis.

Incapacity.—Incapacity rates from rheumatism have been classified in two grades, those losing one week or more and those losing over three months in the five-year-period under review. These are shown in Tables 2 and 3 respectively. Apart from the under-20s more miners stated that they had lost working time from rheumatic complaints at all age groups and particularly in the fourth decade in which there were twice as many. The differences were particularly marked amongst those losing three months or more and in the fourth, fifth, and sixth decades were highly significant. The marked differences in incidence of rheumatic complaints between mining and non-mining families are not reflected in the incapacity rates, and indeed there is a greater proportion with the more prolonged disabilities in those from mining families. It would thus appear that the differences between mining and non-mining families are concerned rather with the tendency to complain than with the extent of incapacitating rheumatic disease.

Those losing three months or more have been further studied as regards site of pain and diagnosis (Tables 4 and 5), and it is clear that pain in the

2.—Incidence of rheumatic complaints in various sites in miners and non-miners and the female members of mining and non-mining families. (The data on which this figure is based are given in Appendix 1, Tables C and D. Figures above columns are the exact percentages.)

TABLE 2

PERCENTAGE OF MINERS AND NON-MINERS ABSENT ONE WEEK OR MORE WITH RHEUMATIC COMPLAINTS IN 1945-49

Age Group	Miners			Non-miners											
	Total Miners			Mining Families			Non-mining Families			Walkden Yard, Offices and Other			Total Non-miners		
	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%
15-19 ..	99	1	1	118	3	3	51	0	0	108	1	0.9	277	4	1
20-29 ..	367	17	5	191	9	5	117	3	3	230	9	4	538	21	4
30-39 ..	302	45 ^s	15	58	2	3	134	11	8	168	15	9	360	28 ^s	8
40-49 ..	429	77	18	30	3	10	160	22	14	158	22	14	348	47	14
50-59 ..	310	59	19	25	5	20	92	12	13	100	10	10	217	27	12
60+ ..	235	31	13	18	1	6	124	15	12	49	3	6	191	19	10
Total ..	1,742	230	—	440	23	—	678	63	—	813	60	—	1,931	146	—

S = 0.02 > P > 0.01

TABLE 3

PERCENTAGE OF MINERS AND NON-MINERS ABSENT THREE MONTHS OR MORE WITH RHEUMATIC COMPLAINTS IN 1945-49

Age Group	Miners			Non-miners											
	Total Miners			Mining Families			Non-mining Families			Walkden Yard Offices and Other			Total Non-miners		
	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%
15–19 ..	99	0	0	118	1	1	51	0	0	108	1	0.9	277	2	1
20–29 ..	367	4	1	191	2	1	117	1	1	230	0	0	538	3	1
30–39 ..	302	18 ^{ss}	6	58	2	3	134	2	1	168	3	2	360	7 ^{ss}	2
40–49 ..	429	31 ^{ss}	7	30	0	0	160	6	4	158	4	3	348	10 ^{ss}	3
50–59 ..	310	26 ^{ss}	8	25	2	8	92	1	1	100	3	3	217	6 ^{ss}	3
60+ ..	235	17	7	18	1	6	124	6	5	49	2	4	191	9	5
Total ..	1,742	96	—	440	8	—	678	16	—	813	13	—	1,931	37	—

SS = 0.01 > P > 0.001

back-sciatic distribution is mainly responsible for the more prolonged forms of incapacity in miners. The diagnosis of disc degeneration figures largely in this group. In non-miners there is not the same preponderance of back-sciatic pain, multiple sites being almost as frequent, and diagnostically non-miners fall most commonly into the undetermined group.

Invaliding.—In the Manchester area during the five year period 1945 to 1949 rheumatism was second only to chest conditions as a cause of invaliding

from the mines, and was more important than injury. In those over 60 years of age it shared top place with heart disease. Between the ages of 30 and 50 it occupied second place and in the younger age groups it was a relatively rare cause of invaliding (Appendix 1, Table G).

The rheumatic causes of invaliding have been analysed by site of pain (Appendix 1, Table H). The sites of pain are similar to those already encountered as causes of prolonged incapacity, low-back-sciatic pain predominating. The unclassified group—elbows, wrists, hands, and feet—has, however, come

1G. 3.—Incidence of rheumatic complaints by diagnosis in miners and non-miners and female members of mining and non-mining families. (The data on which this figure is based are given in Appendix 1, Tables E and F. Figures above columns are the exact percentages.)

TABLE 4

SITE OF RHEUMATIC PAIN IN MINERS AND NON-MINERS ABSENT THREE MONTHS OR MORE IN 1945-49

Age Group	Back, Hips, and Sciatic				Neck, Shoulders, and Brachial				Knees				Multiple Sites				Other Sites			
	Miners		Non-miners		Miners		Non-miners		Miners		Non-miners		Miners		Non-miners		Miners		Non-miners	
	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%
15-19 ..	0	0	1	0.4	0	0	0	0	0	0	0	0	0	0	1	0.4	0	0	0	0
20-29 ..	2	0.5	1	0.2	1	0.3	0	0	0	0	0	0	1	0.3	1	0.2	0	0	0	0
30-39 ..	9	3	3	0.8	4	1	1	0.3	2	0.7	2	0.6	3	1	1	0.3	0	0	0	0
40-49 ..	14	3	5	1	6	1	1	0.3	6	1	1	0.3	5	1	2	0.6	0	0	0	0
50-59 ..	14	5	2	0.9	5	2	0	0	2	0.6	0	0	5	2	2	0.9	0	0	1	0.5
60+ ..	3	1	3	2	1	0.4	0	0	6	3	1	0.5	6	3	4	2	0	0	1	0.5
Total ..	42	—	15	—	17	—	2	—	16	—	4	—	20	—	11	—	0	—	2	—

TABLE 5

DIAGNOSIS IN MINERS AND NON-MINERS ABSENT THREE MONTHS OR MORE WITH RHEUMATIC COMPLAINTS IN 1945-49

Age Group	Osteoarthritis				Rheumatoid Arthritis				Disc Disorders				Undetermined				Other Defined Rheumatic Disorders			
	Miners		Non-miners		Miners		Non-miners		Miners		Non-miners		Miners		Non-miners		Miners		Non-miners	
	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%	Rh.	%
15-19 ..	0	0	0	0	0	0	0	0	0	0	1	0.4	0	0	0	0	0	0	1	0.4
20-29 ..	0	0	0	0	0	0	1	0.2	0	0	1	0.2	2	0.5	2	0.4	1	0.3	0	0
30-39 ..	0	0	1	0.3	2	0.7	0	0	7	2	1	0.3	7	2	2	0.6	1	0.3	2	0.6
40-49 ..	6	1	1	0.3	2	0.5	0	0	12	3	2	0.6	6	1	4	1	4	0.9	2	0.6
50-59 ..	3	1	2	0.9	1	0.3	1	0.5	11	4	0	0	8	3	2	0.9	3	1	0	0
60+ ..	8	3	3	2	1	0.4	2	1	3	1	0	0	1	0.4	1	0.5	4	2	1	0.5
Total ..	17	—	7	—	6	—	4	—	33	—	5	—	24	—	11	—	13	—	6	—

to occupy a more prominent place. Diagnoses were given on the discharge note, i.e., the diagnoses of the medical referee submitting the patient for discharge. Most were described as fibrositis or simply as rheumatism and there was a large proportion of arthritis (unspecified). The large proportion of cases with an ill-defined diagnosis rendered any comparison with our findings of doubtful value.

It should be pointed out that these data for invaliding refer to the miners in the Manchester area as a whole, and not only to those mines

situated in Leigh which were included in the survey. In all, there are 22 mines in the area, and they employ some 25,000 workers, so that the actual invaliding rate from rheumatism for the five-year period averages only eight men per colliery or seven per 1,000 men employed.

Comparison with Other Forms of Illness.—The data for invaliding were obtained from the records of the Ministry of Fuel and Power. In addition it has been possible to consult records of a sick

benefit society at the Parsonage Colliery in Leigh. These show that incapacitating illness is of a similar type to that requiring invaliding from the mines. Chest disease heads the list and rheumatism is the second most important cause of incapacity. This is followed in turn by digestive disorders and upper respiratory infections. Data have not been obtained for incapacity due to compensatable injury. There can be little doubt that such data were they available would include many instances falling within our classification of "rheumatic complaints", arising from, and justifiably attributed to injury.

Discussion

From the data presented it is clear that rheumatic complaints are of frequent occurrence in the population, and that in miners the gross incidence of such complaints is no greater than in the population as a whole. The degree of incapacity, on the other hand, appears greater in miners as shown by statements on loss of working time, and there is evidence of an earlier onset of symptoms as shown by a steeper rise in incidence at the fourth decade.

The more prolonged forms of incapacity are associated for the most part with pain in the low-back-sciatic distribution, but neck-shoulder-brachial and knee pain are also in part responsible for the increased incapacity in miners. Diagnostically there is a predominance of disc degeneration in miners in this group as indeed also in those with lesser grades of incapacity. Osteo-arthritis and undetermined pain are also in part responsible for the increased incapacity rate in miners. When the age groups are studied separately it is seen that low-back-sciatic pain of undetermined origin or due to disc degeneration is mainly responsible for incapacity between the ages of 30 and 60, and pain in the knees due to osteo-arthritis in those over 60 years of age.

Before discussing these points further it is necessary to consider the difference between disc degeneration and "pain undetermined". The tendency was to place the case in the undetermined group if there had been only one attack of pain and no residual physical signs, and into the degenerative group if there had been a history of repeated attacks and if limitation of certain movements of the spine had persisted. Symptoms and signs of prolapse of the nucleus pulposus would also determine that the case be included in this category, though these constitute only a small proportion of the disc disorders. Thus it is likely that at least a proportion of those classed as undetermined were in reality early cases of disc degeneration. This point will be further studied in a later paper.

The fourth decade is of particular importance in this study, as it is this age group which shows an all-round increase of rheumatic complaints in miners. Before this age the miners show a diminished incidence, and in the older age groups there is no significant difference between miners and non-miners. This has been interpreted as indicating an earlier onset of some form of rheumatism normally arising about the fifth decade. It remains to determine the nature of this form of rheumatism. Comparison of the miners and non-miners in this age group indicates that the pain is predominantly in the low-back-sciatic distribution, and that it is those rheumatic complaints which have been diagnosed as disc degeneration which are mainly responsible for the discrepancy between miners and non-miners in this age group. If disc degeneration does, in fact, arise in the fifth decade in males in the general population, an earlier onset of this disease in the lower dorsal and lumbar spine in miners would explain our findings. According to Schmorl and Junghans (1932) routine post-mortem studies of spines have shown that in males the condition commonly makes its appearance in the fifth decade. In females it appears a decade later. Thus, as far as this preliminary survey goes, it points to both an earlier onset of and greater incapacity from lower dorsal and lumbar disc degeneration as the main feature of rheumatism in miners. Whether the greater incapacity in miners is due to more severe disease or to the nature of their work must await the results of the radiological studies.

It remains only to explain the findings in the miners' families. This part of the survey was designed originally to exclude hereditary and home environmental factors as a cause of any increased incidence which might be found in miners. Though male relatives of miners were too few for a detailed study of hereditary factors as such, there is fairly convincing evidence against either an environmental or hereditary factor in the rheumatism of miners. In fact the miners' families had, at all ages, fewer complaints than members of non-mining families. Whether they have less rheumatic disease this survey does not demonstrate, though this is not so improbable as might appear, for mining is essentially a family occupation, some 90% of miners coming of mining stock. Families prone to rheumatism would not tend to favour so heavy an occupation, and those following it would be rapidly weeded out. This would not, however, explain the low incidence in the wives, who comprise the largest proportion of the females in the mining families. Only some 50% of these are of mining stock, a proportion similar to that obtaining in the

local population of Leigh. A more probable explanation is to be found in an altered base-line of normality. Most people have an aching muscle or joint occasionally, but may or may not regard this as abnormal, or worth mentioning in a survey of rheumatic pains. In a family, one of whose members has lost a considerable amount of work from rheumatism, the boundary between normal and abnormal will tend to be relatively higher, as the other members of the family will feel their own complaints to be relatively insignificant. This explanation is supported by the lower incidence in members of mining families of those forms of rheumatism not giving rise to loss of working time, and of those vague rheumatic pains classified as undetermined. Another pointer is that the discrepancy is greatest in the fourth decade when miners are beginning to lose work because of rheumatic complaints; in fact the rheumatic complaints in mining families may be described as a "mirror-image" of the miners' rheumatism. It would be interesting to know whether a similar effect is to be found in the families of other workers prone to rheumatism.

We have not considered a possible beneficial effect from home environment, though this may be a factor. The miners in Lancashire were at the time of the survey receiving an extra hundredweight of coal a month, and besides, the higher rates of pay of miners might result in better food. To what extent these factors might affect the incidence of rheumatic complaints is uncertain, but we venture to think them less important than the factors mentioned above.

Summary

An investigation has been made into the incidence of rheumatic complaints in miners by means of a field survey arranged to include control groups of non-mining males and of females from mining and non-mining families.

The gross incidence of rheumatic complaints was not found to be appreciably different in miners and non-miners, but there was evidence of an earlier

onset in miners, as shown by a higher incidence in the fourth decade.

The miners' statements indicated that they lost more working time from rheumatic complaints than non-miners.

Rheumatic pain in miners was chiefly in the lumbar and sciatic distribution, and pain in these sites was largely accounted for by the increased incidence of rheumatic complaints in the fourth decade and for the increased loss of working time in miners. Miners also showed an increased incidence of knee pain.

Tentative diagnoses made in the field indicated that the lumbar sciatic pain may frequently result from disorders of the intervertebral discs. There was also evidence of an increased incidence of osteo-arthritis in the miners. Confirmation of these findings will be the subject of a further paper.

A study of invaliding records made under the Essential Works Order showed that invaliding from the mines was due most commonly to chest conditions, rheumatism coming second in importance. Those invalided for rheumatism complained chiefly of low-back sciatic pain.

The incidence of rheumatic complaints in members of the miners' families was lower than in the general populations and considerably lower than in miners.

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APPENDIX 1

TABLE A

INCIDENCE OF RHEUMATIC COMPLAINTS IN MINERS AND MALE NON-MINERS IN 1945-49

Age Group	Miners			Non-Miners		
	Leigh, Bedford, and Family Surveys			Leigh, Walkden, and Family Surveys		
	Total	Rheumatic		Total	Rheumatic	
		No.	%		No.	%
15-19.. .. .	99	2	2	277	16	6
20-29.. .. .	367	47	13	538	69	13
30-39.. .. .	302	105s	35	360	93s	26
40-49.. .. .	429	165	39	348	140	40
50-59.. .. .	310	124	40	217	88	41
60+	235	111	47	191	81	41
Total	1,742	554	—	1,931	487	—

S = 0.05 < P > 0.02.

TABLE B

INCIDENCE OF RHEUMATIC COMPLAINTS IN FEMALES IN MINING AND NON-MINING FAMILIES IN 1945-49

Age Group	Mining Families			Non-Mining Families			Family Status Unknown	
	Total	Rheumatic		Total	Rheumatic		Total	Rheumatic
		No.	%		No.	%		
15-19	219	22	10	55	9	16	11	0
20-29	433	50s	12	154	32s	21	42	6
30-39	321	57ss	18	168	59ss	35	58	17
40-49	400	124s	31	171	74s	43	52	19
50-59	331	122s	37	133	69s	52	48	21
60+	231	88	38	141	71	50	117	60
Total	1,935	463	—	822	314	—	328	123

S = 0.05 < P > 0.02.
SS = P < 0.01.

TABLE C
ANALYSIS OF RHEUMATIC COMPLAINTS BY SITE OF PAIN IN MALES IN 1945-49

Age Group	Back, Hips, and Sciatic						Neck, Shoulders, and Brachial						Knees						Multiple Sites						Other Sites																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
	Miners			Non-Miners			Total Males			Miners			Non-Miners			Total Males			Miners			Non-Miners			Total Males			Miners			Non-Miners			Total Males																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
	Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
15-19 ..	1	1	4	1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

S = 0.02 > P > 0.01

S = 0.05 > P > 0.02

S = 0.05 > P > 0.02

TABLE D
ANALYSIS OF RHEUMATIC COMPLAINTS BY SITE OF PAIN IN FEMALES IN 1945-49

Age Group	Back, Hips, and Sciatic						Neck, Shoulders, and Brachial						Knees						Multiple Sites						Other Sites											
	Mining			Non-Mining			Total Females			Mining			Non-Mining			Total Females			Mining			Non-Mining			Total Females			Mining			Non-Mining			Total Females		
	Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%	
15-19 ..	4	2	2	4	6	2	3	1	1	2	4	1	3	1	0	0	3	1	6	3	1	2	7	2	6	3	3	5	9	3						
20-29 ..	11	3	8	5	19	3	12s	3	11s	7	25	4	2	0.5	2	1	5	0.8	16	4	7	5	25	4	7	2	4	3	11	2						
30-39 ..	13	4	13	8	28	5	14s	4	16	10	36	7	2	0.6	2	1	6	1	17s	5	18s	11	39	7	5ss	2	10ss	6	16	3						
40-49 ..	21s	5	19s	11	43	7	25s	6	19s	11	52	8	14	3	6	4	23	4	45	11	14	8	60	10	14s	4	14s	8	30	5						
50-59 ..	17ss	5	18ss	13	40	8	18	5	9	7	31	6	17	5	10	8	30	6	47	14	20	15	75	15	17	5	8	6	26	5						
60+ ..	12	5	11	8	30	6	10	4	7	5	23	5	15	6	13	9	31	6	35	15	29	21	93	19	14	6	7	5	30	6						
Total ..	78	—	71	—	166	—	82	—	63	—	171	—	53	—	33	—	98	—	166	—	89	—	299	—	63	—	46	—	122	—						

S = 0.05 > P > 0.01

SS = P < 0.01

TABLE E
ANALYSIS OF RHEUMATIC COMPLAINTS IN MALES BY DIAGNOSIS IN 1945-49

Age Group	Osteo-Arthritis						Rheumatoid Arthritis						Disc Disorders						Undetermined						Other Defined Rheumatic Disorders											
	Miners			Non-Miners			Total Males			Miners			Non-Miners			Total Males			Miners			Non-Miners			Total Males			Miners			Non-Miners			Total Males		
	Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%	
15-19 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-29 ..	1	0	1	0	2	0	2	0	2	0	2	0	4	0	6	2	2	0	8	1	28	8	43	8	71	8	6	2	12	2	18	2	18	2	18	2
30-39 ..	4	1	4	1	8	1	3	1	3	1	2	1	5	1	18	6	12	3	30	5	65	21	59	16	124	19	11	4	12	3	23	3	23	3	23	3
40-49 ..	26	6	11	3	37	5	4	1	5	1	5	1	9	1	49	11	21	6	70	9	71s	17	79s	23	150	19	9	2	14	4	23	3	23	3	23	3
50-59 ..	32	10	16	7	48	9	2	1	11	5	13	2	36	12	36	12	13	6	49	9	40	13	31	14	71	13	8	3	5	2	13	2	13	2	13	2
60+ ..	51	22	27	14	78	18	5	2	7	4	12	3	19	8	14	7	33	8	20	9	14	7	34	8	12	5	8	4	20	5	8	4	20	5	8	4
Total ..	114	—	59	—	173	—	16	—	27	—	43	—	128	—	63	—	191	—	226	—	235	—	461	—	46	—	55	—	101	—	55	—	101	—	55	—

For ages above 40,
0.02 < P < 0.01

For ages above 30,
0.01 < P < 0.001

s = P = 0.05

TABLE F
ANALYSIS OF RHEUMATIC COMPLAINTS BY DIAGNOSIS IN FEMALES IN 1945-49

Age Group	Osteo-Arthritis						Rheumatoid Arthritis						Disc Disorders						Undetermined						Other Defined Rheumatic Disorders											
	Mining			Non-Mining			Total Females			Mining			Non-Mining			Total Females			Mining			Non-Mining			Total Females			Mining			Non-Mining			Total Females		
	Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%		Rh.	%				
15-19 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
20-29 ..	1	0.2	1	0.7	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3		
30-39 ..	6	2	5	3	12	2	14	4	6	4	21	4	6	2	2	1	8	1	36ss	7	22ss	5	14	46	7	2	7	5	14	2	14	2	14	2		
40-49 ..	29	7	10	6	41	7	20	5	7	4	28	4	5ss	1	9ss	5	16	3	50s	13	36s	21	68	12	5	2	8	5	16	3	5	21	3	3		
50-59 ..	43	13	22	17	71	14	20	6	10	8	37	7	10	3	10	8	25	5	20s	6	17s	13	38	7	11	3	1	0.8	13	3	3	3	3	3		
60+ ..	40	17	36	26	103	21	17	7	8	6	34	7	3ss	1	9ss	6	17	3	12	5	7	5	27	6	10	4	6	4	18	4	18	4	18	4		
Total ..	119	—	74	—	229	—	83	—	34	—	136	—	28	—	30	—	70	—	136	—	125	—	291	—	53	—	32	—	92	—	92	—	92	—	92	—

S = 0.05 < P < 0.01
SS = P < 0.01

TABLE G
DISCHARGES FROM MINES IN NO. 1 (MANCHESTER) AREA* IN 1945-1949 BY DISABILITY AND AGE GROUP

Disability	Total Discharges		Age Groups						
	No.	Rate per 1,000 Miners in Area	15-19	20-29	30-39	40-49	50-59	60+	Age not Stated
Chest complaints ..	272	10.9	4	48	72	78	12	4	54
Rheumatism	171	6.9	2	23	55	58	6	12	15
Ulcers	129	5.2	2	30	43	33	3	0	18
Injuries	119	4.8	0	26	32	28	5	5	23
Disorders of vision ..	112	4.4	7	30	18	27	0	1	29
Skin diseases	110	4.3	7	31	22	21	10	0	19
Neurosis, etc.	103	4.1	10	35	24	10	1	0	23
Cardiac complaints ..	95	3.8	2	17	19	22	8	12	15
E.N.T. complaints ..	67	2.7	5	29	14	5	0	0	14
Hernia	47	1.9	2	11	8	11	6	5	4
Nystagmus	44	1.8	0	1	12	18	3	1	9
Disorders of C.N.S. ..	40	1.7	1	17	8	2	0	1	11
Disorders of digestive system	35	1.4	1	9	8	5	0	2	10
T.B.	33	1.3	1	12	10	3	2	0	5
Rheumatic fever† ..	8	0.4	1	4	0	2	0	0	1
Miscellaneous ..	185	7.4	5	56	36	37	9	11	31
Total	1,570	63.1	50	379	381	360	65	54	281

* Figures from the records of Ministry of Fuel and Power, Manchester. Total population, 24,854.

† Rheumatic fever has not been included with rheumatism as invaliding was for the cardiac complications.

TABLE H
SITE OF PAIN IN INVALIDING FOR RHEUMATISM 1945-1949

Age Groups	Total	Back	Neck	Knees	Multiple Sites	Other Sites	Not Given
15-19	2	0	0	0	0	1	1
20-29	23	12	1	1	0	1	8
30-39	55	22	1	3	6	9	14
40-49	58	26	3	7	3	1	18
50-59	6	0	0	0	2	0	4
60+	12	2	2	1	1	1	5
Not given	15	8	2	2	2	1	0
Total	171	70	9	14	14	14	50

APPENDIX 2

Sources of Error

In addition to problems of memory which have already been considered there are certain other sources of error which are a part of all field survey work and which must briefly be discussed.

Errors of Sampling.—These have been avoided by taking the whole population of the Bedford Colliery and of the Walkden yard and offices. Provided that these are not taken as representative of all miners and non-mining male workers no error of sampling is involved. In the town of Leigh it was impossible to study the whole population, but by the mode of sampling households it is considered that any bias has been overcome.

Observer-bias.—Where several observers are used the question of observer-bias becomes of considerable importance, particularly if there is an uneven distribution of population groups in those seen by each observer. In this survey data were collected by two social workers and five doctors. The question thus arises whether there was uniformity of procedure between these observers and to what extent there was agreement as to diagnosis amongst the latter. For non-medical interviewers the difficulty was to decide whether in any particular case the complaint should be referred to the doctors as possibly rheumatic or whether it could safely be ascribed to recent injury, operation, or unaccustomed exercise, or be a symptom of some acute infection. In this survey all doubtful cases were referred, even if slight, so that selection by the interviewers was reduced to a minimum. The salient question on rheumatic complaints was asked in the same way by all the interviewers whether medical as at the Bedford Colliery, Walkden yard and offices, or non-medical as in the Leigh and

families' surveys. Comparing the incidences of rheumatic complaints in those seen by the two non-medical interviewers these were 30 and 32% respectively after non-rheumatic disorders had been excluded by the medical interviewers. Similarly a comparison of those seen initially by a social worker with those seen only by a medical interviewer shows a similar final incidence of rheumatic complaints of 29% and 26% respectively. Moreover, a comparison of results in miners and non-miners (Table X) shows that the increased incidence of knee pain and loss of working time one week plus and three months plus in miners was noted by all observers and that the increased incidence of low-back-sciatic pain in miners was noted by two observers, the third finding an identical incidence in miners and non-miners. There is thus no evidence that the results of the questionnaire were in any way influenced by an undue bias by one observer.

The diagnoses made by the five physicians taking part in the Leigh and families' surveys are shown in Table Y. As some of the physicians saw only a few and as observer 1 saw some 70% of the whole, the main problem is to find out if the diagnoses made by observer 1 were substantially different from the rest. There is a significant difference between observer 1 and the remainder only in the group of disc disorders, the former placing 16% of the cases in this category, the remainder only 8%. This group, however, is at present ill-defined when taken as a purely clinical diagnosis; indeed, except in a few with nucleus pulposus prolapse there are no clear physical signs on which the diagnosis may be based. In the well defined disorders, rheumatoid and osteoarthritis, there is no significant difference between observer 1 and the remainder. It may thus be concluded

TABLE X
INCIDENCE OF RHEUMATIC PAIN IN MINERS AND NON-MINERS

Observer	Category	Total	Site of Pain		Incapacity	
			Back-sciatic	Knee	1 Week or More	3 Months or More
1. Non-medical	Miners	391	76 (19%)	20 (5%)	67 (17%)	31 (8%)
	Non-miners	713	81 (11%)	16 (2%)	77 (11%)	19 (3%)
2. Non-medical	Miners	145	20 (14%)	11 (8%)	20 (14%)	11 (8%)
	Non-miners	341	35 (10%)	15 (4%)	32 (9%)	8 (2%)
3. Medical	Miners	987	118 (12%)	66 (7%)	125 (13%)	47 (5%)
	Non-miners	703	82 (12%)	31 (4%)	60 (9%)	13 (2%)

TABLE Y
DIAGNOSIS MADE BY FIVE PHYSICIANS IN LEIGH AND FAMILIES SURVEYS

Observer	Total	Osteo- arthritis	Rheumatoid Arthritis	Disc Disorders	Undetermined	Other Diagnoses
1.	906	223 (25%)	107 (12%)	141 (16%)	332 (36%)	103 (11%)
2.	218	50	39	17	72	40
3.	96	25	15	9	37	10
4.	91	21	10	5	45	10
5.	41	18	1	6	12	4
2-5	446	114 (25%)	65 (15%)	37 (8%)	166 (37%)	64 (14%)

that observer bias is not responsible for the findings of this survey relating to site of pain, loss of working time, or to the diagnoses of osteo- and rheumatoid arthritis,

but that it may play a part in the relative distribution of cases between the disc disorders and the undetermined group.